PLAN

Work Plan

Supplemental Remedial Investigation
Elmira (Madison Avenue)
Former MGP Site

New York State Electric & Gas Corporation
Binghamton, New York

August 2003

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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Erin M. Crotty
Commissioner

August 6, 2003

John J. Ruspantini, CHMM
Project Environmental Specialist
Licensing & Environmental Operation
New York State Electric & Gas Corporation
Corporate Drive-Kirkwood Industrial Park
P.O. Box 5224
Binghamton, NY 13902-5224

Re: Former Elmira (Madison Ave) MGP Site
Supplemental Remedial Investigation - Work Plan
Site No: 8-08-018

Dear Mr. Ruspantini:

The New York State Departments of Environmental Conservation and Health have reviewed your July 30, 2003 letter which addressed our July 2, 2003 comments letter on the referenced supplemental remedial investigation work plan and found them acceptable. The Work Plan is hereby approved pending revision to include resolutions to our comments.

Please provide one hard copy and one electronic copy (compact disc format) of the revised final document to this office and the Department of Health, including a schedule to implement the work plan within 30 days of this letter. You may also provide copies to other distribution list as appropriate.

If you have any questions, please call me at (518) 402-9564.

Sincerely,

Amen M. Omorogbe

Amen M. Omorogbe, P.E.
Project Manager
Manufactured Gas Plant Remedial Section
Division of Environmental Conservation

cc: C. Bethoney, NYSDOH
ecc: G. Harris

Table of Contents

Table

Figure

Appendices

1. Introduction

1.1 General

At the request of NYSEG (New York State Electric & Gas Corporation), Blasland, Bouck & Lee, Inc. (BBL) has prepared this work plan for conducting the Supplemental Remedial Investigation (SRI) at the Elmira (Madison Avenue) Former Manufactured Gas Plant (MGP) Site (the "site"), in Elmira, New York.

The tasks described below largely reflect the agreements made in the following correspondence between NYSEG, the New York State Department of Environmental Conservation (NYSDEC), and BBL:

- a draft scope of work proposed in NYSEG's September 23, 2002 letter to the NYSDEC;
- agreements made during a May 8, 2003 site meeting between NYSEG, the NYSDEC, and BBL;
- agreements made during a May 22, 2003 conference call between NYSEG, the New York State Department of Health (NYSDOH), and BBL;
- NYSDEC's and NYSDOH's formal comments on the May 2003 draft SRI Work Plan, as documented in a July 2, 2003 letter to NYSEG; and
- NYSEG's formal response to the NYSDEC's and NYSDOH's July 2, 2003 comments, as documented in a July 30, 2003 letter to NYSDEC.

The SRI consists of the following three general tasks, discussed in the subsequent sections and summarized in Table 1 of this plan:

- Soil Investigation (Section 3);
- Groundwater Investigation (Section 4); and
- Fish and Wildlife Impact Analysis (FWIA) and Human Health Exposure Evaluation (HHEE) (Section 5).

Sections 3 through 5 provide a general discussion of the activities to be performed under each of the tasks, while Table 1 provides a detailed discussion of the activities and the associated rationale for each task.

Section 2, the DNAPL Contingency Plan, describes procedures to be followed during drilling to limit the potential for remobilization and downward migration of dense non-aqueous phase liquid (DNAPL). Section 6 describes general field procedures for survey, waste handling, and decontamination. Section 7 provides the anticipated schedule for completing the SRI field work and submitting the SRI Report. Appendix A – *Field Sampling Plan* (FSP) contains detailed field procedures and protocols that will be followed during the SRI. Appendix B – *Quality Assurance/Sampling and Analysis Project Plan* (QA/SAPP) presents the analytical methods and procedures that will be used to analyze soil and groundwater samples collected during the SRI. Appendix C – *Health and Safety Plan* (HASP) presents the health and safety procedures, methods, and requirements that will apply to field personnel during implementation of the field work. Appendix D – *Community Air Monitoring Plan* (CAMP) was prepared at the request of the NYSDEC to provide a measure of protection for the downwind communities from potential airborne releases of constituents of concern during SRI activities. Appendix E – *Previous Investigation Locations* contains copies of figures from previous reports showing the locations of previous soil borings, test pits, surface soil samples, etc. Appendix E is provided to supplement the discussions throughout this SRI Work Plan. Appendix F – *Work Plan for Cyanide Analyses* comprises a work plan developed by Ish, Inc. for analyzing soil and groundwater samples for cyanide.

1.2 SRI Objectives

The purpose of the SRI is to gather data to 1) complete the characterization of the site with respect to establishing the nature and extent of MGP-related residuals on and adjacent to the site; and 2) support a remedial evaluation for the site. Based on this purpose, NYSEG has developed the following specific objectives:

- implement a SRI that builds in a level of flexibility to allow additional soil borings, test pits, wells, etc. (not proposed in this SRI Work Plan), if needed, to sufficiently characterize the nature and extent of MGP-residuals;
- determine the approximate vertical and horizontal extent of MGP-related impacts in soil at the site by collecting, visually characterizing, and analyzing additional subsurface soil samples;
- better locate and define the extent of the former waste lagoon to the extent practicable and necessary;
- attempt to confirm the depth to the bottom of the former Distribution Holder (potentially at-grade) and Purifier Vessels;
- investigate the condition, configuration, and extent of piping associated with the liquid waste pipeline;
- assess the presence/absence of MGP-related impacts south of the site, in the area of the former canal;
- obtain visual data to evaluate the surface topography and contiguous nature of the underlying confining units;
- obtain visual and analytical data to supplement existing data and produce a three-dimensional (3-D) solid-body model depicting the distribution of NAPL and polycyclic aromatic hydrocarbons (PAHs) in soil potentially originating from the site;
- obtain waste-characterization data for soil samples that exhibit MGP-related impacts; these data will be collected to support a potential Feasibility Study (FS) for the site;
- better characterize the nature and extent of groundwater affected by the former MGP by collecting additional groundwater samples;
- better characterize the groundwater flow direction in the deeper overburden; and
- obtain physical and chemical data for soil and groundwater to enable an evaluation of various in-situ treatment methods, including chemical oxidation.

The technical approach to address these objectives is provided in Sections 3 through 5 and in Table 1.

1.3 Site Setting and History

The site is in the City of Elmira, in Chemung County, New York. The city occupies a the floor of a glacially carved valley, flanked on the east and west by steep bedrock hills rising greater than 500 feet above the valley floor. The city itself is largely flat, sitting in the flood plain of the Chemung River, which flows west to east through the city, before turning toward the southeast and its junction with the Susquehanna River.

The former MGP occupied most of a city block, bounded by East Clinton Street, Madison Avenue and East Fifth Street. The site is approximately 1,500 feet west of Newtown Creek, a tributary to the Chemung River which is just over 3,000 feet to the south. The site is largely flat-lying, with a small topographic rise in the eastern corner, near the intersection of East Fifth and East Clinton Streets.

The MGP was constructed between 1865 and 1869 beside the Junction Canal, a waterway connecting the Chemung and North Branch Canals (see Figure 1). The canal was backfilled and replaced by a railroad in the late 1800s. Given the site's substantial distance from major surface water bodies (i.e., Chemung River and Newtown Creek), it is assumed that water used in the operations of the MGP was likely obtained from an onsite well.

The site is believed to have initially produced coal gas, then water (or blue) gas, and finally carbureted water gas. Three gas holders were constructed; the latest and largest had a 1-million cubic foot capacity. At different stages of operation, the site also contained the following major structures: a gas house, coal house, purifier boxes, retorts, waste lagoons, and tar vessels.

With plant closure in 1947, most of the above-ground MGP structures were dismantled. The present site includes several of the original plant buildings (including the gas house), but none of the material handling components (e.g., holders or purifiers). The locations of the historical MGP structures are shown on Figure 1.

NYSEG used the site as a service station until 1977, when it sold a portion of the property. The western portion of the site, including all the remaining buildings, was sold to I.D. Booth, Inc., an industrial supply wholesaler. I.D. Booth uses several of the old buildings as warehouses, augmenting their larger operations across the Madison Avenue to the west. NYSEG retains ownership of the eastern potion of the site, where it maintains an electrical substation and a storage yard.

Land use in the area is mixed, with industrial and commercial operations immediately south and west, a public park to the northeast, and residential properties not immediately adjacent, but within 1000 feet of the site in all directions. The parcel immediately south of the site is owned by Trayer Products, Inc. (Trayer), a metal-parts manufacturer.

1.4 Summary of Previous Investigations

1.4.1 Groundwater Investigation Program for Trayer Products, Inc.

Trayer completed a limited groundwater investigation of its property located adjacent to the southern boundary of the site. The investigation was performed to facilitate the construction of a building addition in area of their property immediately south of former Gas Holder Nos. 1 and 2 of the site. The investigation included the installation and sampling of four groundwater monitoring wells (TMW-1 to TMW-4). The wells were apparently installed in response to the observation of impacted soils made during the drilling of four geotechnical soil borings in the area of the proposed building addition. The results of the investigation were summarized in a June 15, 1984 letter from Clark Engineers, P.C. to the NYSDEC. The results of the groundwater sampling indicated that groundwater collected (on May 4, 1984) from monitoring well TMW-1 contained benzene (2 parts per billion [ppb]) and the sample collected from TMW-3 contained BTEX (42 ppb, total), naphthalene (121 ppb), 1,2,4-trimethylbenzene (9 ppb), 1,3,5-trimethylbenzene (2 ppb), and various naturally-occurring metals. The NYSDEC re-sampled the wells on May 31, 1984. The results of this sampling indicated only 35 ppb of di-n-butyl-phthalate were detected in groundwater from TMW-3.

1.4.2 Four-Phase Investigation

A four-phase environmental investigation of the site, including a human health and environmental risk assessment was performed by TRC Environmental Consultants, Inc. (TRC) between 1986 and 1990. The purposes of the investigation were to characterize the nature and extent of MGP-related impacts at the site and assess the risks to public health and the environment posed by the site. NYSEG performed this work voluntarily, outside the purview of the NYSDEC. The following subsections summarize the TRC investigation.

1.4.2.1 Task I Report – Preliminary Site Evaluation, March 21, 1986

Task I consisted of completing research of the site history and regional geologic and hydrogeologic information, and conducting an electromagnetic survey using EM-31 to identify potential areas of MGP-residuals. The results of the Task I activities include:

- MGP-residuals were identified in the subsurface on NYSEG's and Trayer's properties;
- potential sources of impacts include: leaking tar tanks; materials disposed of in the canal; spills during operations; spills resulting from flooding; ash disposal in the eastern plant area; purifier chips burning or disposal in the eastern area; and the lagoon and trench in the eastern part of the site;
- inadequate data exists for the types of holders, which are a potential source of MGP-residuals;
- coal tar odors were only observed during the excavation of the Trayer foundation;
- absence of coal tar odors suggests that there is no immediate respiratory hazard at the site; however, further studies are warranted;
- several off-site sources of MGP-residuals exist;
- the site is underlain by at least 80 feet of unconsolidated glacial-derived sediments;
- based on Trayer's groundwater investigation, groundwater flow is toward the east; and
- there is extensive groundwater use within a 1 mile radius of the site.

The Task I Report provided recommendations for performing additional investigations under the Task II investigation.

1.4.2.2 Task II Report – Investigation of the Former Coal Gasification Plant Site, Elmira, NY, June 18, 1987

The Task II investigation included a limited assessment of the nature and extent of MGP-residuals at the site. The investigation consisted of:

- excavating 22 test pits (TP-1 to TP-22);
- drilling two shallow soil borings (B-5S and B-9S);
- installing shallow and deep overburden monitoring wells (MW-1D, MW-2S, MW-3S, MW-4S, MW-6S, MW-7S, and MW-8S);
- air quality monitoring;
- collecting four surface soil samples (SS-1 to SS-4);

- three rounds of groundwater sampling from monitoring wells; and
- collecting two storm water samples (SW-1 and SW-2).

The findings of the Task II activities included the following:

- the site is underlain by more than 70 feet of unconsolidated materials divided into upper and lower aquifers separated by a silt layer; the upper aquifer is a silty sand and the lower aquifer is a sand and gravel; the silt layer is not present in the center of the site;
- groundwater is encountered between 8 and 10 feet bgs; shallow groundwater flow is toward the south-central portion of the site; the vertical hydraulic gradient is downward; shallow groundwater flow velocity is 0.5 to 4.0 feet/day; groundwater flow direction in the deep aquifer was not determined; however, the estimated deep groundwater flow velocity is approximately 54 feet/day;
- several former MGP structures were uncovered during test pit excavations and the structures appeared to be sources of groundwater impacts;
- surface soil samples indicate moderate concentrations of MGP-residuals in a widespread area of the site; a sample collected from an area of visible purifier waste had high concentrations of PAHs, organic nitrogen, and cyanide;
- three rounds of groundwater sampling indicated that the sources of groundwater impacts are primarily above the water table;
- storm water sampling results were inconclusive; and
- several potential risks were identified, including direct contact or inhalation of surface soils; ingestion of groundwater from the Sullivan Well Field; inhalation of VOCs entering basements from groundwater; and inhalation or direct contact from groundwater being pumped for industrial usage.

The Task II Report provided recommendations for performing additional investigations to be included in the subsequent Task III investigation.

1.4.2.3 Task III Report – Investigation of the Former Coal Gasification Plant at Elmira, NY, July 1990

The Task III investigation was conducted to expand the assessment of the Task II investigation with respect to determining the nature and extent of MGP-residuals. The Task III provided more-detailed information on site conditions to support a risk evaluation. Task III field investigation was conducted in three phases between December 1986 and March 1989, and included:

- excavating 22 test pits (TP-101 to TP-122);
- installing 20 piezometers (18 were installed in the test pits during backfilling);
- installing five shallow and four deep monitoring wells (MW-1S, MW-9S, MW-10S, MW-11S, MW-12S, MW-2D, MW-8D, MW-9D, and MW-12D)

- collecting analyzing 16 subsurface soil samples from the test pits and one from the soil boring for MW-8D;
- collecting and analyzing 15 surface soil samples (SS-101 to SS-115); eight surface water samples (ZZ-1 to ZZ-6, including one duplicate and resampling of three locations); and eight sediment samples at the surface water sampling locations; and
- conducting four rounds of groundwater sampling from monitoring wells.

The findings of the Task III activities included the following:

- the site is underlain by as much as 100 feet of unconsolidated deposits consisting of an upper alluvial sand or sand and gravel (18 to 80 feet thick) with discontinuous silt layers; the depth to the sand and gravel increases in the western portion of the site; the sand and gravel is underlain by an dense silt and clay layer;
- the water table is located in the sand and gravel at approximately 10 feet bgs;
- a shallow groundwater divide exists in the eastern portion of the site whereby shallow groundwater diverges north and south from the divide; the shallow groundwater flow gradient is approximately 0.02 in both directions; the average linear horizontal flow velocity in the shallow sand and gravel is approximately 304 to 608 feet/year;
- groundwater flow in the deeper sand and gravel is to the north; the average linear horizontal flow velocity in deeper sand and gravel is approximately 164 feet/year;
- the average linear horizontal flow velocity in dense silt and clay is approximately 0.2 feet/year;
- the vertical hydraulic gradient is generally downward across the site;
- surface soil samples contained PAHs, metals, and cyanide and exposure pathways exist for each media;
- subsurface soils contain varying concentrations of PAHs; the PAHs are primarily concentrated near the former MGP structures and the lagoon;
- VOCs, PAHs, and cyanide were detected in shallow groundwater; groundwater from many of the wells exceed State regulatory levels for at least on constituent;
- trace concentrations of non-MGP related VOCs were detected in three of the deep monitoring wells in at least one sampling event;
- the results of four rounds of groundwater sampling do not indicate that MGP residuals have migrated off site;
- a risk for ingestion and dermal exposure to PAHs of workers exists during subsurface activity; and
- a risk of exposure to PAH-containing surface soil exists through dermal contact, ingestion, or windborne dust.

The Task III Report recommended performing a risk assessment as part of the subsequent Task IV investigation.

1.4.2.4 Task IV Report – Risk Assessment for the Former Coal Gasification Site, Elmira, NY, August 1990

The primary objective of the Task IV investigation was to perform a risk assessment to examine exposure pathways and concentrations and estimate the potential for effects associated with MGP-residuals at the site under existing conditions. The Task IV report concluded that:

- a HASP should be developed to protect workers who may be conducting excavations at the site;
- paving the outdoor I.D. Booth storage area would reduce production of fugitive dusts due to vehicular and wind erosion activity;
- construction of fences around the eastern portion of the site would reduce access by area residents to surface soils in the lagoon area; and
- appropriate risk assessments should be to take into account exposure scenarios if changes to the site are to occur.

1.4.3 Results of PCB Soil Sampling Program, NYSEG Substation, Elmira, NY, June 22, 1989

A PCB soil sampling program was completed by TRC during the week of May 22, 1989. The purpose of the soil sampling program was to determine if PCB residues were present on site from past site activities. The program consisted of collecting 48 surface soil, 35 soil samples from the one-foot depth interval, and six soil samples from two feet bgs and analyzing all samples for PCBs. The results of the program indicated that PCBs were detected in low concentrations in several soil samples collected from across the site. In particular, PCBs were detected in all but one surface soil sample. It was concluded that the ubiquitous distribution of PCBs across the site could be due in part to the regarding of the site. The areas with the highest PCB concentrations were all historically linked to transformer storage areas. All of the areas samples, with the exception of the I.D. Booth loading dock had decreasing PCB concentrations with depth.

1.4.4 USEPA Final Site Inspection Report – NYSEG Former Service Center, Elmira, NY

The United States Environmental Protection Agency (USEPA) performed a Sampling Site Inspection (SSI) on June 3 and 4, 1993. The SSI consisted of groundwater sampling of five monitoring wells (MW-1D, MW-2D, MW-3S, MW-9D, and MW-12D). Groundwater from the wells was analyzed for TCL organic compounds and TAL inorganic compounds, including cyanide. The results of the sampling indicated the presence of arsenic in deep monitoring wells MW-1D and MW-2D, and the presence of numerous metals and VOCs in shallow monitoring well MW-3S. Since a background sample was not collected from the shallow groundwater zone, it was not possible to determine if the shallow groundwater impacts were site-related or from an upgradient source.

1.4.5 PCB Interim Remedial Measure – Final Engineering Report – NYSEG Former Service Center, April 1997

After the MGP was decommissioned in 1947, the site continued to be used as part of NYSEG's Elmira electric and gas service center until 1975. On behalf of NYSEG, Westinghouse Remediation Services, Inc. (Westinghouse) completed a PCB IRM in summer 1996 to remediate PCB-impacted materials associated with the service center. The objective of the IRM was to remove all soil with PCB concentrations of more than 10 parts per million (ppm). Any soil that had a PCB concentration between 1 and 10 ppm was covered with a minimum of 12 inches of clean soil or 2A modified crushed stone. The IRM consisted of excavating and removing PCB-impacted material in several areas, demolition of a concrete slab, and decontamination and demolition of a building in the northern and northeastern portions of the site (the fenced-in area around the substation shown on Figure 1 of this SRI Work Plan). The areas addressed by the IRM included the Concrete Slab Area, Runoff Corridor Area, Runoff Dispersion Area, Lawn Area, Storm Drain Manhole, Transformer Repair Building, Active Substation Area, Loading Dock Area, and Parking Area. These areas are shown on Figure 1-2 of the Final Engineering Report (also included in Appendix E). All waste generated by the IRM was shipped to Chemical Waste Management's (CWM's) secure landfill facility in Model City, NY or to High Acres Landfill in Fairport, NY.

1.5 Site Conceptual Model

1.5.1 Hydrology, Geology, and Hydrogeology

Elmira overlies a portion of a valley-fill aquifer, consisting mainly of glacial outwash sand and gravel. The aquifer provides a municipal water supply to several communities. Locally, the aquifer extends more than 6 miles north of the site up the course of Newtown Creek and less than a mile south to the Chemung River. The aquifer is variously constrained by several geologic units of lesser permeability: till and bedrock below and on the valley slopes, and pockets of lacustrine clay and silt. The principal groundwater flow direction is believed to southward toward the Chemung River (United States Geological Survey, 1982).

Prior investigations have profiled the soil on and near the site to approximately 80 feet. The soil stratigraphy varies both vertically and spatially, creating two distinct water-bearing zones (upper and lower sand and gravel) apparently separated by hydraulic confining units. With the exception of a variable fill layer, the soils appear to be of glacial origin: outwash sand and gravel, till, and glaciolacustrine clays.

The soil profiles change most dramatically from east to west across the site. The adjacent soil columns show the key units identified in two representative wells.

- The upper sand and gravel is apparent across the site, though it appears to be much thicker in the east. The material is generally medium dense, and may have occasional thin beds of silty material. Prior testing of site wells has shown the upper sand and gravel to be highly conductive.

- The “hanging-till” unit, so named because it is sandwiched between sand and gravel deposits, is apparent in many of the western wells, but pinches out near the center of the site. This unit is generally dense, and consists mainly of silt and gravel. The material is inferred to be poorly conductive, and may act as a confining unit.

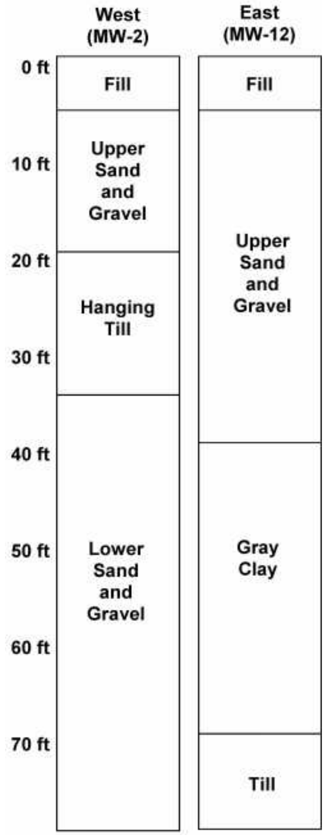
- The gray clay unit was identified in most of the eastern wells, but appears to pinch out at the center of the site. The clay is medium stiff and is inferred to be poorly conductive. Note that the clay and the hanging till were never found in the same location.

- The lower sand and gravel unit was found only in the west, where the hanging till is present, and therefore appears to pinch out near the middle of the site. The unit extends to at least 45 feet thick in places (i.e., MW-2), and its full vertical and horizontal extent was not found. This unit is very dense, but also highly conductive.

- The lower till until was found only in the eastern portion of the site, generally below the gray clay. At MW-8, the till forms an anomalous knob, rising to 14 feet below grade. The basal till appears much the same as the hanging till in hardness, composition, and exceedingly poor conductivity.

This distribution and sequence of deposits suggests a geologic history marked by several glacial advances and withdraws. The lower till and sand and gravel units likely originate from the earliest glacial advance and withdraws. A subsequent glacial readvance would have left the layer of hanging till, and compressed the underlying sand and gravel. During the last deglaciation, the course of the Chemung River ran north of Harris and Hawes Hills (immediately west of Elmira) and wrapped around south through the present locations of Horseheads and Elmira. (USGS, 1982) During this period, the proto-Chemung River would have eroded a channel through the valley floor, and may have scoured away the hanging till and lower sand and gravel in the eastern portion of the site. When the Chemung channel moved to its present course, a melt-water lake likely formed in the old stream channel, leaving the gray clay. The upper sand and gravel in the eastern portion of the site is likely a subsequent outwash deposit.

Generalized Soil Columns



The majority of shallow groundwater storage and flow at the site appears to occur in the upper and lower sand and gravel units. The till and clay units are likely inconsequential with respect to groundwater yield, but may affect flow directions and rates.

Prior gauging data at site wells show that shallow groundwater (which occurs in the upper sand and gravel) flows generally west to east toward Newtown Creek. Several other trends are apparent:

- The water-table maintains a strong eastward gradient across the area underlain by the hanging till unit, but is much more subdued farther east where the till is absent. This effect is most likely the result of mounding above the hanging till, which also would explain the considerable downward gradients observed at the MW-1 and MW-2 well clusters.

- The water-table forms an elongated mound running west to east along the axis of the former canal. This feature may indicate that water is preferentially channeled into the former canal by, for instance, a sewer line or coarse fill materials, and that the channeled water cannot easily migrate out of the former canal bed.

Deeper overburden groundwater flow patterns were not clearly defined by prior investigations. Only two monitoring wells (MW-1D and MW-2D) screen the lower sand and gravel. The remaining deep monitoring wells screen either till or clay, materials very much less conductive and inappropriate to treat as hydraulically linked to the sand and gravel. The existing data do show a gradient northward between MW-2D and MW-1D. This is contrary to the expected flow direction of the valley fill aquifer (i.e., southward toward the Chemung River). However, the gradient direction might be explained if the I.D. Booth water well (immediately west of Madison Avenue) were active. Further complicating the interpretation of deep groundwater flow is the potential influence of Trayer's process wells located near the eastern end of Trayer's elongated building (just south of MW-8S/D). These wells were installed by Trayer in 1968. It is also possible, given the apparent irregularities in the till unit, that localized obstructions in the aquifer might divert the flow direction (for instance, if the till knob observed at MW-8 extended westward, blocking southward flow).

It should also be recognized that until sometime in the 1990s the Sullivan Street Well Field (approximately 1 mile north of the site) pumped on the order of a million gallons per day from this aquifer (TRC Environmental Consultants, Inc., 1986). The well field was shut down in the 1990s until a treatment plant was completed. It was reactivated in 1997, but the pumping rate is uncertain. It is unlikely, however, that the well field's radius of influence extends as far south as the site.

Though the hanging till in the west and the clay in the east both appear to be excellent confining units, the boring data suggest that they neither overlap nor directly touch, leaving an indeterminate area in the center of the site where the upper and lower sand and gravel units may meet. If the two units are in communication, the hydraulic gradient relationship is unclear. Most vertical gradient data (even between the upper sand and gravel and the till) suggest a downward trend. If correct, these data suggest that deep overburden groundwater flows to a different discharge point (likely the Chemung River), while shallow groundwater flows to Newtown Creek.

1.5.2 Site Environmental Conditions

NYSEG has identified several potential forms of site impacts to soil and groundwater in their previous investigations, as summarized below.

1.5.2.1 Coal Tar NAPL

Coal tar NAPL and its associated chemical components are the primary site-related constituents of concern. NAPL has been identified in soils beneath a large section of the site, in particular:

- inside and near the foundations of each of the former gas holders;
- around the former gas house;
- near the former purifier boxes;

- east of the former operations area, in a region presumed to have been occupied by waste-water lagoon (the location of the lagoon has not been precisely delineated to date); and
- offsite to the east, in a pipe found in the bed of the former canal.

The majority of the coal tar was observed in test pits, and was found above or at the water table (nominally 10 feet deep). Though coal tar is traditionally considered a DNAPL, the prevalence of coal tar observed at the water table suggests it may have fractionated to form LNAPL in places, or that the coal tar itself is very nearly neutrally buoyant. There is little current evidence in the existing data that NAPL has migrated below the upper sand and gravel unit, though several key areas have not been investigated to an adequate depth (most notably southeast of the former gas house and in the former lagoon area). This SRI Work Plan includes elements to better delineate the vertical extent of NAPL.

Coal tar residue was not found within 2 feet of the surface except in the former test pits (TP-4 and TP-117), and within the foundation of Gas Holder 2 (TP-107). At both of these locations, asphalt or sand and gravel fill is present over the residual coal tar.

1.5.2.2 Polycyclic Aromatic Hydrocarbons

PAHs constitute most of the organic compounds associated with coal tar. As such, the distribution of PAHs found in subsurface soil samples corresponds well with the observed distribution of coal tar NAPL. As PAHs often result from non-MGP processes (any process involving the combustion of carbon) some of the low-level concentrations of PAHs found in surface soils in prior site investigations may have originated from non-site-related sources. Surface soil samples collected in both the Task II and Task III investigations found PAH concentrations as high as 4,000 ppm (SS-3).

In groundwater, PAHs have only been consistently detected at two shallow monitoring wells (MW-8S and MW-10S) both located in the eastern portion of the site. PAHs were not consistently detected at several other shallow monitoring wells in and near the area of observed NAPL (i.e., MW-3S, MW-4S, MW-9S and MW-7).

In deep monitoring wells, trace levels of PAHs have been detected at least once in both MW-1D and MW-2D, both of which screen the lower sand and gravel unit. PAHs have not been found in the other deep monitoring wells which screen either till or clay.

The extent of PAHs in shallow groundwater has largely been bounded within the eastern portion of the site, except to the immediate east, between MW-11S and MW-12S. In the deep sand and gravel, uncertainty about the patterns of groundwater flow extends to the distribution of dissolved compounds. This SRI Work Plan includes elements to better define the extent of dissolved PAHs in the deep and shallow sand and gravel unit.

1.5.2.3 Cyanide

Cyanide, a relict of the purifying process, has been found in soil and groundwater at elevated concentrations. Cyanide has been detected in soils at concentrations as high as 25.4 ppm (at the purifiers), and was found at concentrations greater than 1 ppm in test pits near the southern property line spanning the full length of the site from TP-120 to TP-114. In surface soil samples only one location, SS-1 (south of the purifiers), exceeded 1 ppm of cyanide.

Cyanide is present in groundwater at concentrations as high as 2,100 ppb (at MW-6S). The distribution of the cyanide in groundwater is more extensive than PAHs, with greatest concentrations in near the former gas house and lagoon area. Cyanide has been detected in the two downgradient perimeter wells (MW-11S and MW-12S), albeit at concentrations below the NYSDEC standard of 200 ppb. The present monitoring-well network has bounded groundwater containing cyanide in excess of this standard in all directions except to the north of MW-6.

1.5.2.4 BTEX

Benzene, toluene, ethylbenzene and xylenes (BTEX) are the principal volatile organic compounds (VOCs) associated with coal tar residues. In groundwater at the site, the distribution of BTEX is similar to that of PAHs, though at lesser concentrations. BTEX has been found consistently at only two wells, MW-8S and MW-10S, both shallow wells in the eastern portion of the site.

In soils, BTEX was detected in only five test pit samples. At four of those locations (TP-103, TP-107, TP-114, and TP-121) NAPL had been observed and PAHs were also detected. At one location, TP-120 (near MW-2 by Madison Avenue), the BTEX was found at 6.4 ppb, while no PAHs were detected. The test pit log of TP-120 notes a diesel odor, indicating that the BTEX observed in this area may not be MGP-related.

1.5.2.5 Chlorinated Organic Compounds

Chlorinated organic solvents have been found in groundwater in shallow wells near the former gashouse, at total concentrations as high as 1200 ppb (at MW-3S, December 1987). The chlorinated organics predominately include 1,1-dichloroethene, 1,1-dichloroethane, 1,1,1-trichloroethane, trichloroethene, and trans 1,2-dichloroethene. This plume appears to be isolated to a small halo in shallow groundwater around the gashouse, suggesting a discrete local source. Trace concentrations of total chlorinated solvents, generally less than 1 ppb, have been intermittently detected at a number of other wells, both deep and shallow. Each of the deep wells, in fact, has had a trace level of chlorinated solvent detected at least once, excluding MW-9D (which is screened entirely in till). Chlorinated solvents are not typically associated with MGPs and are likely the result of more recent, unrelated releases. Some of the deep detections of chlorinated compounds may reflect more wide-spread impacts to the aquifer, possibly relating to the Kentucky Avenue Well Field Superfund Site, located approximately 3.5 miles to the north. Solvents associated with that site have been detected at the Sullivan Street Well Field, less than 1 mile north of the former MGP (EPA Fact Sheet, site ID NYD980650667).

Several chlorinated organic compounds were detected at trace levels in test pit soil samples at the site, though with different compounds and in different locations than the dissolved phase solvent plume near the former gas house. Several isomers of dichlorobenzene were detected in several test pit samples (TP-107, TP-114, TP-116, TP-120 and TP-121), though generally total isomer concentrations less than 3 ppb. At TP-121, by the purifiers, the total isomer concentration of dichlorobenzene was 28 ppb. Dichlorobenzenes are also not typically associated with MGPs.

2. DNAPL Contingency Plan

This section specifies the procedures to be followed during drilling at the site to limit the potential for remobilization and downward migration of DNAPL. These procedures apply to all soil borings and monitoring wells to be completed for the SRI. Soil borings will be drilled to the assumed depth of the underlying clay and hanging till units (note that three soil borings will be advanced through these units as discussed in Table 1), based on available stratigraphic information.

Split-spoon samples will be taken continuously during drilling. Sampling procedures and soil-characterization requirements are outlined in the FSP of this SRI Work Plan. These procedures include geologic descriptions and headspace measurements to gauge the relative concentrations of organic vapors in soil samples. In addition, the field geologist will carefully examine 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 distilled 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 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 pool, 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 percent 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 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. 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 steel 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. 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 and an alternate nearby location will be selected and drilled using a cased drilling method.

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, two-foot sump (at a minimum). The screen size of the NAPL monitoring well will depend on the grain size of the geologic material encountered (e.g., a 20-slot screen will be installed if the geologic materials are predominately comprised of sand and/or gravel).

If a confining unit or former MGP-related structure is not observed, drilling should be discontinued when approximately six feet of clean soil has been observed below the DNAPL impacted interval. One of the four actions discussed above will be taken under this scenario.

3. Soil Investigation

3.1 Soil Investigation Objectives

The objectives of the soil investigation are to:

- determine the approximate vertical extent of MGP-related impacts in soil at the site by collecting, visually characterizing, and analyzing additional subsurface soil samples;
- better locate and define the extent of the former waste lagoon to the extent practicable and necessary;
- attempt to confirm the depth to the bottom of the former Distribution Holder (potentially at-grade) and Purifier Vessels;
- investigate the condition, configuration, and extent of piping associated with the liquid waste pipeline;
- assess the presence/absence of MGP-related impacts south of the site, in the area of the former canal;
- obtain data to better define the surface topography and lateral extents of the underlying confining units;
- obtain visual and analytical data to supplement existing data and produce a 3-D solid-body model depicting the distribution of NAPL and total PAHs potentially originating from the site;
- obtain waste-characterization data for soil samples that exhibit MGP-related impacts; these data will be collected to support a potential FS for the site; and
- obtain physical and chemical data for soil to enable an evaluation of various in-situ treatment methods, including chemical oxidation.

In addition to the objectives outlined above, the subsurface information collected as part of this investigation will be used to characterize the distribution, saturated thickness, and relative permeability of the fill and the sand and gravel, as well as refine the understanding of the surface topography of the underlying clay and hanging till. This information is important in understanding how shallow groundwater is moving and whether there are areas where DNAPL would preferentially collect or migrate.

3.2 General Procedures

3.2.1 Soil Borings

A total of 17 soil borings will be drilled to meet the aforementioned objectives. All soil borings will be drilled using a conventional drilling rig and standard hollow-stem auger and split-spoon sampling techniques. Soil samples will be collected continuously at each boring location from grade to the final depth using a 2-inch diameter by 2-feet long split-spoon samplers. Soil recovered from each 2-foot interval will be visually characterized for color, texture, and moisture content. The presence of visible staining, NAPL, and obvious odors encountered in the soil will be noted.

Each boring will be drilled to a depth of 6 feet below observed MGP-impacted soil or six feet below confining unit surfaces (hanging till and clay). Three of the 17 soil borings will be drilled through the clay and hanging till units in areas of the site where impacts are not observed to confirm the thickness of these units. The final locations of these borings will be determined in the field based on the conditions encountered at the time of drilling. It is expected that one of the deep soil borings will be drilled in the western portion of the site (in the former MGP operations area), a second will be drilled in the center of the site (in the area of proposed boring SB-208), and a third will be drilled in the eastern portion of the site (in the area near proposed boring SB-202). Details of the proposed soil investigation are presented in Table 1 and the soil sampling locations are shown on Figure 1.

NYSEG recognizes that additional soil borings (in addition to the 17 already proposed) may be needed if observations made during drilling indicate the presence of potential MGP-residuals. Therefore, the soil boring program is designed to be flexible, whereby real-time decisions will be made, based on discussions with the NYSDEC, to drill and sample soil from additional borings to adequately define the vertical and horizontal extent of MGP-residuals.

3.2.2 NAPL Monitoring

Should intervals containing potentially free-phase NAPL be encountered while drilling, NYSEG will install NAPL monitoring wells 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 a by completing a shake test on selected soil samples (as specified in the DNAPL Contingency Plan).

The length and slot size of NAPL-monitoring-well screens will depend on the nature of the stratigraphic interval containing NAPL. For example, if a two-foot interval of soil is believed to contain free-phase NAPL, then a two-foot-long well screen will be installed at that interval. If NAPL accumulates in a NAPL monitoring well, then NAPL recovery tests will be performed at the NAPL monitoring well to assess the recoverability of the NAPL. The schedule and protocol for NAPL recovery (if required) will be agreed upon with the NYSDEC prior to completion of SRI field activities. One round of groundwater samples (discussed under Section 4) will be collected from wells containing NAPL if it is determined that a representative groundwater sample can be collected.

3.2.3 Test Pit Excavation

Test pits will be excavated in two areas: 1) in the area of the former canal, south of Gas Holder Nos. 1 and 2; and 2) in the area of former test pit TP-114 where a clay pipe (potentially associated with the liquid waste pipeline) was previously uncovered.

Test pits will be excavated in the area of the former canal to assess the presence/absence of potential MGP-residuals and evaluate the material used to backfill this former water body.

Test pits will be excavated in the area of TP-114 to assess the extent of MGP-residuals associated with the apparent liquid waste pipeline unearthed during the excavation of TP-114. Test pits will be excavated the immediate area surrounding TP-114 to evaluate the configuration of the pipe and whether the pipe is in place or was disposed of in the former canal. Evidence of other piping, if any, will also be noted during the test pit program in this area. If a pipe is observed to contain NAPL during test pitting, measures will be taken to mitigate the leak and collect the NAPL from the pipe (to the extent practicable). Such measures may include contacting a local waste-handling facility to pump the NAPL from the pipe and then repair it.

3.2.4 Surface Soil Sampling

The following two subsections discuss the two different types of surface soil samples that will be collected during the SRI.

3.2.4.1 MGP-Related Surface Soil Sampling

As agreed to during a May 22, 2003 conference call between NYSEG, BBL, and Ms. Charlotte Bethoney of the NYSDOH, 11 surface-soil samples will be collected to evaluate potential impacts from the former MGP. Five of the 11 surface soil samples will be collected from background areas and the remaining six samples will be collected to provide adequate spatial distribution across the MGP operations area of the site. Areas not selected for MGP-related surface soil sampling include the PCB IRM Area (see the 1997 PCB IRM Final Engineer Report for detail), and the three areas chosen by NYSEG for IRMs this year (i.e., Gas Holder Nos. 1 and 2 and the Purifier Waste Area). The locations of the proposed surface-soil samples are shown on Figure 1. Final surface soil sample locations may be altered in the field based on conditions encountered and coordination with the NYSDOH.

As requested by the NYSDOH, surface-soil samples will be collected from 0 to 2 inches below the vegetation sod or sub base material (if present). Surface soil samples collected for volatile analyses will be collected as discrete grab samples (without homogenization). Surface-soil samples for other analytes will be a composite of sub-samples collected from within a 1 meter square area (as discussed in the FSP). MGP-related surface soil samples will be analyzed for TCL VOCs, TCL SVOCs, TAL inorganics, and cyanide (the protocol for sampling and analysis of cyanide has been prepared by Ish, Inc, as presented in Appendix F).

3.2.4.2 PCB IRM Area Surface Soil Sampling

As the NYSDEC requested in their December 16, 2002 response letter to NYSEG's September 23, 2002 draft Scope of Work, NYSEG will collect two surface soil samples from the PCB IRM Area to confirm that the area is free of PCBs. These samples will be analyzed only for PCBs.

3.3 Former Waste Lagoon

As stated in the objectives for the soil investigation, NYSEG will attempt to better define the extent of the reputed former waste lagoon in the eastern area of the site. The precise location of this reputed feature is unknown because available historical photographs, Sanborn Fire Insurance Maps, plant drawings, and historical topographic maps do not show the former lagoon. However, previous investigation reports suggest that the lagoon was located in the eastern portion of the site, east of the former distribution holder. If the analytical and visual data collected from the soil borings already proposed in this area suggest the presence of the lagoon, NYSEG will (to the extent practicable and necessary) conduct additional investigations (soil borings and/or test pits) to further define the extent of the lagoon. The additional investigations (if warranted) will be telescoping and depend on the visual and analytical evidence of the currently proposed borings. If new historical evidence suggests that the lagoon is situated in a different area of the site, NYSEG will consult with the NYSDEC to develop a plan to define its nature and extent.

3.4 Subsurface Soil Analyses for Evaluating Nature and Extent

Up to 34 subsurface soil samples (as indicated in Table 1) will be analyzed for BTEX, PAHs, and cyanide (the protocol for sampling and analysis of cyanide has been prepared by Ish, Inc, as presented in Appendix F). Samples will be from those locations judged necessary by BBL to meet the soil-investigation objectives presented in Section 3.1. This means that subsurface soil samples will be collected from soils exhibiting varying degrees of apparent MGP impacts as well as the first visibly ‘clean’ soils beneath impacted intervals. Note that every impacted or clean interval need not be sampled to meet the soil-investigation objectives. Soil sampling methods are described in the FSP (Appendix A). Analytical methods, sample handling, and laboratory protocols are outlined in the QA/SAPP (Appendix B). Sample analyses will follow the NYSDEC ASP-2000 analytical protocol (or most recent version), and include quality assurance/quality control (QA/QC) samples at a frequency indicated in the QA/SAPP. The sample collection rationale is described in greater detail in Table 1.

3.5 Additional Soil Sampling and Analysis and Treatability Testing

As part of the overall systematic planning for this site, data will be collected to establish a baseline of information needed to assess potential future remedial alternatives for the site, such as soil excavation and in-situ treatment of MGP-related materials.

To help estimate the volume and region(s) of soil that, if excavated, may meet the definition of a hazardous waste, five soil samples will be collected and submitted for waste characterization analyses (TCLP benzene, reactivity [cyanide and sulfide], and total sulfur). The waste characterization samples will be collected to represent the range of observed impacts (i.e., moderate to heavy impacts). Table 1 provides further information about these samples.

To help evaluate the mobility of dissolved MGP-constituents and evaluate potential remedies, several soil samples will be collected and analyzed for selected physical properties. Five soil samples will be collected and analyzed for TOC, three for grain size (including hydrometer), and two for undisturbed vertical hydraulic conductivity. The latter will be collected from the two previously observed confining units (hanging till and clay) using Shelby tubes. Table 1 provides further information about these proposed samples.

The SRI will also provide an opportunity to collect data for a preliminary assessment of the viability of chemical oxidation, a potential in-situ treatment option. Chemical oxidation is a recognized in-situ remedial option for organic constituents (such as BTEX and PAHs) under the correct conditions. The suitability of chemical oxidation will be tested as a remedial technology for the site by collecting samples and testing them for chemical oxidant demand. Two samples will be collected for analysis using one oxidant. The oxidant to be used in the testing will be agreed upon with the NYSDEC prior to completion of the SRI field work. One of the oxidant soil samples will be a composite sample of “background” soil (soil not impacted by MGP-related constituents) from several borings and the second will be a grab sample from an interval that is heavily-impacted by MGP-related constituents.

4. Groundwater Investigation

4.1 Groundwater Investigation Objectives

The objectives of the groundwater investigation are to:

- better characterize the nature and extent of groundwater affected by the former MGP;
- collect sufficient data to refine the distribution of dissolved-phase MGP-related constituents;
- provide current information to assess potential trends in dissolved phase concentrations in wells with multiple time-dependent data sets;
- better characterize groundwater flow directions in the shallow and deeper overburden;
- assess whether existing or proposed monitoring wells screen intervals containing free-phase NAPL, and, if so, quantify relevant physical properties of the NAPL; and
- gather data to help assess the viability of natural attenuation as a remedial option during the FS.

The approach to address each of these objectives is briefly discussed below. Details of the groundwater investigation are presented in Table 1 and the proposed monitoring well locations are shown on Figure 1.

4.2 Groundwater Flow Patterns/Hydraulic Characteristics

The groundwater flow patterns and hydraulic characteristics beneath the site will be evaluated by performing the following activities:

- Conduct an inspection of the existing four Trayer wells to assess their condition and usability. These wells could provide usable groundwater-quality and head data if they are accessible and in good condition. If the wells are determined to be unusable, then NYSEG may propose to replace them or reposition some of the already-proposed monitoring wells, if appropriate.
- Install three new permanent shallow monitoring wells to further define the nature and extent of MGP-related constituents in shallow groundwater and provide water-level data in needed areas.
- Install one deep monitoring well. The flow direction of deeper groundwater in the sand and gravel unit is currently uncertain due to several factors. As NYSEG mentioned in its September 23, 2002 letter to the NYSDEC, the well elevation data for the deep overburden wells may be incorrect. As discussed in Site Conceptual Model (Section 1.5), the previously noted deep groundwater flow direction is to the north. This may be explained by the deep overburden wells being installed in distinctively different geologic units (clay versus sand and gravel). NYSEG's new elevation survey (completed in July 2002) will be used to help assess the deep overburden groundwater flow direction. Another factor for the uncertainty in flow direction is that only two wells presently screen the deep sand and gravel (MW-1D and MW-2D). Two wells are inadequate for estimating the direction of groundwater movement. For this reason, NYSEG proposes to

install a deep monitoring well at a strategic location (paired with existing monitoring well MW-4S) to better determine horizontal and vertical groundwater flow components in this area. The location of this well was also selected to provide:

  - vertical gradient data to assess the vertical component of groundwater flow;
  - information on the continuity of the hanging till/clay confining unit(s); and
  - information on the potential vertical extent of DNAPL in this area.

- Perform specific-capacity tests on all site monitoring wells during low-flow sampling to obtain hydraulic-conductivity data for the units screened.

- Conduct two comprehensive fluid-level measurement rounds from all new and existing site wells and the Trayer wells. The general groundwater flow direction in the shallow overburden (above the confining units) beneath the site is generally to the east, with an elongate mound centered along the former canal at the southern site boundary. These data will be used to assess temporal variation of the mound (if any) and whether the mound may be an artifact caused by erroneous survey data for the Trayer wells.

The locations of the proposed monitoring wells are shown on Figure 1 and the rationale for the proposed work described above is discussed in Table 1.

4.3 Groundwater Quality and Trend Analysis

To assess the current distribution of dissolved-phase MGP related constituents in groundwater at and near the former MGP site, one complete round of groundwater sampling will be conducted. This sampling round will entail sampling of groundwater from:

- three temporary monitoring wells installed on a straight line equally spaced between MW-11S and MW-12S/D (discussed below);

- the four newly installed permanent monitoring wells installed as part of this proposed program;

- the 18 existing monitoring wells shown on Figure 1;

- three Trayer monitoring wells (TMW-1, TMW-2, and TMW-4)[1]; and

- any newly installed NAPL monitoring well (if it is determined that a representative sample can be collected).

At the NYSDEC's request, temporary monitoring wells will be installed in the shallow overburden between MW-11S and MW-12S/D (Figure 1). The results of the groundwater samples from the temporary wells will be used to fine-tune the location of permanent monitoring well MW 0301S.

Groundwater samples from the temporary wells will be collected using new polyethylene bailers and groundwater samples from permanent monitoring wells will be collected using low-flow sampling techniques as described in the FSP. Samples from the temporary wells will be analyzed for BTEX and cyanide and samples

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[1] Trayer well TMW-3 was observed to be of poor condition during the May 8, 2003 site meeting and will not likely be sampled.

collected from the permanent wells will be analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, and cyanide (the protocol for sampling and analysis of cyanide has been prepared by Ish, Inc, as presented in Appendix F). In addition, groundwater samples collected from monitoring wells MW-7 and MW-9 will be analyzed for PCBs. Field parameters collected during groundwater sampling will consist of pH, oxidation/reduction potential (ORP), turbidity, temperature, conductivity, and dissolved oxygen. These field measurements will supplement the geochemical data collected at a subset of monitoring wells (described in Section 4.6, below).

4.4 Cyanide Assessment

The protocol for sampling and analysis of cyanide has been prepared by Ish, Inc and is presented in Appendix F.

4.5 Assess the Presence/Characteristics of Free-Phase NAPL

The existing monitoring wells and NAPL monitoring wells (if installed) will be gauged for the presence of NAPLs during the two water-level monitoring rounds. An interface probe will be used to check for accumulated LNAPL and/or DNAPL in the monitoring wells. If during the gauging, DNAPLs are observed to be present in sufficient volume at any monitoring well, the DNAPL will be sampled and analyzed for density, viscosity, and interfacial tension. Analyses will be conducted at ambient groundwater temperatures.

4.6 Baseline Monitored Natural Attenuation (MNA) Assessment

Most dissolved-phase MGP residuals can be destroyed or immobilized by means of naturally occurring microorganisms present in the subsurface. In some cases where the dissolved contaminant plumes are stable, monitored natural attenuation (MNA) is an appropriate remedy component. Tracking the progress of MNA typically requires that a baseline MNA assessment be performed first, followed by long-term monitoring. The purpose of the baseline MNA assessment is to collect sufficient data to develop a conceptual model of MNA, and the objectives include identifying relevant degradation/immobilization processes, estimating degradation rates and travel velocities, and evaluating risk to potential receptors. Data gathered for an MNA assessment can also be used to help evaluate the viability of enhanced bioremediation as a potential remedial component, should MNA alone prove undesirable.

To enable future assessment of the potential for MNA or enhanced bioremediation of dissolved phase MGP-related constituents as a remedial alternative component, a baseline of data will be developed by collecting one round of groundwater samples from a subset of monitoring wells and analyzing them for a series of geochemical parameters. The subset of wells has been selected to:

- provide areal coverage.
- evaluate groundwater conditions in an upgradient direction (MW-1S).
- assess the geochemical conditions at monitoring wells:
  - Where MGP-related constituents have been previously observed to be present in relatively elevated concentrations (MW-8S, MW-6S, and MW-10S); and

  - Located in generally downgradient direction (MW-11S, and two proposed monitoring wells [MW 0301S and MW 0302S].

- evaluate groundwater conditions in a deeper groundwater flow zone (proposed deep monitoring well MW 0304D).

This baseline sampling will include analysis of nitrate, ammonia, total and dissolved iron and manganese, sulfate, sulfide, methane, orthophosphate, and alkalinity, in addition to the field parameters discussed above. These analytical data will be used to identify the predominant oxidation-reduction reactions occurring in site groundwater associated with biodegradation of dissolved MGP residuals. Biodegradation rates will be estimated if possible, depending on the availability of historic time-series data.

5. Fish and Wildlife Impact Analysis and Human Health Exposure Evaluation

5.1 Fish and Wildlife Impact Analysis

An FWIA through Step IIB will be conducted for the site. The analysis will be conducted in accordance with the NYSDEC guidance document entitled "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites" (October, 1994). The objectives of the FWIA are to identify fish and wildlife resources that exist on and near the site, and to evaluate the potential for exposure of these resources to site-related constituents in environmental media.

As established in the guidance, Step IA of the FWIA will involve the development of a covertype map for the site and surrounding areas within a 0.5-mile radius of the site. Significant ecological resources (e.g., surface water bodies, wetlands) within a 2-mile radius of the site will also be identified. Step IB will involve identifying fish and wildlife resources in the vicinity of the site. In addition, the New York Natural Heritage Program and U.S. Fish and Wildlife Service (USFWS) will be contacted to determine if any threatened or endangered species are known to exist in the vicinity of the site. Step IC will involve a qualitative assessment of fish and wildlife resource values, and Step ID will include the identification of applicable fish and wildlife regulatory criteria.

Step IIA involves a pathway analysis, which utilizes the ecological receptor information generated in Step I and the location of site-related chemical constituents to determine if complete ecological exposure pathways exist. As specified in the NYSDEC guidance, if no fish and wildlife resources or complete exposure pathways are identified, then potential impacts to ecological resources will be considered "minimal," and no further evaluation will be necessary.

Step IIB involves a criteria-specific analysis, and compares constituent levels in the environmental media to media-specific numerical criteria. This step is used as a screening step to evaluate the potential significance of ecological exposure and determine if further evaluation is warranted.

5.2 Human Health Exposure Evaluation

The SRI will include a qualitative human health exposure assessment. The purpose of the assessment will be to identify whether potentially complete exposure pathways exist for the site, and identify for each media and each human receptor group the relative magnitude of the potential for exposure. The exposure assessment will be based on site land use patterns, site-specific fate and transport mechanisms, and information regarding chemical constituents in various media. Information from the qualitative human exposure assessment will be used, in part, in remedial decision-making.

Existing site data indicate elevated levels of site-related constituents (e.g., PAHs, phenolics, VOCs, and select inorganics) in onsite media (e.g., soils and groundwater). Existing data reports indicate that there is no localized groundwater use at the site, and that onsite groundwater is not likely affecting public water supply wells. If this is the case, there would be little potential for people to be exposed to site-related constituents in groundwater. However, this exposure pathway will likely need to be revisited based on groundwater data collected during the SRI. Because land use at the site is commercial/industrial, the most-likely current and future receptors would be onsite workers, including those engaged in construction or excavation work (via direct contact with soils and inhalation of vapors and particulates released from soils). Although the site is generally fenced, exposure of trespassers to site-related constituents would also need to be considered.

The significance of potential exposure pathways will be evaluated by comparing concentrations of site-related constituents to available screening criteria. Screening criteria may include the NYSDEC TAGM 4046 Soil Cleanup Levels, and other criteria as appropriate. In addition to evaluating the potential magnitude of exposure, the assessment will also suggest measures that could be taken to mitigate potential exposure. For example, potential exposure to onsite workers could be mitigated by using properly trained personnel and personal protective equipment. In addition, measures could be taken to reduce the amount of airborne particulates (e.g., dust control) released during excavation work. Implementing the NYSDOH Generic Community Air Monitoring Plan (CAMP) when soils are disturbed may also be considered.

6. Survey, Decontamination, and Waste Handling

The following subsections describe the procedures that apply generally to all aspects of the SRI fieldwork.

6.1 Survey

Prior to completing the SRI field activities, field personnel will label and/or stake (with flagging) all investigation locations. A New York State licensed surveyor will field survey all investigation locations after completion of the SRI activities. All locations will be established with respect to the state plane coordinate system (NAD 83 or NAD 27). All elevations will be established with respect to the 1929 National Geodetic Vertical Datum (NDVD).

For each soil boring, the surveyor will determine its location and the ground surface elevation. For each monitoring well, the surveyor will determine the location, ground-surface elevation, and measuring-point elevation (defined as the top of the inner casing).

6.2 Decontamination

All equipment decontamination will follow the procedures outlined in the FSP of this SRI Work Plan. In general, all non-disposable equipment, in particular all drilling tools and groundwater-sampling equipment, will be decontaminated prior to first use on site, between each investigation location, and prior to demobilization. The integrity of the decontamination procedures will be checked periodically with equipment rinse blanks, as required by the QA/SAPP.

6.3 Waste Handling

All investigation-derived waste (IDW) will be contained on-site (in the western plant area) for appropriate characterization and disposal. Soil cuttings, drilling mud (if any), personal protective equipment (PPE), and spent disposable sampling materials will be segregated by waste type and placed in DOT-approved 55 gallon steel drums. All decontamination water, purged groundwater, and drilling water will be stored in polyethylene tanks. All storage vessels will be appropriately labeled with the contents, generator, location, and date for offsite transportation and disposal by NYSEG.

7. Project Schedule and Reporting

7.1 Project Schedule

The field tasks outlined in this SRI Work Plan will take approximately six weeks to complete. To streamline the program, certain tasks will be undertaken simultaneously. It is assumed that the water-level round to be measured during a relatively dry period will be conducted during the first mobilization (late Fall 2003). The measurement round to be conducted during a relatively wet period is assumed to be conducted in Spring 2004. The round may also be conducted sooner dependent on weather. The SRI Report cannot be submitted until the final measurement round has been conducted and the results of the round incorporated into the SRI Report. The table below shows the approximate project schedule. The actual project starting date will be dependent on obtaining access to properties not owned by NYSEG (I.D. Booth, Trayer, and possibly the City of Elmira). The project duration will depend largely on whether additional investigation locations are required to meet project objectives due to unforeseen field conditions.

Work Activity	Start Date	Duration
SRI Work Plan Approval	August 6, 2003	--
Implement SRI Work Plan		
Soil Investigation	September 8, 2003	4 Weeks
Groundwater Investigation	October 6, 2003	3 Weeks
FWIA & HHEE Reconnaissance	October 6, 2003	1 Day
Second Water-Level Measurement Round	Spring 2004	1 Day
Submit Draft SRI Report	May 28, 2004	--
NYSDEC Provides Comments on Draft SRI Report	June 25, 2004	--
Submit Final SRI Report	July 16, 2004	--
Public Meeting to Discuss SRI Report	August 6, 2004	1 Day

7.2 Reporting

BBL will prepare an SRI report once field activities are completed and laboratory data are received. The text of the SRI Report will include a discussion of the following general topics:

- site and project background;
- field activities completed;
- methodologies used to complete the field activities;
- findings of the field activities, including the FWIA and HHEE;
- an understanding of the conceptual site model, including the geologic and hydrogeologic site conditions; and
- an understanding of the distribution of MGP-related constituents in the media sampled.

The text of the SRI Report will be supported by presentation of subsurface logs, analytical data summary tables, and figures illustrating site-specific data including hydrogeologic conditions and constituent distribution.

8. References

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Table

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Table 1

Elmira (Madison Avenue) Former MGP Site
Conceptual SRI Work Plan

Location/Activity	Action	Rationale
Subtask 1 - Soil Investigation		
SB-201 through SB-206 Eastern corner of site, along the northeast property line, in the former waste water lagoon area, and former canal	Drill 17 continuously-sampled soil borings with a conventional drill rig (hollow stem augers and split-spoon sampling) to: • confirm the depth to the bottom of the former MGP structures; • assess the vertical and horizontal extent of MGP residuals around the structures and other potential source areas across the site; • better locate and define the extent of the former waste lagoon to the extent practicable and necessary; • collect sufficient data to support a 3-D model for visualizing the distribution of NAPL and total PAHs in soil; and • provide data to evaluate the top of the confining units' surface and whether the confining units are contiguous. Collect soil samples continuously at each boring location from grade to the final depth of completion using a 2-inch diameter by 2-feet long split-spoon samplers. Soil recovered at each 2-foot interval will be visually characterized for color, texture, and moisture content. The presence of visible staining, NAPL, and obvious odors encountered in the soil will be noted. Each boring will be drilled to a depth of 6 feet below observed MGP-impacted soil or 6 feet below confining unit surfaces (till and clay). Maximum boring depths will be dependent upon the depth of the former structures or top of confining units. Three of the 17 soil borings will be drilled through the confining units in the eastern, western, and central regions of the site in non-impacted areas. Information from these borings will be used to confirm the thickness of the confining units as presented in previous reports. The locations of the borings will be decided in the field upon consultation with the NYSDEC. Additional investigation activities may be warranted in the area of the reputed former waste lagoon. If additional investigations are required, they will be telescoping and depend on visual and analytical evidence of currently planned borings to be drilled in the lagoon area.	These borings will be drilled to the top of the confining unit (clay) in this area to constrain the horizontal and vertical limits of MGP-residuals observed in several test pits in this area of the site. The MGP-residuals in this area may be attributed to the former waste lagoons. SB-201 and SB-205 will be drilled in the location of the former canal to assess the potential presence of MGP-residuals in this former surface-water feature.
SB-207 NYSEG storage yard, just west of the substation, in the PCB IRM area		Provide additional visual and analytical data to constrain the northern limits of potential MGP residuals.
SB-208 NYSEG storage yard, near concrete slab in the PCB IRM area		Evaluate subsurface conditions in the area of the former oil tanks. No previous soil sampling has been performed to address this potential source area.
SB-209 Near existing well MW-6S		Provide additional visual and analytical data to constrain the northern limits of potential MGP residuals and further investigate the elevated concentration of cyanide detected in monitoring well MW-6S.
SB-210 Former MGP operations area, inside former Distribution Holder		Assess the depth to the bottom of the former Distribution Holder and the vertical extent of potential MGP-residuals beneath the holder. Information from this boring will also be evaluate whether MGP-residuals are present in the former canal extension in this area.
SB-211 Former MGP operations area, near former Purifier Boxes		Evaluate subsurface conditions in the area of the former purifiers.
SB-212 and SB-213 Former MGP operations area, inside former Gas Holders No. 1 and 2		Assess the vertical extent of potential MGP-residuals beneath former Gas Holder Nos. 1 and 2 (to be removed during and IRM prior to SRI activities).
SB-214 Former MGP operations area, near south end of former Gas House		Provide visual and analytical data to delineate the vertical extent of potential MGP residuals in this area.
SB-215 Former MGP operations area, near north end of former Gas House		Provide visual and analytical data to constrain the northern limits of potential MGP residuals between the operations area and existing monitoring well MW-6S.
SB-216 Former MGP operations area, just east of former Distribution Holder		Provide additional visual and analytical data to assess the horizontal and vertical extent of potential MGP residuals immediately downgradient from the former Distribution Holder.
SB-217 Near existing monitoring well MW-3S		Provide additional visual and analytical data to assess potential MGP residuals associated with the former tar vessel in this area, and further investigate the elevated concentration of cyanide detected in monitoring well MW-3S.

Table 1

Elmira (Madison Avenue) Former MGP Site
Conceptual SRI Work Plan

Location/Activity	Action	Rationale
	Drilling will not be performed through any subsurface concrete slabs where significant quantities of NAPL are encountered, in an effort to limit the potential downward migration of NAPL. Submit up to 34 soil samples for laboratory analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX compounds), polycyclic aromatic hydrocarbons (PAHs), and cyanide to further evaluate the horizontal and vertical extent of MGP residuals in subsurface soil. The soil samples will target visible MGP residuals impacts (i.e., samples will be collected from moderate to heavily impacted soils) and the first visibly 'clean' interval beneath the residuals.	
Test Pit Excavations Near existing test pit TP-114 (liquid waste pipeline), east of the site	Test pits will allow better identification of subsurface materials and structures associated with these former features.	Assess the extent of MGP-residuals associated with the apparent liquid waste pipeline unearthed during the excavation of TP-114. Test pits will be excavated the immediate area surrounding TP-114 to evaluate the configuration of the pipe and if the pipe is in place or was disposed of in the former canal. Evidence of other piping will also be noted during the test pit program in this area.
Test Pit Excavations Former canal along southern property boundary		Test pitting will be performed to assess the presence/absence of potential MGP-residuals in this former water body, particularly south of former Gas Holder Nos. 1 and 2.
Waste Characterization and Treatability Sampling	Submit up to 5 samples of MGP-impacted subsurface soil for laboratory analysis of waste characterization parameters, including TCLP benzene, reactivity, and total sulphur. The waste characterization samples will be collected to represent the range of observed impacts (i.e., moderate to heavy impacts). If appropriate, one of the five waste characterization samples will be collected during the test pit excavations in the liquid waste pipeline area (near former test pit TP-114). Collect 2 soil samples for chemical oxidant demand, including one 'heavily' impacted sample (either soil or NAPL) and one "background" composite sample. Collect 5 soil samples for total organic carbon (TOC), 3 soil samples for grain size/hydrometer analysis, and 2 Shelby-tube samples for permeability testing.	These additional physical and chemical parameters will be required for evaluating potential remedies, including natural attenuation, off-site treatment, and chemical oxidation.

Table 1

Elmira (Madison Avenue) Former MGP Site
Conceptual SRI Work Plan

Location/Activity	Action	Rationale
Surface Soil Samples	Thirteen additional surface soil samples will be collected, as follows: • five background samples (3 residential and 2 industrial) for analysis of TCL VOCs, TCL SVOCs, TAL inorganics, and cyanide; • six on-site samples for analysis of TCL VOCs, TCL SVOCs, TAL inorganics, and cyanide; and • two samples from the PCB IRM Area for analysis of PCBs. Surface soil sampling locations are shown on Figure 1. Final locations may be altered in the field based on conditions encountered and coordination with the NYSDOH.	Surface soil sampling results will be evaluated qualitatively to assess potential exposure risks.
Subtask 2 – Groundwater Investigation		
Monitoring Well Inspection – Trayer Wells	Inspect the surface condition and integrity of the Trayer monitoring wells to assess the usability of these wells for future groundwater sampling and head measurements.	These wells could provide usable groundwater quality and head data if the wells are accessible and of good condition. If wells are determined to be unusable, then NYSEG may propose to install replacement monitoring wells or reposition some of the already-proposed monitoring wells.
Temporary Monitoring Wells **TW 0301S** **TW 0302S** **TW 0303S**	Install three 1-inch-diameter temporary monitoring wells using -Geoprobe™-like equipment, and sample groundwater from the wells for BTEX and total cyanide. Temporary wells will be installed with 10-foot long screens positioned on top of the clay layer previously observed in this area at approximately 30 to 35 feet bgs. Groundwater will be collected using new polyethylene disposable bailers immediately following screen placement in the borehole. Three well volumes will be removed prior to sample collection. Temporary wells will be abandoned immediately after groundwater samples are collected. Soil samples will be collected continuously during the drilling of the soil borings intended for temporary well installations. Soil recovered at each 2-foot depth interval will be visually characterized for color, texture, and moisture content. The presence of visible staining, NAPL, and obvious odors encountered in the soil will be noted.	At the NYSDEC's request, temporary monitoring wells will be installed in the shallow overburden between MW-11S and MW-12S/D. The results of the groundwater samples from the temporary wells will be used to fine-tune the location of permanent monitoring well MW 0301S.

Table 1

Elmira (Madison Avenue) Former MGP Site
Conceptual SRI Work Plan

Location/Activity	Action	Rationale
MW 0301S East of site, between MW-11S and MW-12S	Install 4 additional monitoring wells with a conventional drill rig (hollow stem augers and split-spoon sampling) to: • further evaluate the deep groundwater flow patterns; • collect sufficient data to support a 3-D model for visualizing the distribution of MGP-residuals in groundwater; and • define the horizontal and vertical limits of MGP residuals in groundwater. Collect soil samples continuously at each well location from grade to the depth of completion using a 2-inch diameter by 2-feet long split-spoon samplers. Soil recovered at each 2-foot depth interval will be visually characterized for color, texture, and moisture content. The presence of visible staining, NAPL, and obvious odors encountered in the soil will be noted.	Further evaluate the presence of MGP-residuals in groundwater above the confining unit (clay) and downgradient from the site, and fill the data gap between MW-11S and MW-12S. The location of this monitoring well will be dependent on the analytical results of the temporary wells installed in this area.
MW 0302S Southeast of site, corner of parking lot near the intersection of East Clinton and Oak Streets		Assess the presence of MGP-residuals in groundwater above the confining unit (clay) downgradient from the site. Based on the results of the Trayer Well Inspections, this well will may serve as a replacement for the Trayer monitoring well in this area (TMW-1). If TMW-1 is determined to be usable, then the location of MW 0302S will shifted further to the west based on consultation with the NYSDEC.
MW 0303S Near north entrance to site, from East Fifth Street		Define the northern extent of cyanide detected in groundwater from existing monitoring well MW-6.
MW 0304D Paired with existing monitoring well MW-4S		This well will be used to evaluate the groundwater flow direction in the deep overburden (below the till in this area). Groundwater levels will be measured at existing monitoring wells MW-1D and MW-2D, and new well MW 0304D. The groundwater levels will be converted to elevations and the levels will be triangulated to assess the direction of deep groundwater flow. This well, combined with existing well MW-4S, will also provide vertical hydraulic gradient data in this area.
Groundwater Sampling and Specific Capacity Testing	Collect groundwater samples using the low-flow sampling technique from the proposed new wells, each of the existing site monitoring wells, Trayer monitoring wells, and any new NAPL monitoring wells (if a representative sample can be collected). Specific capacity tests will be conducted at the new monitoring wells in connection with the groundwater sampling activities. Submit 25 groundwater samples for laboratory analysis for TCL VOCs, TCL SVOCs, and cyanide. Submit 2 of the groundwater samples (from MW-7 and MW-9) for analysis of these compounds and PCBs. Submit groundwater samples from 8 selected monitoring wells for laboratory analysis of the following geochemical parameters: nitrate, ammonia, total iron and manganese, dissolved iron and manganese, sulfate, sulfide, orthophosphate, alkalinity, and methane. Monitor standard field parameters (temperature, pH, specific conductance, and turbidity) and "natural attenuation" field parameters (dissolved oxygen and oxidation-reduction potential) during sampling.	Assess the horizontal and vertical distribution of dissolved-phase MGP-related constituents in groundwater at and near the former MGP site. Monitoring wells MW-7 and MW-9 are selected for analysis of PCBs because these are the only two wells having historical detections of PCBs. Specific capacity test data will be used to estimate the hydraulic conductivity of material screened by the new wells. The geochemical parameters indicated are needed to develop an understanding of the viability of NA as a potential remedial alternative.

Table 1

Elmira (Madison Avenue) Former MGP Site
Conceptual SRI Work Plan

Location/Activity	Action	Rationale
Fluid Level Measurement	Obtain two synoptic rounds of fluid level measurements, including one during a relatively wet period and the second during a relatively dry period. Assess the potential presence of LNAPL and DNAPL in the wells during both water level measurement rounds using an oil/water interface meter. If DNAPL is observed at a monitoring well, a DNAPL sample will be collected from the well (or wells) for laboratory analysis for density, viscosity, and interfacial tension.	Hydraulic head data will be used to evaluate temporal changes in, and general configuration of, horizontal and vertical gradients and flow patterns at the site. The DNAPL physical characterization data (if collected) will help characterize the behavior of DNAPL in the subsurface.
Subtask 3 – FWIA & HHEE Reconnaissance		
Fish and Wildlife Impact Analysis (through Step IIB) & Human Health Exposure Evaluation	Perform field reconnaissance for the FWIA and human health exposure evaluation.	This work is required to complete the FWIA (through Step IIB) and exposure evaluation.

Figure

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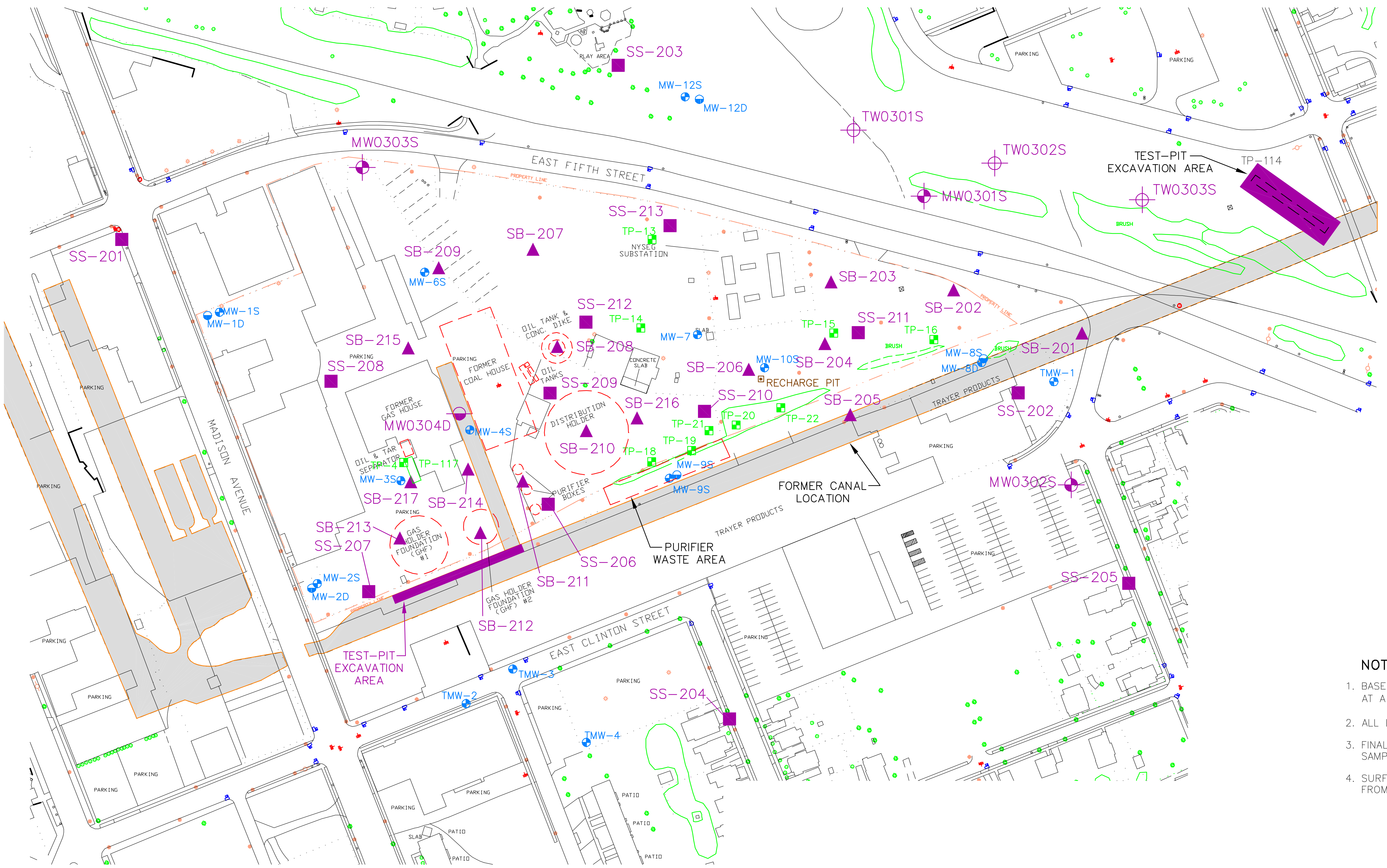

LEGEND:

●	EXISTING MONITORING WELL; SHALLOW (S), DEEP (D), TRAYER WELL (TMW)
🟩	EXISTING TEST PIT
⊖	PROPOSED DEEP MONITORING WELL
⊕	PROPOSED SHALLOW MONITORING WELL
⊕	PROPOSED TEMPORARY MONITORING WELL
▲	PROPOSED SOIL BORING
■	PROPOSED SURFACE SOIL SAMPLING LOCATION
▣	RECHARGE PIT
●	POWER POLE
○	UTILITY POLE W/GUY
●	LIGHT POLE
○○	POST, SIGN
▫	CATCH BASIN
○	TRAFFIC LIGHT
●	MANHOLE

NOTES:

1. BASE MAP SUPPLIED BY NYSEG, LATEST REVISION DATED 1-03, AT A SCALE OF 1"= 60'.
2. ALL LOCATIONS ARE APPROXIMATE.
3. FINAL LOCATION OF MW0301S DEPENDENT ON GROUNDWATER SAMPLING RESULTS OF TEMPORARY MONITORING WELLS.
4. SURFACE SOIL SAMPLING LOCATIONS SS-212 AND SS-213 FROM PCB IRM AREA.

0 80' 160'
GRAPHIC SCALE

ELMIRA MADISON AVENUE FORMER MGP SITE
ELMIRA, NEW YORK
SUPPLEMENTAL REMEDIAL INVESTIGATION

PROPOSED INVESTIGATION LOCATIONS

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FIGURE
1

L: ON=*, OFF=REF*
P: PAGESET/PLT-DL
8/12/03 SYR-54-RCA RCA GMS
13043204/13043P01.DWG

Appendices

Appendix A

Field Sampling Plan

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Field Sampling Plan

Supplemental Remedial Investigation
Elmira (Madison Avenue)
Former MGP Site

New York State Electric & Gas Corporation
Binghamton, New York

August 2003

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Table of Contents

1. Introduction

1.1 General

This Field Sampling Plan (FSP) supports the Supplemental Remedial Investigation (SRI) Work Plan prepared by Blasland, Bouck & Lee, Inc. (BBL) for the Elmira (Madison Avenue) Former Manufactured Gas Plant (MGP) Site (the "site") located in Elmira, New York. The investigation locations described in the SRI Work Plan are shown on Figure 1 of the Work Plan. The SRI Work Plan and this FSP were prepared on behalf of NYSEG (New York State Electric & Gas Corporation).

This FSP addresses the field procedures and sample collection methods to be used during implementation of the investigation field activities. The FSP should be used in conjunction with the SRI Work Plan, the Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP), the Health and Safety Plan (HASP), and the Community Air Monitoring Plan (CAMP). The SRI Work Plan presents the site background and defines the field sampling program. The QA/SAPP presents the quality assurance/quality control (QA/QC) procedures to be used during implementation of the SRI Work Plan, as well as a description of the general field and laboratory procedures. The QA/SAPP, HASP, and CAMP are provided in Appendix B, Appendix C, and Appendix D, respectively, of the SRI Work Plan.

1.2 Project Objectives

The purpose of the SRI is to gather data to 1) complete the characterization of the site with respect to establishing the nature and extent of MGP-related residuals on, and adjacent to, the site; and 2) support a remedial evaluation for the site. The data collected during the investigation will be used in conjunction with existing data from the previous investigations to develop a remedial design for the site.

1.3 Overview of Investigation Field Activities

To obtain information necessary to meet the investigation objective stated above, the following activities will be conducted:

- Soil boring advancement;
- Surface soil sampling;
- Test pit excavation;
- Monitoring well installation;
- Two comprehensive measurement rounds of fluid levels;
- Collection of soil samples during the advancement of the monitoring wells and soil borings; and
- Groundwater sampling of new and existing monitoring wells.

The sampling locations and quantities for each field sampling activity are described in detail in the SRI Work Plan, and therefore, are not further described in this FSP. Soil and water samples will be analyzed for volatile organic compounds (VOCs), semi-VOCs, inorganics, cyanide, and in some cases, total organic carbon (TOC), waste characterization parameters, chemical oxidant demand, and geochemical/natural attenuation indicator parameters, as discussed in the SRI Work Plan. Table 1 of the QA/SAPP presents the anticipated number of samples for specific laboratory analyses from each matrix type.

A site location map and a figure with sampling locations have been prepared for the site to support the field investigation. These figures are presented in the SRI Work Plan.

2. Field Activities

2.1 General Field Guidelines

All underground utilities will be identified prior to any drilling or subsurface sampling. Public and privately owned utilities will be located by contacting responsible agencies by phone so that their underground utilities can be marked at the site. Other potential on site hazards such as traffic, overhead power lines, and building hazards will be identified during a site reconnaissance visit.

The following is a general list of equipment necessary for sample collection.

- Stainless steel spoons and bowls for compositing soil samples;
- Appropriate sample containers provided by the laboratory (kept closed and in laboratory supplied coolers until the samples are collected);
- Reagent grade preservatives and pH paper (or pre-preserved sample containers) for aqueous samples;
- Chain of custody record forms;
- Log book, field sampling records, and indelible ink pens and markers;
- Laboratory grade soap (such as Alconox), reagent grade solvents, and distilled water to be used for decontaminating equipment between sampling stations;
- Buckets, plastic wash basins, and scrub brushes for decontaminating equipment;
- Camera and film;
- Stakes to identify sampling locations;
- Shipping labels and forms;
- Knife;
- Packing/shipping material for sample bottles;
- Strapping tape;
- Clear plastic tape;
- Duct tape;
- Aluminum foil;

- Reclosable plastic bags; and

- Portable field instruments, including a photoionization detector (PID), water quality parameter meter, conductivity meter, and water-level indicator.

Field log books will be maintained by the field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation.

Information pertinent to the field investigation and/or sampling activities will also be recorded in the log books. The books will be bound with consecutively numbered pages. Entries in the log book will include, at a minimum, the following information:

- Name of author, date of entry, and physical/environmental conditions during field activity;
- Purpose of sampling activity;
- Location of sampling activity;
- Name of field crew members;
- Name of any site visitors;
- Sample media (soil, groundwater, etc.);
- Sample collection method;
- Number and volume of sample(s) taken;
- Description of sampling point(s);
- Volume of groundwater removed before sampling (where appropriate);
- Preservatives used;
- Date and time of collection;
- Sample identification number(s);
- Field observations; and
- Any field measurements made, such as pH, temperature, conductivity, water-level, etc.

All original data recorded in field log books and Chain of Custody Records will be written with indelible ink. If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error and entering the correct information. The erroneous information will not be erased. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

2.2 Sample Labeling, Packing, and Shipping

Each sample will be given a unique identification. With this type of identification, no two samples will have the same label.

Samples will be promptly labeled upon collection with the following information:

- Project number and site;
- Unique sample identification;
- Analysis required;
- Date and time sampled;
- Sample type (composite or grab); and
- Preservative, if applicable.

Clear tape will be secured over the sample label and the chain-of-custody will be initiated. A sample chain of-custody form is included on Figure A-1.

Appropriate sample containers, preservation methods, and laboratory holding times for each sample type will be applied as identified in the QA/SAPP.

If samples are to be shipped by commercial carrier (e.g., Federal Express), sample bottles/jars will be packed in coolers containing the following:

- A drain plug (if present) that has been sealed with duct tape;
- One to 2 inches of vermiculite or bubble wrap on the bottom of the cooler;
- Water ice packaged in re-sealable plastic bags;
- Sufficient vermiculite or bubble wrap to fill in the remaining area; and
- The completed chain-of-custody in a re-sealable plastic bag, taped in place on the inside cover of the cooler.

The cooler will then be sealed with tape. Appropriate shipping labels, such as "this-end-up" and "fragile" stickers will be affixed to the cooler. Samples will be hand delivered or delivered by an express carrier within 48 hours of sample collection. The express carrier will not be required to sign the chain-of-custody form, however, the shipping receipt should be retained by the sampler, and forwarded to the project files.

2.3 Equipment Decontamination

2.3.1 Drill Rig Decontamination

A decontamination pad will be lined with plastic sheeting on a surface sloped to a sump. The sump must also be lined and of sufficient volume to contain approximately 20 gallons of decontamination water. All drilling equipment including rear-end of drilling rig, augers, bits, rods, tools, split spoon samplers, and tremie pipe will be cleaned on the decontamination pad with a high pressure hot water "steam cleaner" unit and scrubbed with a wire brush, as needed, to remove dirt, grease, and oil before beginning work in the project area. If heavy accumulations of tars or oils are present on the downhole tools, a citrus-based cleaner (e.g., Citra-Solv®) may be used to aid in equipment cleaning. Tools, drill rods, and augers will be placed on sawhorses, decontaminated pallets, or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be avoided. The back of the drill rig, and augers, rods, and tools will be decontaminated between each drilling location according to the above procedures. Decontamination water will be contained in a dedicated plastic tank or 55-gallon open-top drums located on site. All open-top drums will remain closed when not in use.

Following decontamination of all heavy site equipment, the decontamination pad will be decommissioned. The decommissioning will be completed by:

- Transferring the bulk of the remaining liquids and solids into the drums, tanks, and roll-offs to be provided by NYSEG or the drilling subcontractor for these materials; and

- Rolling the sheeting used in the decontamination pad onto itself to prevent discharge of the remaining materials to the ground surface. Once rolled up, the polyethylene sheeting will be placed in the roll-off or drums used for disposal of personal protective equipment (PPE) and disposable equipment.

Unless sealed in manufacturers packaging, polyvinyl chloride (PVC) monitoring well casing screens will be decontaminated by the above procedures before installation.

2.3.2 Sampling Equipment Decontamination

Prior to collecting samples to be submitted for chemical analysis, all non dedicated bowls, spoons, hand augers, bailers, and filtering equipment will be washed with potable water and a detergent (such as Alconox). Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, etc. The sampling equipment will then be rinsed with potable water, followed by a 10 percent "pesticide-grade" methanol rinse, and finally a distilled water rinse. When sampling for inorganic constituents in an aqueous phase, an additional rinse step will be added prior to the rinse with methanol. The rinse step will entail a rinse with a 10 percent "ultra pure-grade" nitric acid followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. At no time will washed equipment be placed directly on the ground. Equipment will be either be used immediately or wrapped in plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location.

2.4 Subsurface Soil - Split-Spoon Sampling Method

The Standard Penetration Test (ASTM D 1586 84) and hollow stem augers or flush joint casing will be used during drilling in overburden to collect split spoon samples from the unconsolidated fill and soils beneath the site. Samples will be selected for laboratory analysis based on:

- Their position in relation to potential source areas;
- The visual presence of source materials;
- The relative levels of volatile organics based on PID field screening measurements; and/or
- The discretion of the on-site geologist.

Samples selected for laboratory analysis will be placed in the appropriate containers provided by the laboratory. Sample containers for volatile organic analyses will be filled first. Soil samples collected for VOC analysis will be collected in a manner consistent with the previous soil VOC analyses completed at the site to provide data comparability (soil VOC samples will not be collected using methanol preservation or analyzed using USEPA Method 5035). Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel tray or bowl with a decontaminated stainless steel trowel or disposable scoop. Laboratory-supplied sample containers for other analytes will then be filled. Duplicate samples will be collected at the frequency detailed in the QA/SAPP (Appendix B) by alternately filling two sets of sample containers.

Where there is sufficient sample volume, representative portions of each soil sample will be placed in a one-pint jar or re-closable plastic bag, labeled, and stored on site. This container will be labeled with:

- Site;
- Boring number;
- Interval sampled;
- Date; and
- Initials of sampling personnel.

These soil samples will be screened for organic vapors using a PID. In addition, a geologist will be on site during the drilling operations to describe each sample including:

- Soil type and sorting;
- Color;
- Feet of recovery;
- Moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observation.

For samples that may be submitted for chemical analysis, split spoons will be decontaminated, as specified in Section 2.3.2, after each sample is collected. Sample descriptions, PID readings, and location will be recorded in the field book or on the field drilling log presented on Figure A-2. Calibration, operation, and maintenance procedures are included as Attachment A-1 for one type of PID commonly used in the field. The procedures to be followed will be dependent on the PID acquired for this project, as described in the equipment manual.

2.5 Monitoring Well Installation and Development

Monitoring wells will be installed to the depths and at the locations defined in the SRI Work Plan. After completion of drilling and well installation, all wells will be developed to establish hydraulic connection between the well and the formation. The following procedures will be used to drill, install, and develop monitoring wells.

2.5.1 Drilling and Geological Logging Methods

The drilling and geological logging methods to be completed in connection with monitoring well installation are as follows:

- Boreholes in the overburden will usually be drilled with hollow stem augers. Based on subsurface conditions discussed in the SRI Work Plan, drilling conditions may be difficult at depth. At these locations, flush-joint casing may be used.

- Split spoon sampling will be conducted during the advancement of soil borings for the overburden monitoring wells. Sampling will be performed in accordance with ASTM Specification D 1586 84 for standard penetration test and split-spoon sampling, unless otherwise authorized by the field geologist.

- The designated field geologist will log borehole geology and monitoring well specifications in the field book and/or field forms.

- A plywood sheet or tub may be placed around the auger or casing when drilling to contain cuttings.

- Soil cuttings will be placed in a drum or roll off supplied by NYSEG or the drilling subcontractor. Decontamination water will be placed in plastic tanks/drums supplied by NYSEG or the drilling subcontractor. Soil cuttings and decontamination water will be picked up and containerized at the end of each work day. The roll-offs or open-top drums used to contain the solids will be covered when not in use.

Results from the drilling efforts will be recorded in the field book.

2.5.2 Monitoring Well Specifications

Figure A-3 shows details of a typical monitoring well construction for shallow wells installed in unconsolidated sediments that do not penetrate a presumed confining layer, above which DNAPL is known or suspected to exist. The overburden monitoring wells will be installed according to the following specifications:

- PVC 2 inch-diameter threaded, flush joint casing and 10 foot long, 0.020-inch slot screens will be installed.

- A sump, 2 feet in length and grouted in with cement, may be attached to the bottom of the screen for potential collection of DNAPL, if present.

- The top of the casing will extend approximately 2 feet above ground surface given site specific considerations, otherwise, flush mount casings will be used.

- The annulus around the screens will be backfilled with an appropriate size of silica sand such as Morie #1 sand to a minimum height of one foot above the top of the screen, assuming there is sufficient room to install an appropriate surface seal above the sand.

- An approximately one-foot-thick chipped bentonite seal or slurry (30 gallons water to 25 to 30 pounds bentonite, or relative proportions) will be placed above the sand pack. The pellet seal must be allowed to partially hydrate before placing grout above the seal.

- The remainder of the annular space will be filled with a cement/bentonite grout to approximately 2 feet below grade. The grout will be placed with a tremie pipe from the bottom up. The grout will consist of a cement mixture of one 94-pound bag of Portland cement, approximately 5 pounds of granular bentonite, and approximately 7 gallons of water. The grout will be allowed to set for a minimum of 24 hours before wells are developed.

- Each monitoring well will have a vented cap and a 4 inch-diameter steel casing with a locking cap placed over the monitoring well. The protective casing will extend approximately one to 2 feet below ground surface and be set in concrete. In some areas, it may be necessary to provide flush-mounted casings.

- A concrete seal or pad, approximately 2 feet in diameter and 1.5 feet below grade, will be installed.

- A weep hole will be drilled through the protective standpipe casing just above the top of the concrete seal to allow water between the inner and outer casing to drain.

- The top of the PVC well casing and outer protective casing will be marked and the elevation determined by survey to the nearest 0.01 foot, relative to a fixed benchmark or datum.

- The measuring point on all wells will be on the innermost PVC casing, at the highpoint of the casing, if any.

The following characteristics of each newly installed well will be recorded in the field log book:

- Date/time of construction;
- Drilling method and drilling fluid used;
- Approximate well location;
- Borehole diameter and well casing diameter;
- Well depth;
- Drilling and lithologic logs;
- Casing materials;
- Screen materials and design;
- Casing and screen joint type;
- Screen slot size/length;
- Filter pack material/size;
- Filter pack placement method;
- Sealant materials;
- Sealant placement method;
- Surface seal design/construction;
- Well development procedure;
- Type of protective well cap; and
- Detailed drawing of well (including dimensions).

2.5.3 Monitoring Well Development

A minimum of 24 hours after installation, the monitoring wells will be developed by surging/bailing, using a centrifugal pump and dedicated polyethylene tubing, or by Waterra positive displacement pumps and dedicated polyethylene tubing, or other methods at the discretion of the field geologist. The development water will be contained in a tank on site or in drums to be provided by NYSEG or the drilling subcontractor. The wells will be developed until the water removed from the well is reasonably free of visible sediment (50 nephelometric turbidity units [NTUs]), if possible, or until the turbidity levels stabilize, assuming a minimum of 10 well volumes of water have been removed from the monitoring well during development. Following development, wells will be allowed to recover for at least one week before groundwater is purged and sampled. All monitoring well development will be overseen by a field geologist and the duration, method of development, and approximate volume of water removed will be recorded in the field book.

2.6 Fluid-level Measurements

The following procedure will be used to measure fluid-level depths at monitoring wells and surface water gauges:

- Decontaminate the water level probe or oil/water interface probe (for wells expected to contain NAPL); and

- Measure the static fluid-level, fluid interfaces (i.e., NAPL/water interface), and sound the bottom of the well (if applicable) with reference to the surveyed elevation mark on the top of the PVC casing or surface water gauge. Record all measurements to nearest 0.01 foot and record in the field book.

The measurements will be made in as short a timeframe as practical to minimize temporal fluctuations in hydraulic conditions. Two rounds of fluid-level elevations will be collected as discussed in the SRI Work Plan.

2.7 Low-Flow Groundwater Sampling Procedures for Monitoring Wells

This protocol describes the procedures to be used to collect groundwater samples. No wells will be sampled until well development has been performed. During precipitation events, groundwater sampling will be discontinued until precipitation ceases. When one round of water levels is taken to generate water-elevation data, the water levels will be taken consecutively at one time prior to sampling or other activities.

The following materials, as required, shall be available during groundwater sampling:

- Sample pump;
- Sample tubing;
- Power source (i.e., generator);
- PID;
- Appropriate health and safety equipment as specified in the HASP;
- Plastic sheeting (for each sampling location);
- Dedicated or disposable bailers;
- New disposable polypropylene rope;
- Buckets to measure purge water;
- Water-level probe;
- Six-foot rule with gradation in hundredths of a foot;
- Conductivity/temperature meter;
- pH meter;
- Turbidity meter;
- DO meter;
- ORP meter;
- Appropriate water sample containers;
- Appropriate blanks (trip blank supplied by the laboratory);
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Groundwater sampling logs;
- Chain-of-Custody forms;
- Indelible ink pens;

- Site map with well locations and groundwater contours maps; and
- Keys to wells.

The following 21 steps detail the monitoring well sampling procedures:

1. Review materials checklist (Part II) to ensure that the appropriate equipment has been acquired.

2. Identify site and well sampled on sampling log sheets, along with date, arrival time, and weather conditions. Identify the personnel and equipment used and other pertinent data requested on the logs (Attachment A-2).

3. Label all sample containers using an appropriate label.

4. Use safety equipment, as required in the HASP.

5. Place plastic sheeting adjacent to the well to use as a clean work area.

6. Establish the background reading with the PID and record the reading on the field log.

7. Remove lock from the well and if rusted or broken replace with a new brass keyed-alike lock.

8. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe in the breathing zone above the well casing following instructions in the HASP.

9. Set out on plastic sheeting the dedicated or disposable sampling device and meters.

10. Prior to sampling, groundwater elevations will be measured at each monitoring well and the presence of LNAPL or DNAPL (if any) within the well will be evaluated. Obtain a water-level depth and bottom of well depth using an electric well probe and record on the sampling log sheet. Clean the well probe after each use with a soapy (Alconox) water wash and a tap water rinse. [Note: water levels will be measured at all wells prior to initiating a sampling event].

11. After groundwater elevations are measured and NAPLs are determined not to be present, groundwater will be purged from the wells. If NAPLs are determined present, then a groundwater sample will not be collected, rather a representative NAPL sample may be collected (if required) using a peristaltic pump.

12. Pump, safety cable, electrical lines, and/or tubing (for peristaltic pumps) will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well.

13. Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 100 to 500 milliliters per minute. Ideally, the pump rate should cause little water-level drawdown in the well (less than 0.3 feet and the water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause the pump suction to be broken or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit sample collection.

14. During well purging, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every three to five minutes (or as appropriate). The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    ±0.1 for pH
    ±3% for specific conductance (conductivity)
    ±10 mv for redox potential
    ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling. If the parameters have stabilized, but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to no more than 100 millimeters per minute. Measurement of the indicator parameters should continue every three to five minutes. Measurements for dissolved oxygen (DO) and oxidation reduction potential (ORP) must be obtained using a flow-through cell. Other parameters may be taken in a clean container such as a glass beaker.

15. Fill in the sample label and cover the label with clear packing tape to secure the label onto the container.

16. After the groundwater quality parameters have stabilized as discussed above, obtain the groundwater sample needed for analysis directly from the sampling device in the appropriate container and tightly screw on the caps.

17. Secure with packing material and store at 4 degrees Celsius on wet ice in an insulated transport container provided by the laboratory.

18. After all sampling containers have been filled, remove one additional volume of groundwater. Check the calibration of the meters and then measure and record on the field log the physical appearance, pH, ORP, DO, temperature, turbidity, and conductivity.

19. Record the time sampling procedures were completed on the field logs.

20. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to the next well and repeat Step 1 through Step 21 until all wells are sampled.

21. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody forms (Section 2.2).

2.8 Surface Soil Sampling

The SRI activities will include collecting surface soil samples at the designated surface soil sampling locations shown on Figure 1 of the SRI Work Plan. As discussed in the SRI Work Plan, the sampling locations will be adjusted, as necessary, in the field based on site reconnaissance activities and concurrence with the NYSDOH. Surface soil sample locations will be collected from below the vegetative sod layer or sub base material (if these materials are present at the selected locations). One composite PCB, SVOC, inorganic, and/or cyanide soil sample will be collected at each surface soil sampling location to reduce the potential effect of local spatial variation in the concentration of potential site-related constituents present in the surface soil. The composite surface soil sample at each location will be formed from eight subsamples collected at a depth of approximately 0 to 2 inches below the vegetative sod layer or sub base material. The eight subsamples will be collected from within a one-square-meter area centered on the sampling location and evenly distributed throughout the square meter area. Each composite sample will be visually characterized for color, texture, and moisture content.

One discrete grab VOC sample will also be collected at selected locations from the same depth interval as the SVOC, inorganic, and cyanide samples, but the VOC sample will not be formed as a composite sample from sub samples. The grab VOC sample will be collected from one of the composite sub sample locations based on visible staining/noticeable odors (if present).

A grab sample will also be placed into a container for headspace screening using a PID to measure the relative concentration of total VOC vapors, if any. Equipment, materials, and procedures for collecting surface soil grab samples are presented below.

The following equipment and materials will be available, as required, during the surface soil sampling:

- Appropriate health and safety equipment;
- Camera;
- Cleaning equipment;
- Aluminum or stainless steel tray;
- Measuring device;
- Appropriate sample containers and forms;
- Coolers with ice; and
- Field book.

The procedures for collecting surface soil samples and presented below.

1. Don personal protective equipment (as required by the Health and Safety Plan).

2. Identify sample locations from sample location plan and note locations in field notebook. Locations should not be selected in areas covered with crushed stone or hard-packed gravel.

3. Eight subsoil samples will be collected from a one-square meter area centered on the sampling location by carefully cutting into and removing the surface material (sod, sub base, etc.) with a precleaned stainless steel scoop. The subsamples will be collected from 0 to 2 inches below the surficial material and placed into a stainless steel or aluminum tray.

4. Gently mix the soil in the tray and obtain one surface soil sample and place it into an 8 ounce jar and screen the headspace with a PID. Record PID reading in field book. Visually characterize the soil for presence of stains and classify according to ASTM soil classification procedures.

5. Obtain one composite sample and place into appropriate sample containers provided by the analytical laboratory for SVOC, inorganic, and total cyanide analysis.

6. Based on the presence of staining, etc., collect a grab sample from 0 to 2 inches from one of the eight subsample locations and place into an appropriate sample container provided by the analytical laboratory for VOC analysis.

7. Fill out sample labels, in accordance with procedures in Subsection 2.2, and affix the labels on the containers. Also, label the sample bottle caps with the sample ID.

8. Place the sample containers on ice in an insulated transportation cooler.

9. Discard gloves and stainless steel scoop in designated location.

10. Handle, pack, and ship the samples with appropriate chain-of-custody procedures in accordance with Subsection 2.2.

11. Record all other appropriate information in the field log book.

2.9 Test Pit Excavation

The test pits/trenches will be excavated using a backhoe equipped with a bucket. If residues are visually observed in the test pit/trenches, the contents may also be sampled.

The following materials will be available, as required, during test pit excavation.

- Backhoe with bucket;
- Shovel;
- Plastic sheeting;
- Stainless steel hand trowel;
- Stainless steel pan;
- Appropriate sample containers and packing materials, if required;
- Potable water;
- Steam cleaning equipment;
- Appropriate Health and Safety equipment as required by the HASP;
- Photoionization detector (PID);
- Camera/video camera; and
- Test pit/trench log.

2.9.1 Procedures for Test Pit Excavation

The following procedures will be used to excavate test pits.

1. Identify the test pit/trench number on an appropriate log or in the designated field notebook, along with the temperature, weather, date, time, and personnel at the site.

2. Set up decontamination station and decontaminate the backhoe, bucket, shovel, and other sampling apparatus with a high-pressure steam rinse using a tap water source.

3. Put on appropriate health and safety equipment.

4. Place the plastic sheeting on the ground next to the test pit/trench location.

5. Position backhoe and personnel at upwind (to the extent feasible) locations of the test pit/trench area.

6. Turn on the PID. Measure and record on the test pit/trench log background PID readings on the log or in the field book.

7. Excavate the soil with the backhoe in approximately one-foot increments. At each interval, examine and classify the soils according to applicable standards. Record these observations in the test pit/trench log or field book. Also screen the soil samples with a PID. These measurements will also be recorded in the test pit/trench log (or field book).

8. If the contents of the test pit/trench visually appear to consist of site residues, the test pit/trench contents may be sampled. If sampling is required, the test pit/trench will be sampled with a shovel if the test pit/trench is less than 3 feet deep. If the test pit/trench is greater than three feet deep, then the test pit/trench will be sampled with the backhoe bucket. The contents of the bucket will then be sampled with a cleaned stainless steel hand trowel.

9. If sampling is required, the samples will be collected in the appropriate containers and placed immediately in a cooler of wet ice to maintain a 4ºC temperature for preservation. Volatile organic samples will be collected immediately after sample retrieval. Next, a sufficient amount of the remaining soil will be removed from the sampling device and homogenized by mixing thoroughly in a clean stainless steel pan with a clean stainless steel trowel. Samples will be selected for analytical characterization only if visible residues are present and/or relatively high PID screening readings are measured.

10. The test pit/trench will be terminated when significant residues are encountered, the top of the water table is reached, or to the maximum reach of the backhoe, whichever occurs first.

11. Soils generated during drilling will be staged on plastic during excavation, monitored for PID readings and visual observations, then placed back into the test pit/trench. Clean fill will be placed at the surface.

12. A labeled stake will be placed at the test pit/trench location.

13. A photograph of each location before, during, and after each test pit/trench is excavated will be taken.

14. The backhoe, backhoe bucket, and all tools used at the test pit/trench area will be decontaminated using a high-pressure steam rinse using a tap water source. Decontamination water and residual materials associated with decontamination will be contained.

2.10 Air Monitoring

Air monitoring will be conducted with a PID and dust monitor during all intrusive activities and only a PID during sampling activities. The PID will be used to monitor organic vapors in the breathing zone and borehole, and to screen samples for analysis and the dust monitor will be used to monitor particulate concentration in the breathing zone for particulates less than 10 microns in diameter.

The PID and dust monitor readings will be recorded in the field book during trenching and drilling activities. The instruments will be calibrated at least once each day, and more frequently if needed. A detailed procedure for the PID calibration is included as Attachment A-1.

3. Field Instruments

All field-screening equipment will be calibrated immediately prior to each day's use and more frequently if required. The calibration procedures will conform to the manufacturer's standard instructions. Records of all instrument calibration will be maintained by the field personnel. Copies of all of the instrument manuals will be maintained on site by the field personnel.

3.1 Portable Photoionization Analyzer

The photoionization analyzer will be a Photovac MicroTip (or equivalent), equipped with a 10.6 eV lamp. The Photovac is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73 percent of the VOCs on the Target Compound List. Calibration will be performed according to the procedures outlined in Attachment A-1.

3.2 Dust Monitor

The dust monitor will be a MIE DataRAM (or equivalent) and will be calibrated at the start of each day of use. Calibration and maintenance of the dust monitor will be conducted in accordance with the manufacturer’s specifications. The calibration data will be recorded in field notebooks.

3.3 pH Meter

The pH meter will be calibrated at the start of each day of use, and after very high or low readings as required by this plan. National Institute of Standards and Technology traceable standard buffer solutions that bracket the expected pH range will be used. The standards will most likely be a pH of 7.0 and 10.0 standard units. The pH calibration and slope knobs will be used to set the meter to display the value of the standard being checked. The calibration data will be recorded in field notebooks.

3.4 Specific Conductivity Meter

Calibration checks using the appropriate conductivity standard for the meter will be performed at the start of each day of use, and after very high or low readings, as required by this plan. Readings must be within five percent to be acceptable. The thermometer of the meter will be calibrated against the field laboratory thermometer on a weekly basis.

3.5 Dissolved Oxygen (DO) Meter

The DO meter will be calibrated and the condition of the DO sensor will checked at the start of each day of use. Calibration and maintenance of the DO meter will be conducted in accordance with the manufacturer’s specifications. The calibration data will be recorded in field notebooks.

3.6 Water-Level Meter

The water-level cable will be checked once to a standard to assess if the meter has been correctly calibrated by the manufacturer or vendor. If the markers are incorrect, the meter will be sent back to the manufacturer or vendor.

3.7 Turbidity Meter

The turbidity meter will be calibrated daily prior to use. Calibration and maintenance will be conducted in accordance with the manufacturer's specifications. Calibration and maintenance information will be recorded in the field notebook.

3.8 Oxidation-Reduction Potential (ORP) Meter

The ORP meter will be calibrated at the start of each day of use. Calibration and maintenance of the ORP meter will be conducted in accordance with the manufacturer's specifications. The calibration data will be recorded in the field notebook.

Appendix A

Field Sampling Plan

Figures

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Figure A-1

Sample Chain-of-Custody

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6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066
TEL: (315) 446-9120

CHAIN OF CUSTODY RECORD

PROJ. NO.	**PROJECT NAME**
SAMPLERS: *(Signature)*	

STA. NO.	**DATE**	**TIME**	**COMP.**	**GRAB**	**STATION LOCATION**	**Number of Containers**							**REMARKS**

Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**DATE**	**TIME**	**Relinquished by:** *(Signature)*
Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**DATE**	**TIME**	**Relinquished by:** *(Signature)*
Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received for Laboratory by:** *(Signature)*	**DATE**	**TIME**	**Remarks:**	

10/23/95
5951188L.CDR

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Figure A-2

Field Drilling Log

Date Start/Finish:
Drilling Company:
Driller's Name:
Drilling Method:
Bit Size:
Auger Size:
Rig Type:
Sampling Method:

Northing:
Easting:
Casing Elevation:

Borehole Depth:
Surface Elevation:

Geologist:

Well/Boring ID:

Client:

Location:

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	PID Headspace (ppm)	Analytical Sample	Geologic Column	Stratigraphic Description	Well/Boring Construction
0	0										
5	-5										
10	-10										
15	-15										

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Remarks:

Project:
Data File:

Template:
Date:

Page: 1 of 1

Figure A-3

Monitoring Well Construction Diagram

Date Start/Finish: 10/16/00-10/16/00
Drilling Company: Drillers, Inc.
Driller's Name: Joe Smith
Drilling Method: Hollow Stem Auger
Bit Size: 8.25" OD
Auger Size: 4.25" ID
Rig Type: BK-81
Sampling Method: 2" and 3" OD x 2'

Northing: NA
Easting: NA
Casing Elevation: NA

Borehole Depth: 16' below grade
Surface Elevation: NA

Geologist: Jason C. Sents

Well ID: EXAMPLE WELL 2

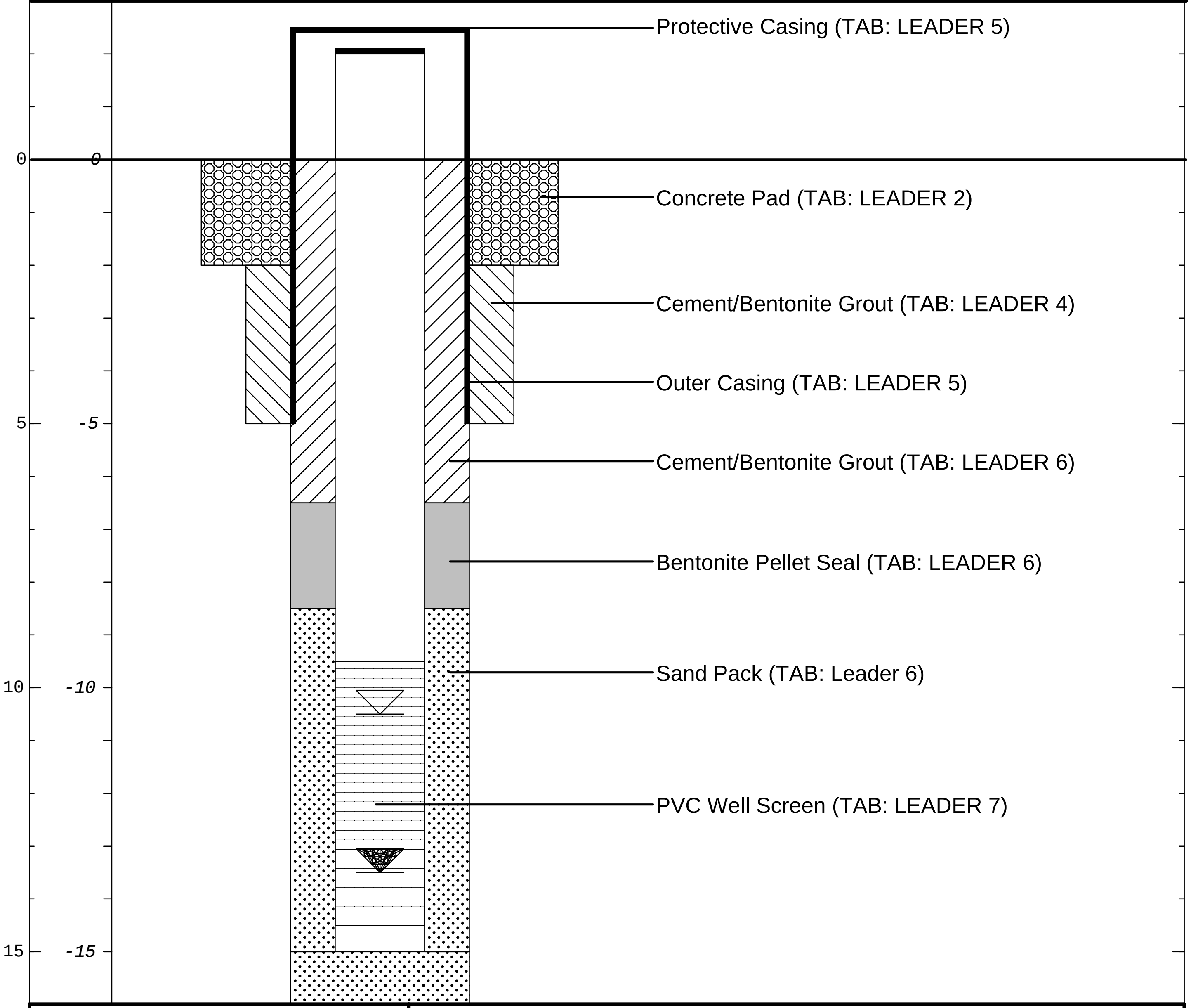
Client: XYZ Chemical

Location: Smith Street Site
Syracuse, NY

DEPTH

ELEVATION

Well Construction Details



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Remarks: The design file used for this log is: Wellconst2003.ldf
The data file used for this log is: Wellconst2003.dat

Project: 00000.000
Data File:Wellconst2003.dat

Template:J:\Rockware\LogPlot2001\LogFiles\Templates\wellconst2003.ldf
Date:

Appendix A

Field Sampling Plan

Attachments

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Appendix A
Attachment 1

MicroTIP Photoionization Detector Calibration, Operation, and Maintenance Procedures

Appendix A – Attachment 1

MicroTIP Photoionization Detector Calibration, Operation, and Maintenance Procedures

I. Introduction

The MicroTIP measures relative total concentrations of organic and inorganic vapors in the field and will be calibrated daily prior to use. The MicroTIP does not carry an Intrinsic Safety Rating and will be used in a controlled environment only. The MicroTIP will be used to screen soil samples, the head space of soil/water samples, and to monitor the breathing and work zones as specified in the Health and Safety Plan.

II. Materials

- Photovac MicroTIP (PID);
- Isobutylene calibration gas tank with pressure regulator and up to four other selected span gases;
- Zero span gas (clean outdoor air or zero grade gas);
- Gas sampling bag with plastic tubing to connect PID probe to calibration gas;
- Flow regulator; and
- PID calibration and maintenance log.

III. Calibration Procedures

1. Turn on the MicroTIP and monitor the ambient air. If there is any doubt of the air quality, then zero grade gas will be obtained.

2. Connect the regulator to the span gas cylinder. Hand-tighten the fittings.

3. Open the valve on the gas bag by turning the valve stem fully counterclockwise.

4. Attach the gas bag to the regulator. Hand-tighten the fittings.

5. Turn the regulator knob counterclockwise half a turn to start the gas flow.

6. Fill the gas bag half full and then close the regulator fully clockwise to turn off the flow of gas.

7. Fill the gas bag, and then turn the valve clockwise.

8. Press "CAL" and expose MicroTIP to zero gas. Press "ENTER" and MicroTIP sets its zero point.

9. MicroTIP then asks for the Span Gas concentration. Enter the known Span Gas concentration and then expose the MicroTIP to the Span Gas.

10. Press "ENTER" and MicroTIP sets its response factor.

11. When MicroTIP's display reverts to normal, the MicroTIP is calibrated and ready to use. Remove the Span Gas from the inlet.
12. After seven hours of use, recharge the battery pack. Record the time the battery pack was charged on the MicroTIP Calibration and Maintenance Log (Attachment 1).
13. Record the date, time, your initials, calibration gas, and concentration on the Micro TIP Calibration and Maintenance Log (Attachment 1).

IV. Operation Procedures

1. Use the health and safety equipment as required by the Health and Safety Plan.
2. Calibrate the instrument as described in subsection III of this Appendix.
3. Measure and record the background PID reading.
4. If the PID will be used for more than seven hours during optimal weather conditions (50º or greater), or during extreme cold or precipitation, have a fully charged battery available for use.
5. In the event of precipitation, fully cover the instrument, leaving the probe accessible for measurements.
6. Measure and record PID reading.

V. Maintenance Procedures

1. At the end of each day or when the battery is fully discharged, recharge batteries overnight.
2. Store the instrument in the protective case when not in use.
3. Keep records of operation, maintenance, calibration problems, and repairs.
4. A replacement instrument will be available on site or ready for overnight shipment, if necessary.
5. The MicroTIP will be sent back to the manufacturer for service if needed.

Appendix A
Attachment 2

Field Sampling Log

Site *Event*

GROUND-WATER SAMPLING LOG

Sampling Personnel: **Well ID:**

Client / Job Number: **Date:**

Weather: **Time In:** **Time Out:**

Well Information

Depth to Water:	(feet)	(from MP)
Total Depth:	(feet)	(from MP)
Length of Water Column:	(feet)	
Volume of Water in Well:	(gal)	
Three Well Volumes:	(gal)	

Well Type:	Flushmount	Stick-Up	
Well Material:	Stainless Steel	PVC	
Well Locked:	Yes	No	
Measuring Point Marked:	Yes	No	
Well Diameter:	1"	2"	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Grundfos	Other:
Tubing/Bailer Material:	St. Steel	Polyethylene	Teflon	Other:
Sampling Method:	Bailer	Peristaltic	Grundfos	Other:
Duration of Pumping:	(min)			
Average Pumping Rate:	(ml/min)	Water-Quality Meter Type:		
Total Volume Removed:	(gal)	Did well go dry:	Yes	No

Conversion Factors				
gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.469
1 gal = 3.785 L =3875 ml = 0.1337 cubic feet				

Unit Stability			
pH	DO	Cond.	ORP
± 0.1	± 10%	± 3.0%	± 10 mV

Parameter:	1	2	3	4	5	6	7	8	9
Volume Purged (gal)									
Rate (mL/min)									
Depth to Water (ft.)									
pH									
Temp. (C)									
Conductivity (mS/cm)									
Dissolved Oxygen									
ORP (mV)									
Turbidity (NTU)									
Notes:									

Sampling Information

Analyses	#	Laboratory

Sample ID: Sample Time:

MS/MSD: Yes No

Duplicate: Yes No

Duplicate ID Dup. Time:

Chain of Custody Signed By:

Problems / Observations

Appendix B

Quality Assurance/Sampling and Analysis Project Plan

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Quality Assurance/Sampling and Analysis Project Plan

Supplemental Remedial Investigation Elmira (Madison Avenue) Former MGP Site

New York State Electric & Gas Corporation
Binghamton, New York

August 2003

BLASLAND, BOUCK & LEE, INC.
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QUALITY ASSURANCE/SAMPLING AND ANALYSIS PROJECT PLAN

Prepared By: Blasland, Bouck & Lee, Inc.

Approved: ____
Project Manager
Blasland, Bouck & Lee, Inc.

Approved: ____
Quality Assurance Manager
Blasland, Bouck & Lee, Inc.

Approved: ____
Laboratory Project Manager

Approved: ____
Laboratory Quality Assurance Manager

Approved: ____
Project Manager
New York State Department of Environmental Conservation

Approved: ____
Quality Assurance Manager
New York State Department of Environmental Conservation

Table of Contents

Acronyms

References

Tables

Preface

This Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP) presents the sampling and analytical methods and procedures that will be used during implementation of the select actions at the site.

This QA/SAPP was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) "Test Methods for Evaluating Solid Waste, SW-846" (USEPA, 1996);
- The USEPA's guidance document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Operations, "EPA-QA/R-5 (USEPA, 2001), which replaces QAMS-005/80 "Interim Guidance and Specifications for Preparing Quality Assurance Project Plans" (USEPA, 1980); and
- The National Enforcement Investigations Center (NEIC) Policies and Procedures Manual (USEPA, 1991).

Information contained in this QA/SAPP has been organized into the following sections:

Section	Content
Project Management	
1	Project Organization
2	Project Background
3	Project Description
4	Quality Objectives and Criteria for Measurement Data
5	Specialized Training Requirements/Certification
6	Documentation and Records
Measurement/Data Acquisition	
7	Sampling Process Design
8	Sampling Method Requirements
9	Sample Handling and Custody Requirements
10	Analytical Method Requirements
11	Quality Control Requirements
12	Instrument/Equipment Testing, Inspection, and Maintenance Requirements
13	Instrument Calibration and Frequency
14	Inspection/Acceptance Requirements for Supplies and Consumables
15	Data Acquisition Requirements for Nondirect Measurements
16	Data Management
Assessment/Oversight	
17	Assessment and Response Actions
18	Reports to Management
Data Validation and Usability	
19	Data Review, Validation, and Verification
20	Validation and Verification methods
21	Reconciliation with User Requirements

Details are provided in the subsequent sections. This document also contains pertinent information from the Work Plan related to the measurements and evaluation of the analytical data.

1. Project Organization and Responsibilities

1.1 Project Organization

The site will require integration of personnel from the organizations identified below, collectively referred to as the project team. A detailed description of the responsibilities of each member of the project team is presented in Section 2.2.

1.1.1 Overall Project Management

Blasland, Bouck & Lee, Inc. (BBL), on behalf of the New York State Electric & Gas (NYSEG), has overall technical responsibility for the SRI. BBL personnel will perform the tasks and subtasks presented in Section 3 and will be responsible for evaluating resultant investigation data and preparing the SRI deliverables specified in the Work Plan. Project direction and oversight will be provided by NYSEG personnel. A listing of project management personnel and their responsibilities is provided below.

Title	Company/Organization	Name	Phone Number
Project Manager	NYSEG	John J. Ruspantini, CHMM	(607) 762-8787
Project Officer	Blasland, Bouck & Lee, Inc.	Frederick J. Kirschenheiter, II, P.E.	(315) 446-9120
Project Manager	Blasland, Bouck & Lee, Inc.	Scott A. Powlin, P.G.	(315) 446-9120
Field Activities Task Manager	Blasland, Bouck & Lee, Inc.	Jason C. Sents	(315) 446-9120

1.1.2 Analytical Laboratory Services and Subcontractors

Analytical services for the SRI will be provided by Severn Trent Laboratories, Inc. of Edison, New Jersey. Lyon Drilling Co., of Tully, New York, will perform drilling work during the SRI. Laboratory and subcontractor management personnel are listed below.

Title	Company/Organization	Name	Phone Number
Laboratory Project Manager	Severn Trent Laboratories, Inc.	Joy Kelly	(732) 549-3900
Driller	Lyon Drilling Co.	Harry Lyon	(607) 842-6580

1.1.3 Quality Assurance Staff

The QA aspects of the SRI will be conducted by BBL. The following personnel have been assigned to this project component:

Title	Company/Organization	Name	Phone Number
Quality Assurance Manager	Blasland, Bouck & Lee, Inc.	Scott A. Powlin, P.G.	(315) 446-9120
Quality Assurance Officer	Severn Trent Laboratories, Inc.	Madhuri Dave	(732) 549-3900

1.2 Team Member Responsibilities

This section of the QA/SAPP discusses the responsibilities and duties of the project team members.

1.2.1 NYSEG

Project Manager

1. Overall direction of the SRI; and
2. Review of BBL work products.

1.2.2 Blasland, Bouck & Lee, Inc.

Project Officer

1. Oversight of the BBL SRI work products; and
2. Provide BBL approval for major project deliverables.

Project Manager

1. Management and coordination of all aspects of the project as defined in the SRI Work Plan with an emphasis on adhering to the project objectives;
2. Reviews SRI Report and all documents prepared by BBL; and
3. Assures corrective actions are taken for deficiencies cited during audits of the SRI activities.

Field Activities Task Manager

1. Oversight of field hydrogeologic efforts;
2. Oversight of field screening and collection of soil samples;
3. Review of field hydrogeologic records and boring logs;
4. Oversight of groundwater sampling;
5. Oversight of field analysis and collection of QA samples.
6. Reduction of field data calibration and maintenance;
7. Review of the field instrumentation, maintenance, and calibration to maintain quality data;
8. Preparation of draft reports and other key documents;
9. Maintenance of field files of notebooks and logs, and calculations;
10. Instruction of field staff; and
11. Coordination of field and laboratory schedules.

Field Personnel

1. Perform field procedures associated with the tasks and subtasks presented in 1.3.1 (above);
2. Perform field analyses and collect QA samples;
3. Calibrate, operate, and maintain field equipment;
4. Reduce field data;
5. Maintain sample custody; and
6. Prepare field records and logs.

Quality Assurance Manager

1. Review laboratory data packages;
2. Oversee and interface with the analytical laboratories;
3. Coordinate field QA/QC activities with task managers, including audits of SRI activities, concentrating on field analytical measurements and practices to meet DQOs;
4. Review field reports;
5. Review audit reports; and
6. Prepare QA/QC report which includes an evaluation of field and laboratory data and data validation reports.

1.2.3 Severn Trent Laboratories, Inc.

General responsibilities and duties include:

1. Perform sample analyses;
2. Supply sample containers and shipping cartons;
3. Maintain laboratory custody of samples; and
4. Strictly adhere to laboratory protocols.

Laboratory Project Manager

1. Serve as primary communication link between BBL and laboratory staff;
2. Monitor workloads and ensure availability of resources;
3. Oversee preparation of analytical reports; and
4. Supervise in-house chain-of-custody.

Quality Assurance Officer

1. Supervise technical staff in QA/QC procedures; and
2. Conduct audits of all laboratory activities.

1.2.4 Data Validator

1. Provide independent validation of analytical data.

1.2.5 Lyon Drilling Co.

1. Performance of groundwater monitoring well installations and test borings in accordance with the SRI protocols; and
2. Decontamination of drilling and sampling equipment.

2. Project Background

The following summarizes background information for the facility and the off-site areas. Additional information can be found in the Work Plan.

2.1 Site Location and Description

The site is in the City of Elmira, in Chemung County, New York. The city occupies a the floor of a glacially carved valley, flanked on the east and west by steep bedrock hills rising greater than 500 feet above the valley floor. The city itself is largely flat, sitting in the flood plain of the Chemung River, which flows west to east through the city, before turning toward the southeast and its junction with the Susquehanna River. The former MGP occupied most of a city block, bounded by East Clinton Street, Madison Avenue and East Fifth Street. The site is approximately 1,500 feet west of Newtown Creek, a tributary to the Chemung River which is just over 3,000 feet to the south. The site is largely flat-lying, with a small topographic rise in the eastern corner, near the intersection of East Fifth and East Clinton Streets.

2.2 Site History

The MGP was constructed between 1865 and 1869 beside the Junction Canal, a waterway connecting the Chemung and North Branch Canals. The canal was backfilled and replaced by a railroad in the late 1800s. Given the site's substantial distance from major surface water bodies (i.e., Chemung River and Newtown Creek), it is assumed that water used in the operations of the MGP was likely obtained from an onsite well.

The site is believed to have initially produced coal gas, then water (or blue) gas, and finally carbureted water gas. Three gas holders were constructed; the latest and largest had a 1-million cubic foot capacity. At different stages of operation, the site also contained the following major structures: a gas house, coal house, purifier boxes, retorts, waste lagoons, and tar vessels.

With plant closure in 1947, most of the above-ground MGP structures were dismantled. The present site includes several of the original plant buildings (including the gas house), but none of the material handling components (e.g., holders or purifiers). The locations of the historical MGP structures are shown on Figure 1 of the SRI Work Plan.

NYSEG used the site as a service station until 1977, when it sold a portion of the property. The western portion of the site, including all the remaining buildings, was sold to I.D. Booth, Inc., an industrial supply wholesaler. I.D. Booth uses several of the old buildings as warehouses, augmenting their larger operations across the Madison Avenue to the west. The former gas house is leased to a bakery wholesale supplier. NYSEG retains ownership of the eastern potion of the site, where it maintains an electrical substation and a storage yard.

Land use in the area is mixed, with industrial and commercial operations immediately south and west, a public park to the northeast, and residential properties not immediately adjacent, but within 1000 feet of the site in all directions. The parcel immediately south of the site is owned by Trayer Products, Inc. (Trayer), a metal-parts manufacturer.

2.3 SRI Objectives

The purpose of the SRI is to gather data to 1) complete the characterization of the site with respect to establishing the nature and extent of MGP-related residuals on and adjacent to the site; and 2) support a remedial evaluation for the site. Based on this purpose, NYSEG has developed the following specific objectives.

- implement a SRI that builds in a level of flexibility to allow additional investigations (not proposed in this SRI Work Plan), if needed, to sufficiently characterize the nature and extent of MGP-residuals;
- determine the approximate vertical and horizontal extent of MGP-related impacts in soil at the site by collecting, visually characterizing, and analyzing additional subsurface soil samples;
- attempt to confirm the depth to the bottom of the former Distribution Holder (potentially at-grade) and Purifier Vessels;
- investigate the condition, configuration, and extent of piping associated with the liquid waste pipeline;
- assess the presence/absence of MGP-related impacts south of the site, in the area of the former canal;
- obtain visual data to evaluate the surface topography and contiguous nature of the underlying confining units;
- obtain visual and analytical data to supplement existing data and produce a three-dimensional (3-D) solid-body model depicting the distribution of NAPL and polycyclic aromatic hydrocarbons (PAHs) in soil potentially originating from the site;
- obtain waste-characterization data for soil samples that exhibit MGP-related impacts; these data will be collected to support a potential Feasibility Study (FS) for the site;
- better characterize the nature and extent of groundwater affected by the former MGP by collecting additional groundwater samples;
- better characterize the groundwater flow direction in the deeper overburden; and
- obtain physical and chemical data for soil and groundwater to enable an evaluation of various in-situ treatment methods, including chemical oxidation.

3. Project Description

This section presents a description of the investigation activities to be conducted during the SRI. Sampling activities associated with the SRI will be conducted under the following tasks:

- Soil Investigation; and
- Groundwater Investigation.

Sampling protocols to be followed during the investigation activities are detailed in the FSP. Samples collected during the investigation will be analyzed in accordance with USEPA's SW-846, Test Methods for Evaluating Solid Waste. Table 2 presents a list of the constituents that will be analyzed for samples collected as part of the SRI. Health and Safety protocols to be followed by field personnel during completion of the investigation activities are discussed in the Health and Safety Plan (HASP).

A brief description of the objectives for each task associated with the SRI is presented below. A more detailed description can be found in the associated Work Plan.

3.1 Soil Investigation

The objectives of the soil investigation are to:

- determine the approximate vertical extent of MGP-related impacts in soil at the site by collecting, visually characterizing, and analyzing additional subsurface soil samples;

- attempt to confirm the depth to the bottom of the former Distribution Holder (potentially at-grade) and Purifier Vessels;

- investigate the condition, configuration, and extent of piping associated with the liquid waste pipeline;

- assess the presence/absence of MGP-related impacts south of the site, in the area of the former canal;

- obtain data to better define the surface topography and lateral extents of the underlying confining units;

- obtain visual and analytical data to supplement existing data and produce a 3-D solid-body model depicting the distribution of NAPL and total PAHs potentially originating from the site;

- obtain waste-characterization data for soil samples that exhibit MGP-related impacts; these data will be collected to support a potential FS for the site; and

- obtain physical and chemical data for soil to enable an evaluation of various in-situ treatment methods, including chemical oxidation.

In addition to the objectives outlined above, the subsurface information collected as part of this investigation will be used to characterize the distribution, saturated thickness, and relative permeability of the fill and the sand and gravel, as well as refine the understanding of the surface topography of the underlying clay and hanging till.

This information is important in understanding how shallow groundwater is moving and whether there are areas where DNAPL would preferentially collect or migrate.

3.2 Groundwater Investigation

The objectives of the groundwater investigation are to:

- better characterize the nature and extent of groundwater affected by the former MGP;
- provide current information to assess potential trends in dissolved phase concentrations in wells with multiple time-dependent data sets;
- better characterize groundwater flow directions in the shallow and deeper overburden;
- assess whether existing or proposed monitoring wells screen intervals containing free-phase NAPL, and, if so, quantify relevant physical properties of the NAPL; and
- gather data to help assess the viability of natural attenuation as a remedial option during the FS.

4. Quality Objectives and Criteria for Measurement Data

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during site-related activities and are based on the end uses of the data to be collected. Preliminary DQOs were identified to ensure that the data generated during field investigations will be of adequate quality and sufficient quantity to form a sound basis for decision making relative to the above objectives. Data quality objectives have been specified for each data collection activity or investigation. The DQOs presented herein address investigation efforts only and do not cover health and safety issues, which are addressed in detail in the HASP for this project.

A DQO summary for the sampling investigation efforts is presented below. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

Three data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Screening Data with Definitive Confirmation: Screening data allows rapid identification and quantitation, although the quantitation can be relatively imprecise. This objective for data quality is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings (10% or more). This objective can also be used to verify less rigorous laboratory-based methods.

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

It is anticipated that both the screening and definitive data categories will be used during the investigation. Field parameters (i.e., turbidity, conductivity, temperature, and pH) that will be obtained during surface water sampling for use in qualitatively interpreting other site data will be determined using screening techniques. All remaining parameters will be determined using definitive techniques.

For this project, three levels of data reporting have been defined. They are as follows:

Level 1 – Minimal Reporting: Minimal or "results only" reporting is used for analyses that, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

Level 2 – Modified Reporting: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols and that, based on the intended data use, require some supporting documentation but not, however, full "CLP-type" reporting.

Level 3 – Full Reporting: Full "CLP-type" reporting is used for those analyses that, based on intended data use, require full documentation. This reporting level would include ASP Superfund and Category B reporting.

The analytical methods to be used during the SRI will be USEPA SW-846 methods with New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP) Revision 2000, QA/QC requirements and Category B reporting deliverables.

To obtain information necessary to meet the SRI objectives stated above in Section 2.3, the following tasks and subtasks will be performed (Note: only subtasks that require collection and analysis of environmental samples or collecting field measurements are listed below. Refer to the SRI Work Plan for a description of the tasks and subtasks):

- Task 1 – Soil Investigation; and
- Task 2 – Groundwater Investigation.

A description of the DQOs for the SRI is presented below.

4.1 DQOs for Task 1 – Soil Investigation

As described in the SRI Work Plan, 17 soil borings will be advanced to varying depths to investigate the extent of NAPL in selected areas around the perimeter of the former MGP. Up to 13 surface soil and 34 subsurface soil samples will be collected from the borings and submitted for laboratory analysis for the following:

- Method 8260 for volatile organic compounds (VOCs);
- Method 8270 for semivolatile organic compounds (SVOCs);
- Method 8082 for polychlorinated biphenyls (PCBs);
- Method 6010 for inorganics;
- Method 7470/7471 for mercury; and
- the methods and protocol for cyanide sampling and analysis developed by Ish, Inc., as described in Appendix F of the SRI Work Plan.

Up to five soil samples will be collected and submitted for laboratory analysis for waste characterization parameters, including TCLP benzene, reactive cyanide, reactive sulfide, and total sulfur. Two soil samples will also be collected for analysis for chemical oxygen demand, including one 'heavily' impacted sample (either soil or NAPL) and one "background" composite sample. Five soil samples will be collected for analysis for total organic carbon (TOC), three soil samples for grain size/hydrometer analysis, and two Shelby-tube samples for permeability testing.

The number of soil samples that will be collected, including QA/QC samples, is summarized in Table 1. Table 2 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

4.2 DQOs for Task 2 – Groundwater Investigation

This task involves the installation of new monitoring wells and temporary monitoring wells and collecting one round of groundwater samples from the new temporary and permanent wells and 18 existing site monitoring wells to further characterize the nature and extent of groundwater. The resulting groundwater-quality data will also be used to assess the risks to human health and the environment associated with the level of constituents detected in the groundwater. The number of groundwater samples that will be collected, including QA/QC samples, is summarized in Table 1. Table 2 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

As described in the SRI Work Plan, both hydrogeologic and water quality data are required to meet the objective of this task. Hydrogeologic data will consist of water level information and hydraulic conductivity values that will be used to calculate other hydrogeologic parameters. Groundwater quality data will consist of field parameters, including pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen, as well as the laboratory parameters described below. The rationale for the selection of these parameters is discussed in Table 1 of the SRI Work Plan.

The groundwater level measurement procedures, the field parameter measurement procedures, and the groundwater sampling methods are provided in the FSP and SRI Work Plan.

Groundwater samples will be analyzed according to the following methods:

- Method 8260 for VOCs;
- Method 8270 for SVOCs; and
- the methods and protocol for cyanide sampling and analysis developed by Ish, Inc., as described in Appendix F of the SRI Work Plan.

Groundwater will also be analyzed for a suite of geochemical/natural attenuation indicator parameters, including nitrate, ammonia, total iron and manganese, dissolved iron and manganese, sulfate, sulfide, orthophosphate, alkalinity, and methane.

5. Special Training Requirements/Certification

Compliant with the Occupational Safety and Health Administration's (OSHA's) final rule, "Hazardous Waste Operations and Emergency Response," 29 CFR§1910.120(e), all personnel performing remedial activities at the site will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training.

6. Documentation and Records

6.1 General

Samples of the various media will be collected as described in the Work Plan. Detailed descriptions of the documentation and reporting requirements are presented below.

6.2 Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes of a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include:

- <u>Daily Production Documentation</u> – A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- <u>Sampling Information</u> – Detailed notes will be made as to the exact site of sampling, physical observations, and weather conditions (as appropriate).

- <u>Sample Chain-of-Custody</u> – Chain-of-custody (COC) forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by BBL's field personnel designated to be responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample COC form is included in Appendix A.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- <u>Field Equipment, Calibration, and Maintenance Logs</u> – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

6.3 Laboratory Documentation

6.3.1 Laboratory Project Files

The laboratory will establish a file for all pertinent data. The file will include all correspondence, faxed information, phone logs, and COC forms. The laboratory will retain all project files and data packages for a period of 5 years.

6.3.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document and relate important aspects of the work, including the associated quality controls. As such, all logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QA/SAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

6.3.3 Computer Tape and Hard Copy Storage

All electronic files will be maintained on magnetic tape or diskette for 5 years; hard copy data packages will be maintained in files for 5 years.

6.4 Data Reporting Requirements

6.4.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the Work Plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Where appropriate, field data forms and calculations will be processed and included in appendices to a Site Action Report (when generated). The original field logs, documents, and data reductions will be kept in the project file at the BBL office in Syracuse, New York.

6.4.2 Laboratory Data Reporting

The laboratory is responsible for preparing ASP Category B data packages for all VOC, SVOC, and TOC data, reduced data packages, and case narratives for all other analyses.

All data reports for all parameters will include, at a minimum, the following items:

Narrative: Summary of activities that took place during the course of sample analysis, including the following information:

- laboratory name and address;
- date of sample receipt;
- cross reference of laboratory identification number to contractor sample identification;
- analytical methods used;
- deviations from specified protocol; and
- corrective actions taken.

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results: Reported according to analysis type and including the following information, as acceptable:

- sample ID;
- laboratory ID;
- date of collection;
- date of receipt;
- date of extraction;
- date of analysis; and
- detection limits.

Sample results on the report forms will be collected for dilutions. Soil samples will be reported on a dry weight basis. Unless otherwise specified, results will be reported uncorrected for blank contamination.

The data for VOC, SVOC, and TOC analyses will be expanded to include all supporting documentation necessary to provide a Category B package. This additional documentation will include, but is not limited to, all raw data required to recalculate any result, including printouts, chromatograms, and quantitation reports. The report also will include: standards used in calibration and calculation of analytical results; sample extraction; digestion; and other preparation logs; standard preparation logs, instrument run logs; and moisture content calculations.

6.5 Project File

Project documentation will be placed in a single project file at the BBL office in Syracuse, New York. This file will consist of the following components:

1. Agreements (file chronologically);
2. Correspondence (filed chronologically);
3. Memos (file chronologically); and
4. Notes and Data (filed by topic).

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation when received) and field data will be filed with notes and data. Filed materials may be removed and signed out by authorized personnel on a temporary basis only.

7. Sampling Process Design

Information regarding the sampling design and rationale and associated sampling locations can be found in the Work Plan.

8. Sampling Method Requirements

Source materials, groundwater, and soil samples will be collected as described in the SRI Work Plan and the FSP. The FSP also contains the procedures that will be followed to install monitoring wells; measure water levels; perform field measurements; and handle, package, and ship collected samples.

9. Sample Handling and Custody Requirements

9.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in Table 3.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned to USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate).

9.2 Packing, Handling, and Shipping Requirements

Sample packaging and shipment procedures are designed to insure that the samples will arrive at the laboratory, with the COC, intact.

Samples will be packaged for shipment as outlined below:

- Ensure that all sample containers have the sample labels securely affixed to the container with clear packing tape.
- Check the caps on the sample containers to ensure that they are properly sealed.
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- Complete the COC form with the required sampling information and ensure the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer.
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Ice layer.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.

- Place COC forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.

- Close the lid of the cooler, lock, and secure with duct tape.

- Wrap strapping tape around both ends of the cooler at least twice.

- Mark the cooler on the outside with the following information: shipping address, return address, “Fragile” labels, and arrows indicating “this side up.” Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

All samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will be hand-delivered or delivered by an express carrier within 48 hours of the time of collection. All shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading should be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form, as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage. Trip blank(s) of analyte-free water will be provided by the laboratory and included in each cooler containing aqueous samples to be analyzed for VOCs.

Procedures for packing, handling, and shipping environmental samples are included in the FSP.

9.3 Field Custody Procedures

The objective of field sample custody is to assure that samples are not tampered with from the time of sample collection through the time of transport to the analytical laboratory. Persons will have “custody of samples” when the samples are in their physical possession, in their view after being in their possession, or in the physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field COC forms.

9.3.1 Field Logbooks

Field logbooks will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned;
- logbook number;
- project name;
- project start date; and
- end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the FSP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

9.3.2 Sample Labeling

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required in each sample label.

- project;
- date collected;
- time collected;
- location;
- sampler;
- analysis to be performed;
- preservative; and
- sample number.

9.3.3 Field Chain-of-Custody Forms

Completed COC forms will be required for all samples to be analyzed. COC forms will be initiated by the sampling crew in the field. The COC forms will contain the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original COC form will accompany the samples to the laboratory. Copies of the COC will be made prior to shipment (or multiple copy forms used) for field documentation. The COC forms will remain with the samples at all times. The samples and signed COC forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express) or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink, unless prohibited by weather conditions. The labels will include sample information, such as: sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are co-located with a source or government agency, a separate Sample Receipt will be prepared for those samples and marked to indicate with whom the samples are being co-located. The person relinquishing the samples to the facility or agency should request the representative's signature, acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

9.4 Management of Investigation-Derived Materials and Wastes

Disposable equipment, debris, and decontamination rinsate (e.g., tap and distilled water containing small amounts of solvent) will be containerized during the sampling events and labeled for appropriate disposal.

9.5 Laboratory Procedures

9.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. A field chain-of-custody form will accompany all samples requiring laboratory analysis. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for maintaining sample integrity.

9.5.2 Sample Receipt and Storage

Upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, verify the sample integrity, and compare the contents against the field chain-of-custody. If a sample container is broken, the sample is in an inappropriate container, has not been preserved by appropriate means, or if there is a discrepancy between the chain-of-custody and the sample shipment, BBL will be notified. The laboratory sample custodian will then log the samples in, assign a unique laboratory identification number to each, and label the sample bottle with the laboratory identification number. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory information management system. If the sample container is broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, BBL will be notified.

9.5.3 Sample Chain-of-Custody and Documentation

Laboratory chain-of-custody and documentation will follow procedures consistent with Exhibit F of the NYSDEC ASP 2000.

9.5.4 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory COC form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. An SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days, and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific matrix/matrix spike duplicate (MS/MSD) pair, which shall be received by the laboratory at the start of the SDG assignment.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will ensure that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons can be made.

9.5.5 Sample Storage Following Analysis

The remaining samples will be maintained by the laboratory for 1 month after the final report is delivered to BBL. After this period, the samples will be disposed of in accordance with applicable rules and regulations.

10. Analytical Procedures

10.1 Field Analytical Procedures

Field analytical procedures will include the measurement of pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen, and groundwater levels. Specific field measurement protocols are provided in the FSP.

10.2 Laboratory Analytical Procedures

Laboratory analytical requirements presented in the sub-sections below include a general summary of requirements, specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. SW-846 methods with NYSDEC, ASP, 2000 Revision, QA/QC and reporting deliverables requirements will be used for all analytes.

10.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 1	Environmental and Quality Control Sample Analyses
Table 2	Parameters, Methods, and Quantitation Limits
Table 3	Sample Containers, Preservation Methods, and Holding Times Requirements

10.2.2 SRI Sample Matrices

10.2.2.1 Groundwater

Analyses will be performed following the methods listed in Table 1. Analytical results for all analyses will be reported in units identified in Table 2.

10.2.2.2 Soil

Analyses in this category will relate to soil samples. Analyses will be performed following the methods listed in Table 1. Results will be reported as dry weight, in units presented in Table 2. Moisture content will be reported separately.

10.2.3 Analytical Requirements

The primary sources to describe the analytical methods to be used during the investigation are provided in USEPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition and USEPA Methods for Chemical

Analysis of Water and Waste with NYSDEC ASP 2000 Revision, QA/QC and reporting deliverables requirements. Detailed information regarding quality control procedures including matrix spike, matrix spike duplicates, matrix spike blanks, and surrogate recoveries is provided in NYSDEC, ASP 2000 Revision, Exhibit E.

11. Quality Control Requirements

11.1 Quality Assurance Indicators

The overall quality assurance objective for this QA/SAPP is to develop and implement procedures for sampling, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in the following sections of the QA/SAPP. Specific QC checks are discussed in Section 11.2.

Quality assurance indicators are generally defined in terms of five parameters:

1. Representativeness;
2. Comparability;
3. Completeness;
4. Precision; and
5. Accuracy.

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QA/SAPP, as referenced below.

11.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability. The SRI has been designed to assess the presence of the constituents at the time of sampling. The Work Plan presents the rationale for sample quantities and location. The FSP and this QA/SAPP present field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

11.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between this investigation, and to the extent possible, with existing data will be maintained through consistent sampling and analytical methodology set forth in the FSP and this QA/SAPP, SW-846 analytical methods with NYSDEC ASP Revision 2000 QA/QC requirements and Category B reporting deliverables, and through use of QA/QC procedures and appropriately trained personnel.

11.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the amount that was expected to be obtained under normal conditions. This will be determined upon assessment of the analytical results, as discussed in Section 11.6.

11.1.4 Precision

Precision is the measure of reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the project objectives. To maximize precision, sampling and analytical procedures will be followed. All work for this investigation will adhere to established protocols presented in the SRI Work Plan. Checks for analytical precision will include the analysis of matrix spike duplicates, laboratory duplicates and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Section 11.4.

11.1.5 Accuracy

Accuracy is the deviation of a measurement from the true value of a known standard. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, matrix spikes, blank spikes, and surrogates (system monitoring compounds) will be used to assess the accuracy of the laboratory analytical data. Further discussion of these QC samples is provided in Section 11.4.

11.2 Field Quality Control Checks

11.2.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field analytical measurements.

11.2.2 Sample Containers

Certified-clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2000 (Eagle Picher pre-cleaned containers or equivalent) will be supplied by the laboratory.

11.2.3 Field Duplicates

Field duplicates will be collected for groundwater and source materials/soil samples to check reproducibility of the sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, source material/soil and groundwater sample field duplicates will be analyzed at a 5 percent frequency (every 20 samples). Table 1 provides an estimated number of field duplicates for each applicable parameter and matrix.

11.2.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis at a frequency of one per day (when sample equipment cleaning occurs) or once for every 20 samples collected, whichever is less. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) which has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be necessary. Table 1 provides an estimated number of rinse blanks collected during the SRI.

11.2.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during storage and transport. Trip blanks will be analyzed at a frequency of once per day, per cooler containing groundwater samples to be analyzed for volatile organic constituents. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory) which remains unopened with field samples throughout the sampling event. Trip blanks will only be analyzed for aqueous volatile organic constituents. Table 1 provides an estimated number of trip blanks collected for each matrix and parameter during the SRI.

11.3 Analytical Laboratory Quality Control Checks

Internal quality control procedures are specified in the analytical methods. These specifications include the types of QC checks required (method blanks, reagent/preparation blanks, matrix spike and matrix spike duplicates (MS/MSD), calibration standards, internal standards, surrogate standards, the specific calibration check standards, laboratory duplicate/replicate analysis), compounds and concentrations to be used, and the QC acceptance criteria.

11.3.1 Method Blanks

Method blanks will serve as a measure of contamination attributable to a variety of sources including glassware, reagents, and instrumentation. The method blank will be initiated at the beginning of an analytical procedure and is carried through the entire process.

11.3.2 Matrix Spike/Matrix Spike Duplicates

The MS will serve as a measure of method accuracy in a given matrix. The MS and the MSD together will serve as a measure of method precision.

11.3.3 Surrogate Spikes

Surrogate spikes are organic compounds that have similar properties to those being tested. They will serve as indicators of method performance and accuracy in organic analyses.

11.3.4 Laboratory Duplicates

Laboratory duplicates will serve to the measure method precision in inorganic and supplemental analyses.

11.3.5 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding the instruments' stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours, or more frequently, as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If results of the calibration check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods, as summarized in Section 13.

11.3.6 Internal Standards

Internal standard areas and retention times will be monitored for organic analyses performed by GC/MS methods. Method-specified internal standard compounds will be spiked into all field samples, calibration standards, and QC samples after preparation and prior to analysis. If internal standard areas in one or more samples exceed the specified tolerances, then cause will be investigated, the instrument will be recalibrated if necessary, and all affected samples will be reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods.

11.3.7 Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from the calibration standards. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

11.4 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision for organic analyses will be monitored through the use of MSD, laboratory duplicate, and field duplicates as identified in Table 1.

The precision of data will be measured by calculation of the relative percent differences (RPDs) of duplicate sample sets.

The RPD can be calculated by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement.

Precision objectives for matrix spike duplicate and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2000.

11.5 Data Accuracy Assessment Procedures

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spikes, surrogate spikes, and internal standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated as a percent recovery as follows:

$$\text{Accuracy} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy over the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for matrix spike recoveries and surrogate recovery objectives are identified in the NYSDEC ASP, 2000 Revision.

11.6 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of samples collected or analyzed to the proposed number.

$$\text{Completeness} = \frac{\text{No. Valid Samples Collected or Analyzed}}{\text{No. Proposed Samples Collected or Analyzed}} \times 100$$

As general guidelines, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data useability for intended purposes.

12. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Preventive maintenance schedules have been developed for both field and laboratory instruments. A summary of the maintenance activities to be performed is presented below.

12.1 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to assure it is operational. If the equipment is not operational, it must be serviced prior to use. All meters which require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the Field Activities Task Manager to follow the maintenance schedule and arrange for prompt service.

Field instrumentation to be used in this study includes meters to measure pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen and groundwater levels. Field equipment also includes sampling devices for groundwater. A logbook will be kept for each field instrument. Each logbook contains records of operation, maintenance, calibration, and any problems and repairs. The Field Activities Task Manager will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the logbook or field notebooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

Non-operational field equipment will be either repaired or replaced. Appropriate spare parts will be made available for field meters. A summary of preventive maintenance requirements for field instruments, and details regarding field equipment maintenance, operation, and calibration, are provided in the FSP.

12.2 Laboratory Instruments and Equipment

12.2.1 General

Only qualified personnel will service instruments and equipment. Repairs, adjustments, and calibrations are documented in the appropriate logbook or data sheet.

12.2.2 Instrument Maintenance

Preventive maintenance of laboratory equipment will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired by in-house staff or through a service call by the manufacturer as appropriate.

The laboratory will maintain a sufficient supply of spare parts for its instruments to minimize downtime. Whenever possible, backup instrumentation will be retained.

Whenever practical, analytical equipment will be maintained under a service contract. The contract allows for preventative system maintenance and repair on an “as-needed” basis. The laboratory has sufficiently trained staff to allow for the day-to-day maintenance of equipment.

12.2.3 Equipment Monitoring

On a daily basis, the operation of balances, incubators, ovens, refrigerators, and water purification systems will be checked and documented. Any discrepancies will be immediately reported to the appropriate laboratory personnel for resolution.

13. Instrument Calibration and Frequency

13.1 Field Equipment Calibration Procedures and Frequency

Specific procedures for performing and documenting calibration and maintenance for the equipment measuring conductivity, temperature, pH, groundwater levels, and surface water levels are provided in the FSP. Calibration checks will be performed daily when measuring pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen. Field equipment operation, calibration, and maintenance procedures are provided in the FSP.

13.2 Laboratory Equipment Calibration Procedures and Frequency

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used. The analytical methods for target constituents are identified separately below.

Volatile Organics

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2000 Revision, Exhibit E, Part III.

Semivolatile Organics

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2000 Revision, Exhibit E, Part IV.

Metals and Cyanide

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2000 Revision, Exhibit E, Part VII.

Total Organic Carbon

Equipment calibration procedures will follow guidelines presented in Lloyd Kahn Method.

Supplemental Parameters

Additional parameters (COD, nitrate, ammonia, sulfate, sulfide, orthophosphate, alkalinity, methane, reactive sulfide, and reactive cyanide) will be calibrated according to their respective methods, following the guidance presented in NYSDEC ASP 2000, Exhibit E, Part VIII.

14. Inspection/Acceptance Requirements for Supplies and Consumables

The laboratory shall inspect/test all supplies and consumables prior to use with SRI samples. Documentation shall be maintained for all associated testing and analyses.

15. Data Acquisition Requirements for Nondirect Measurements

At this point in time, historical data generated by outside parties is not anticipated to be used directly in completing the SRI. However, historical data will be used as guidance in determining sampling locations for the SRI.

Prior to their use, historic data sets will be reviewed according to the procedures identified in subsequent sections of this QA/SAPP to determine the appropriate uses of such data. The extent to which these data can be validated will be determined by the analytical level and QC data available. The evaluation of historic data for SRI purposes requires the following:

- identification of analytical levels;
- evaluation of QC data, when available; and
- development of conclusions regarding the acceptability of the data for intended uses.

Acceptability of historic data for intended uses will be determined by application of these procedures and professional judgment. If the historic data quality cannot be determined, its use will be limited to general trend evaluations.

16. Data Management

The purpose of the data management is to ensure that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigations will encompass a large number of samples and a variety of sample matrices and analytes from a large geographic area. From the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements:

1. Sample designation system;
2. Field activities;
3. Sample tracking and management;
4. Data management system; and
5. Document control and inventory.

16.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected.

16.2 Field Activities

Field activities designed to gather the information necessary to make decisions regarding the off-site areas require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and QA. These procedures are described in further detail in the following subsections.

16.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To ensure that all aspects of the field investigation are thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- field logs;
- instrument calibration records; and
- chain-of-custody forms.

A description of each of these types of field documentation is provided below.

Field Logs

The personnel performing the field activities will keep field logs that detail all observations and measurements made during the remedial investigation. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To ensure at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media sampling locations will be surveyed to accurately record their locations. The survey crew will use their own field logs and will supply the sampling location coordinates to the File Custodian.

Instrument Calibration Records

As part of data quality assurance procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration ensures that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Section 13.1. In order to demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- calibration date and time;
- type and identification number of equipment;
- calibration frequency and acceptable tolerances;
- identification of individual(s) performing calibration;
- reference standards used;
- calibration data; and
- information on calibration success or failure.

The calibration record will serve as a written account of monitoring or detection equipment QA. All erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Chain-of-Custody Forms

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the COC procedure. A more thorough description of the COC forms is located in the SOPs.

16.2.2 Data Security

Measures will be taken during the field investigation to ensure that samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office in a locked, fireproof cabinet. Access to these files will be limited to the field personnel who utilize them.

16.3 Sample Management and Tracking

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure the validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms, as described in Section 9.3.3. On a daily basis, the completed COC forms associated with samples collected that day will be faxed from the project office to the QAM. Copies of all completed COC forms will be maintained in the field office. On the following day, the QAM will telephone the laboratory to verify receipt of samples.

When analytical data are received from the laboratory, the QAM will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed-up by the QAM.

16.4 Data Management System

In addition to the sample tracking system, a data management system may be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database, to be maintained by the Database Administrator, will combine pertinent geographical, field, and analytical data. Information that will be used to populate the database will be derived from three primary sources: surveying of sampling locations, field observations, and analytical results. Each of these sources is discussed in the following sections.

16.4.1 Computer Hardware

If required, the database will be constructed on Pentium®-based personal computer work stations connected through a Novell network server. The Novell network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners, modems, etc. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

16.4.2 Computer Software

If required, the database will be written in Microsoft Access, running in a Windows operating system.

16.4.3 Surveying Information

In general, each location sampled as part of the SRI will be surveyed to ensure accurate documentation of sample locations for mapping and GIS purposes (if appropriate), to facilitate the re-sampling of select sample locations during future monitoring programs, if needed, and for any potential remediation activities. The surveying activities that will occur in the field will consist of the collection of information that will be used to compute a northing and easting in state plane coordinates for each sample location and the collection of information to compute elevations relative to the National Geodetic Vertical Datum of 1988 for select sample locations, as appropriate. All field books associated with the surveying activities will be stored as a record of the project activities.

Conventional surveying techniques will be used to gather information such as the angle and distance between the sample location and the control monument, as well as point attributes. This information will be digitally stored in a data logger attached to the total station. On a weekly basis, each data logger in use will be transferred to the BBL Syracuse Office, where the information will be downloaded into a personal computer for processing with surveying software. Control monuments will be established using GPS techniques. The surveying software allows the rapid computation of a location's state plane coordinates.

Differential leveling techniques will be used to gather information to be used to compute a sample location's (or top-of-casing for groundwater monitoring wells) elevation. During the differential leveling process, which includes at least one benchmark of known elevation, detailed field notes will be kept in a field book. On a weekly basis, a copy of the relevant pages will be forwarded to Syracuse, New York, where the relevant information will be manually keyed into BBL's surveying software package for further processing. The surveying software reduces the field notes and calculates a location's elevation relative to the project datum.

Following computation of a location's state plane coordinates and, at select locations, elevations, the computer information will undergo a QA/QC review by a licensed land surveyor. Following the approval of the computed information, the coordinates and elevations will be transferred to the File Custodian both in a digital and a hard copy format.

16.4.4 Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field.

Following each sampling event, a status memorandum may be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to present a summary and a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Tables are typically attached to the memorandum and are used to summarize measurements that were recorded in the field books. It is anticipated that these tables will be developed using a personal computer spreadsheet program to reduce possible transcription error and to facilitate the transfer of information to the data management system. For example, for soil samples, the table would present the sampling date and time, soil depth, depth of soil recovered in a given core, the depth increment submitted for analysis, and a description of the lithology.

Status memos are valuable tools to keep project personnel informed on the details of the field activities and are also invaluable during the development of the final report. Each status memo will be reviewed for accuracy and completeness by the respective sampling activity manager. Following the approval and finalization of each memo, the status memo will be used to transfer field observations into the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the COC forms and field notebooks.

16.4.5 Analytical Results

Analytical results provided by the laboratory will generally be available in both a digital and a hard copy format. Upon receipt of each analytical package, the original COC form will be placed in the project files. The data packages will be examined to ensure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the QAM will be notified and will promptly follow up with the laboratory to resolve any issues.

Where appropriate, the data packages will be validated in accordance with the procedures presented in Section 20. Any data that does not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation (if necessary), the digital files of analytical data will be processed to populate the appropriate database tables. Specific fields include:

- sample identification number;
- date sampled;
- date analyzed;
- parameter name;
- analytical result;
- units;
- detection limit; and
- qualifier(s).

The individual EDDs, supplied by the laboratory in either an ASCII comma separated value (CSV) format or in a Microsoft Excel 97 worksheet, will be loaded into the appropriate database table. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually.

After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

16.4.6 Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of the off-site SRI data. Data entry screens will be developed to assist in the keypunching of field observations. Routines will also be developed to permit the user to scan analytical data from a given site for a given media. Several output functions that have been developed by BBL will be appropriately modified for use in the data management system.

A valuable function of the data management system will be the generation of tables of analytical results from the project databases. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function creates a digital comma-delimited ASCII file of analytical results and qualifiers for a given media. The ASCII file is then processed through a spreadsheet, which transforms the comma-delimited file into a table of rows and columns. Tables of analytical data will be produced as part of data interpretation tasks, the reporting of data, and the generation of the SRI Report.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/presentation software. A function has been created by BBL that creates a digital file consisting of sample location number, state plane coordinates, sampling date, and detected constituents and associated concentrations and analytical qualifiers. The file is then transferred to an AutoCAD work station, where another program has been developed to plot a location's analytical data in a "box" format at the sample location (represented by the state plane coordinates). This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

The data management system also has the capability of producing a digital file of select parameters that exists in one or more of the databases. This type of custom function is accomplished on an interactive basis and is best used for transferring select information into a number of analysis tools, such as statistical or graphing programs.

16.5 Document Control and Inventory

BBL maintains project files in its Syracuse, New York office. Each client project is assigned a file/job number (e.g., for the remedial activities, 130.42). Each file is then broken down into the following subfiles:

#1- Agreements and Contracts -all agreements and contracts involving the off-site investigations;
#2- Correspondence -all external correspondence, including reports;
#3- Memoranda -all internal and external memoranda;
#4- Notes and Data -notes and data from field, laboratory, and internal calculations; and
#5- News Clippings -local newspapers, USEP A publications, and technical publications are sources of articles.

Originals, when possible, are placed in the files. These are the central files and will serve as the site-specific files for the off-site investigations.

17. Assessment and Response Actions

Performance and systems audits will be completed in the field and the laboratory during the SRI as described below.

17.1 Field Audits

The following field performance and systems audits will be completed during this project.

17.1.1 Performance Audits

The appropriate Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibrations to verify that measurements are taken according to established protocols. The BBL Quality Assurance Manager will review all field reports and communicate concerns to the BBL Project Manager and/or Task Managers, as appropriate. In addition, the BBL Quality Assurance Manager will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures.

17.1.2 Internal Systems Audits

A field internal systems audit is a qualitative evaluation of all components of field QA/QC. The systems audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed. The appropriate Task Manager will periodically confirm that work is being performed consistent with the SRI Work Plan, the FSP, and the HASP.

17.2 Laboratory Audits

The laboratory will perform internal audits consistent with NYSDEC ASP, 2000 Revision, Exhibit E.

In addition to the laboratory's internal audits and participation in state and federal certification programs, the laboratory sections at the laboratory are audited by representatives of the regulatory agency issuing certification. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

BBL reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

17.3 Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QA/SAPP, the FSP, or the Work Plan. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the SRI are described below.

17.3.1 Field Procedures

When conducting the SRI field work, if a condition is noted that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented will be documented on a Corrective Action Report Form and reported to the appropriate BBL Project Manager and Task Manager.

Examples of situations that would require corrective actions are provided below:

1. Protocols as defined by this QA/SAPP, the FSP, or the Work Plan have not been followed;
2. Equipment is not in proper working order or properly calibrated;
3. QC requirements have not been met; and
4. Issues resulting from performance or systems audits.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

17.3.2 Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented, and reported to the appropriate Project Manager and Task Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

1. Specific laboratory analytical protocols have not been followed;
2. Predetermined data acceptance standards are not obtained;
3. Equipment is not in proper working order or calibrated;
4. Sample and test results are not completely traceable;
5. QC requirements have not been met; and
6. Issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

18. Reports to Management

18.1 Internal Reporting

The analytical laboratory will submit analytical reports to BBL for review. If required, BBL will, in turn, submit the reports to the data validator for review. Supporting data (i.e., historic data, related field or laboratory data) will also be reviewed to evaluate data quality, as appropriate. The BBL Quality Assurance Manager will incorporate results of the data validation reports (if required) and assessments of data useability into a summary report (if required) that will be submitted to the BBL Project Manager and appropriate Task Managers. If required, this report will be filed in the project file at BBL's office and will include the following:

1. Assessment of data accuracy, precision, and completeness for both field and laboratory data;
2. Results of the performance and systems audits;
3. Significant QA/QC problems, solutions, corrections, and potential consequences; and
4. Analytical data validation report.

18.2 SRI Reporting

Upon sample transport to the laboratory, a copy of the chain-of-custody will be forwarded to NYSEG. Upon receipt of the ASP - Category B Data Package from the laboratory, the BBL Quality Assurance Manager will determine if the data package has met the required data quality objectives. The analytical data package will be submitted to the NYSEG Project Manager and will also be incorporated into the SRI Report.

19. Data Review, Validation, and Verification

After field and laboratory data are obtained, these data will be subject to:

1. Validation of the data;
2. Reduction or manipulation of the data mathematically or otherwise into meaningful and useful forms; and
3. Organization, interpretation, and reporting of the data.

19.1 Field Data Reduction, Validation, and Reporting

19.1.1 Field Data Reduction

Information that is collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field notebooks, log sheets, and/or other appropriate forms. Such data will be reviewed by the appropriate Task Manager for adherence to the Work Plan and consistency of data. Any concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and as necessary incorporated into the data evaluation process.

19.1.1.1 Task 1 – Soil Investigation

The specific data reduction activity that will be performed during Task 1 is:

1. Mapping of areas impacted with MGP-related constituents based on findings of the soil-boring program.

19.1.1.2 Task 2 – Groundwater/Hydraulic Investigation

Reduction of the field data collected during performance of Task 3 will include:

1. Calculation of water elevations by subtracting the depth-to-water data from the surveyed elevation of the measuring point; and
2. Production of hydrogeologic contour maps by contouring lines of equal water elevations using known elevation points.

19.1.2 Field Data Validation

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the Quality Assurance Manager. Task Managers will recalculate at least five percent of all data reductions. Field documentation and data reduction prepared by field personnel will be reviewed by the appropriate Task Manager and Quality Assurance Manager. All logs and documents will be checked for:

1. General completeness;
2. Readability;

3. Usage of appropriate procedures;
4. Appropriate instrument calibration and maintenance;
5. Reasonableness in comparison to present and past data collected;
6. Correct sample locations; and
7. Correct calculations and interpretations.

19.1.3 Field Data Reporting

Where appropriate, field data forms and calculations will be processed and included in appendices to the SRI Report. The original field logs, documents, and data reductions will be kept in the project file at the BBL office in Syracuse, New York.

19.2 Laboratory Data Reduction, Review, and Reporting

19.2.1 Laboratory Data Reduction

Laboratory analytical data will be directly transferred from the instrument to the computer or the data reporting form (as applicable). Calculation of sample concentrations will be performed using the appropriate regression analysis program, response factors, and dilution factors (where applicable).

19.2.2 Laboratory Data Review

All data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation, and the laboratory director will review a cross section of the final data reports. All final data reports are reviewed by the laboratory QAM prior to shipment to BBL.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 17. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the BBL Project Manager.

20. Validation and Verification Methods

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results are correctly transcribed from the instrument, and which, if any, environmental samples are related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

No validation of the analytical data collected during the SRI is proposed at this time. If required, data validation will consist of data screening, checking, reviewing, editing, and interpreting to document analytical data quality and determine if the quality is sufficient to meet the DQOs. The data validation will also include a review of completeness and compliance, including the elements provided in Table 4.

The data validator will use the most recent versions of the USEPA functional guidelines for data validation with NYSDEC, ASP, 2000 Revision, QA/QC and reporting deliverables requirements available at the time of project initiation and for the entire duration of the project, as guidance, where appropriate.

The data validator will verify reduction of laboratory measurements and laboratory reporting of analytical parameters are in accordance with the procedures specified for each analytical method (i.e., perform laboratory calculations in accordance with the method-specific procedure).

If required, upon receipt of the laboratory data, the following reduction, validation, and reporting scheme will be executed by the data validator:

1. Laboratory data will be screened to ensure that the necessary QC procedures (detection limit verification, initial calibration, continuing calibration, duplicates, spikes, blanks, etc.) have been performed. QC information not included or of insufficient frequency will be identified in the validation report along with a discussion of the implications.

2. QC supporting information will subsequently be screened to identify QC data outside established control limits. If out-of-control data are discovered, documentation of appropriate corrective action will be reviewed. Out-of-control data without appropriate corrective action shall result in designation of the affected data as qualified or rejected, as appropriate.

   It should be noted that the existence of qualified results does not automatically invalidate data. This point is repeatedly emphasized in the USEPA functional guidelines for data validation and is inherently acknowledged by the very existence of the data validation/flagging guidelines. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the data validator, laboratory Project Manager, and the BBL Project Manager.

Upon completion of the data validation (if required), a report addressing the following topics will be prepared.

1. Assessment of the data package;
2. Description of any protocol deviations;
3. Failures to reconcile reported and/or raw data;
4. Assessment of any compromised data;

5. Laboratory case narrative;
6. Overall appraisal of the analytical data; and
7. Table of site name, sample quantities, data submitted to the laboratory, year of protocol used, matrix, and fractions analyzed.

21. Reconciliation with User Requirements

The data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives. Of particular note will be samples at or near action levels. All deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Action options may include any or all of the following:

- retrieval of missing information;
- request for additional explanation or clarification;
- reanalysis of sample from extract (when appropriate); and
- recalculation or reinterpretation of results by the laboratory.

These actions may improve the data quality, reduce uncertainty, and may eliminate the need to qualify or reject data.

If these actions do not improve the data quality to an acceptable level, the following actions may be taken:

- extrapolation of missing data from existing data points;
- use of historical data; and
- evaluation of the critical/non-critical nature of the sample.

If the data gap can not be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, then the following action must be taken:

- additional sample collection and analysis.

Acronyms

ASTM	American Society for Testing and Material
BBL	Blasland, Bouck & Lee, Inc.
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CSV	Comma Separated Value
DUP	Duplicate
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable GC Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
mg/kg	Milligram per kilogram
mg/L	Milligrams per liter
mS/cm	Millisiemens per centimeter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NEIC	National Enforcement Investigations Center
ng	Nanogram
NIST	National Institute of Science and Technology
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PNP	Paranitrophenol
PPE	Personal Protective Equipment
ppb	Parts per billion
ppm	Parts per million
QAM	Quality Assurance Manager
QA/SAPP	Quality Assurance/Sampling and Analysis Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation Recovery Act
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SDG	Sample Delivery Group
SOP	Standard Operating Procedures
SU	Standard Units

TOC	Total Organic Carbon
TSS	Total Suspended Solids
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency

References

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Tables

Table 1

Elmira (Madison Avenue) Former MGP Site
Environmental and Quality Control Analyses

Environmental Sample Matrix/ Laboratory Parameters	Field QC Analyses					Laboratory QC Analyses[1,2]	
	Trip Blank	Field Duplicate	Rinse Blank[3]	MS	MSD	MSB	Lab Duplicate
Soils							
Volatile Organics Method 8260	--	1/20	1/20	1/20	1/20	1/20	--
Semivolatile Organics Method 8270	--	1/20	1/20	1/20	1/20	1/20	--
Polychlorinated Biphenyls (PCBs) Method 8082	--	1/20	1/20	1/20	1/20	1/20	--
TAL Metals Method 6010 (Mercury Method 7470/7471) (Cyanide Method 9010)	--	1/20	1/20	1/20	1/20	1/20	--
Total Sulphur Bomb Method D129	--	--	--	--	--	--	--
Chemical Oxygen Demand Hach Method 8034	--	--	--	--	--	--	--
Total Organic Carbon (TOC) (Lloyd Kahn)	--	1/20	--	1/20	1/20	1/20	--
TCLP Benzene (1311/8260)	--	--	--	--	--	--	--

Table 1

Elmira (Madison Avenue) Former MGP Site
Environmental and Quality Control Analyses

Environmental Sample Matrix/ Laboratory Parameters	Field QC Analyses					Laboratory QC Analyses[1,2]	
	Trip Blank	Field Duplicate	Rinse Blank[3]	MS	MSD	MSB	Lab Duplicate
Reactive Sulfide Method SW846 Chapter 7.3	--	--	--	--	--	--	--
Reactive Cyanide Method SW846 Chapter 7.3	--	--	--	--	--	--	--
Groundwater							
Volatile Organics Method 8260	1/cooler	1/20	--	1/20	1/20	1/20	--
Semivolatile Organics Method 8270	--	1/20	--	1/20	1/20	1/20	--
Nitrate Method 353.2	--	1/20	--	--	--	--	--
Ammonia Method 350.1	--	1/20	--	--	--	--	--
Total Iron & Manganese Method 200.7	--	1/20	--	--	--	--	--
Dissolved Iron & Manganese Method 200.7	--	1/20	--	--	--	--	--
Sulfate Method 375.4	--	1/20	--	--	--	--	--
Sulfide Method 376.1	--	1/20	--	--	--	--	--
Orthophosphate Method 365.2	--	1/20	--	--	--	--	--
Alkalinity Method 310.1	--	1/20	--	--	--	--	--

Table 1

Elmira (Madison Avenue) Former MGP Site
Environmental and Quality Control Analyses

Environmental Sample Matrix/ Laboratory Parameters	Field QC Analyses					Laboratory QC Analyses[1,2]	
	Trip Blank	Field Duplicate	Rinse Blank[3]	MS	MSD	MSB	Lab Duplicate
Methane Method 3810	--	1/20	--	--	--	--	--

Notes:

[1] The number of laboratory QC analyses is based on the frequencies given for the number of environmental samples estimated, not including field QC analyses (i.e., rinse and trip blanks).

[2] Laboratory QC analyses are listed only for those parameters that must be performed on site samples. The laboratory is required to analyze QC samples for the remaining parameters at the frequency listed in the associated analytical method.

[3] Rinse blank samples will be collected only when non-dedicated sampling devices are used. Rinse blanks will be collected at a frequency of one per day of use or one per 20 samples, whichever is less.

MS = Matrix spike.
MSB = Matrix spike blank.
MSD = Matrix spike duplicate.
TAL = Target Analyte List.
TOC = Total organic carbon.
TCLP = Toxicity Characteristic Leaching Procedure.
DNAPL = Dense Non-Aqueous Phase Liquid.

Table 2

Elmira (Madison Avenue) Former MGP Site
Parameter, Methods, and Quantitation Limits

Parameter	Quantitation Limit[1]	
Volatile Organics Method 8260	**Water (ug/L)**	**Soil (ug/kg)[2]**
Chloromethane	5	5
Bromomethane	5	5
Vinyl Chloride	5	5
Chloroethane	5	5
Methylene Chloride	3	3
Acetone	5	5
Carbon Disulfide	5	5
1,1-Dichloroethylene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethylene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	2	2
2-Butanone	5	5
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	2	2
Bromodichloromethane	1	1
1,2-Dichloropropane	1	1
cis-1,3-Dichloropropene	5	5
Trichloroethane	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	3	3
Benzene	1	1
trans-1,3-Dichloropropene	5	5
Bromoform	4	4
4-Methyl-2-pentanone	5	5
2-Hexanone	5	5
Tetrachloroethene	1	1
Toluene	5	5
1,1,2,2-Tetrachloroethane	1	1
Chlorobenzene	5	5
Ethylbenzene	4	4
Styrene	5	5
2-Chloroethyl Vinyl Ether	5	5
1,2-Dichlorobenzene	5	5
1,3-Dichlorobenzene	5	5
1,4-Dichlorobenzene	5	5
Vinyl Acetate	5	5
Total Xylenes	5	5
Semivolatile Organics Method 8270	**Water (ug/L)**	**Soil (ug/kg)**
1,2,4-Trichlorobenzene	1	33
1,2-Dichlorobenzene	10	330
1,2-Diphenylhydrazine	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,4-Dioxane	10	330
2,4,5-Trichlorophenol	10	330
2,4,6-Trichlorophenol	10	330
2,4-Dichlorophenol	10	330

Table 2

Elmira (Madison Avenue) Former MGP Site
Parameter, Methods, and Quantitation Limits

Parameter	Quantitation Limit[1]	
Semivolatile Organics Method 8270 (Cont'd.)	**Water (ug/L)**	**Soil (ug/kg)**
2,4-Dimethylphenol	10	330
2,4-Dinitrophenol	40	1300
2,4-Dinitrotoluene	2	67
2,6-Dinitrotoluene	2	67
2-Chloronaphthalene	10	330
2-Chlorophenol	10	330
2-Methylnaphthalene	10	330
2-Methylphenol	10	330
2-Nitroaniline	20	670
2-Nitrophenol	10	330
3,3'-Dichlorobenzidene	20	670
3-Nitroaniline	20	670
4,6-Dinitro-2-methylphenol	40	1300
4-Bromophenyl-phenylether	10	330
4-Chloro-3-methylphenol	10	330
4-Chloroaniline	10	330
4-Chlorophenyl-phenylether	10	330
4-Methylphenol	10	330
4-Nitroaniline	20	670
4-Nitrophenol	40	1300
Acenaphthene	10	330
Acenaphthylene	10	330
Acetophenone	10	330
Aniline	10	330
Anthracene	10	330
Atrazine	10	330
Benzaldehyde	10	330
Benzidine	40	1300
Benzo(a)anthracene	1	33
Benzo(a)pyrene	1	33
Benzo(b)fluoranthene	1	33
Benzo(g,h,i)perylene	10	330
Benzo(k)fluoranthene	1	33
Benzoic Acid	10	330
Benzyl Alcohol	10	330
bis(2-chloroethoxy)methane	10	330
bis(2-chloroethyl)ether	1	33
bis(2-chloroisopropyl)ether	10	330
bis(2-ethylhexyl)phthalate	10	330
Butylbenzylphthalate	10	330
Caprolactam	10	330
Carbazole	10	330
Chrysene	10	330
Dibenzo(a,h)anthracene	1	33
Dibenzofuran	10	330
Diethylphthalate	10	330
Dimethylphthalate	10	330
Di-n-butyl phthalate	10	330
Di-n-octyl phthalate	10	330

Table 2

Elmira (Madison Avenue) Former MGP Site
Parameter, Methods, and Quantitation Limits

Parameter	Quantitation Limit[1]	
Semivolatiles Method 8270 (Cont'd.)	**Water (ug/L)**	**Soil (ug/kg)**
Diphenyl	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	1	33
Hexachlorobutadiene	2	67
Hexachlorocyclopentadiene	10	330
Hexachloroethane	1	33
Indeno(1,2,3-cd)pyrene	1	33
Isophorone	10	330
N,N-Dimethylaniline	1	33
Naphthalene	10	330
Nitrobenzene	1	33
N-Nitrosodimethylamine	10	330
N-Nitroso-di-n-propylamine	1	33
N-Nitrosodiphenylamine	10	330
Pentachlorophenol	40	1300
Phenanthrene	10	330
Phenol	10	330
Pyrene	10	330
Pyridine	10	330
TAL Metals (6010/7470)	**Water (ug/L)**	**Soil (ug/Kg)**
Aluminum	--	40
Antimony	--	2
Arsenic	--	1
Barium	--	40
Beryllium	--	0.4
Cadmium	--	1
Calcium	--	1000
Chromium	--	2
Cobalt	--	10
Copper	--	5
Iron	--	30
Lead	--	1
Magnesium	--	1000
Manganese	--	3
Mercury	--	0.033
Nickel	--	8
Potassium	--	1000
Selenium	--	1
Silver	--	2
Sodium	--	1000
Thallium	--	2
Vanadium	--	10
Zinc	--	6
Supplemental Parameters	**Water (ug/L)**	**Soil (mg/kg)**
Total Organic Carbon (Lloyd Kahn)	NA	100
Chloride Method 325.3	1,000	--

Table 2

Elmira (Madison Avenue) Former MGP Site
Parameter, Methods, and Quantitation Limits

Parameter	Quantitation Limit[1]	
Supplemental Parameters (Cont'd.)	**Water (ug/L)**	**Soil (mg/kg)**
Nitrate Method 353.2	100	--
Ammonia Method 350.1	100	--
Iron Method 200.7	150	--
Manganese Method 200.7	15	--
Sulfate Method 375.4	5,000	--
Sulfide Method 376.1	1,000	--
Orthophosphate Method 365.2	30	--
Alkalinity Method 310.1	5,000	--
Methane Method 3810	--	--
Reactive Sulfide	--	20
Reactive Cyanide	--	25
TCLP Benzene	--	1
Total Sulfur	--	50
Chemical Oxygen Demand	--	120

Notes:

[1] Specific quantitation limits are highly matrix dependent. The quantitation limits listed are for guidance and may not always be achievable due to matrix interference.

[2] Quantitation limits for source materials/soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for source materials/soil/sediment (calculated on a dry weight basis) will be higher.

Table 3

Elmira (Madison Avenue) Former MGP Site
Sample Containers, Preservation, and Holding Time Requirements

Parameter	Container	Preservation	Maximum Holding Time from VTSR
Groundwater Samples			
Volatile Organics	(2) 40-ml Teflon-lined septa (glass)	Cool 4ºC HCl to pH <2	7 days (unpreserved) 10 days (preserved)
Semivolatile Organics	(2) 1-liter containers (glass)	Cool 4ºC	5 days extraction; 40 days analysis
Nitrate	(1) 500-ml container (plastic/glass)	Cool 4ºC	48 hours (from collection)
Ammonia	(1) 500-ml container (plastic/glass)	H_2SO_4 Cool 4ºC	26 days
Iron	(1) 1,000-ml container (plastic/glass)	HNO_3 Cool 4ºC	6 months
Manganese	(1) 1,000-ml container (plastic/glass)	HNO_3 Cool 4ºC	6 months
Sulfate	(1) 500-ml container (plastic/glass)	Cool 4ºC	26 days
Sulfide	(1) 500-ml container (plastic/glass)	Cool 4ºC Zinc acetate NaOH to pH>12	5 days
Orthophosphate	(1) 500-ml container (plastic/glass)	Cool 4ºC Filter Immediately	48 hours (from collection)
Alkalinity	(1) 500-ml container (plastic/glass)	Cool 4ºC	12 days
Methane	(2) 40-ml Teflon-lined septa (glass)	Cool 4ºC HCl to pH<2	12 days
Soil Samples			
Volatile Organics	(1) 4-oz container (glass)	Cool 4ºC	10 days
Semivolatile Organics	(1) 4-oz container (glass)	Cool 4ºC	5 days extraction; 40 days analysis
TAL Metals	(1) 250-ml wide mouth container (glass)	Cool 4ºC	180 days; 28 days for mercury; 14 days for cyanide
TOC	(1) 8-oz container (glass)	Cool 4ºC	14 days
Total Sulfur	(1) 10-oz container (glass)	Cool 4ºC	--
Reactive Sulfide	(1) 8-oz container (glass)	Cool 4ºC	5 days
Reactive Cyanide	(1) 8-oz container (glass)	Cool 4ºC	12 days
TCLP Benzene	(1) 4-oz container (glass)	Cool 4ºC	10 days
Chemical Oxygen Demand	(2) 4-oz wide mouth container (glass)	Cool 4ºC	26 days

Notes:
VTSR = Verifiable time of sample receipt. Samples must be delivered to laboratory within 48 hours from day of collection.

Table 4

Data Validation Checklist
Laboratory Analytical Data

REVIEW FOR COMPLETENESS
1. Chain-of-custody forms included.
2. Sample preparation and analysis summary tables included.
3. QA/QC summaries of analytical data included.
4. Relevant calibration data included with analytical data.
5. Instrument and method performance data included.
6. Method detection limits documented.
7. Data report forms of examples for calculations of concentrations.
8. Raw data used in identification and quantification of the analysis required.
REVIEW OF COMPLIANCE
1. Data package completed.
2. QAPP requirements for data met.
3. QA/QC criteria met.
4. Instrument type and calibration procedures met.
5. Initial and continuing calibration met.
6. Data reporting forms completed.
7. Problems and corrective actions documented.

Appendix

Appendix A-1

Sample COC form

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066
TEL: (315) 446-9120

CHAIN OF CUSTODY RECORD

PROJ. NO.	**PROJECT NAME**
SAMPLERS: *(Signature)*	

STA. NO.	**DATE**	**TIME**	**COMP.**	**GRAB**	**STATION LOCATION**	**Number of Containers**							**REMARKS**

Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**DATE**	**TIME**	**Relinquished by:** *(Signature)*
Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**DATE**	**TIME**	**Relinquished by:** *(Signature)*
Relinquished by: *(Signature)*	**DATE**	**TIME**	**Received for Laboratory by:** *(Signature)*	**DATE**	**TIME**	**Remarks:**	

10/23/95
5951188L.CDR

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

Appendix C

Health and Safety Plan

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Health and Safety Plan

Supplemental Remedial Investigation Elmira (Madison Avenue) Former MGP Site

New York State Electric & Gas Corporation
Binghamton, New York

August 2003

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Approvals and Acknowledgments

Approvals

I have read and approved this Addendum with respect to project hazards, regulatory requirements, and BBL procedures.

Project Name: New York State Electric and Gas Corporation, Oneonta Former Manufactured Gas Plant Site - Oneonta, New York
Project Number: 130.42.001

Project Manager/Date

Health and Safety Officer/Date

Health and Safety Supervisor/Date

Acknowledgments

The final approved version of this HASP has been provided to the Site Supervisor. I acknowledge my responsibility to provide the Site Supervisor with the equipment, materials and qualified personnel to implement fully all safety requirements in this HASP. I will formally review this plan with the Health and Safety Staff every six months until project completion.

Project Manager/Date

I acknowledge receipt of this HASP from the Project Manager, and that it is my responsibility to explain its contents to all site personnel and cause these requirements to be fully implemented. Any change in conditions, scope of work, or other change that might affect worker safety requires me to notify the Project Manager and/or the Health and Safety Officer.

Site Supervisor/Date

Table of Contents

Tables

Figures

Attachments

1. Introduction

1.1 Objective

The objective of site activities is to conduct a Supplemental Remedial Investigation (SRI) at the Elmira (Madison Avenue) Former Manufactured Gas Plant (MGP) Site (the site), in Elmira, New York. Field activities are expected to include the following general tasks:

- Mobilization;
- Installation of groundwater monitoring wells and soil borings;
- Groundwater sampling and monitoring;
- Surface and sub-surface soil sampling;
- Decontamination; and
- Demobilization.

The objective of this Health and Safety Plan (HASP) is to provide a mechanism for establishing safe working conditions at the site. The safety organization, procedures, and protective equipment have been established based on an analysis of potential physical, chemical, and biological hazards. Specific hazard control methodologies have been evaluated and selected to minimize the potential of injury, illness, or other hazardous incident.

1.2 Site and Facility Description

The site is in the City of Elmira, in Chemung County, New York. The city occupies a the floor of a glacially carved valley, flanked on the east and west by steep bedrock hills rising greater than 500 feet above the valley floor. The city itself is largely flat, sitting in the flood plain of the Chemung River, which flows west to east through the city, before turning toward the southeast and its junction with the Susquehanna River.

The former MGP occupied most of a city block, bounded by East Clinton Street, Madison Avenue and East Fifth Street. The site is approximately 1,500 feet west of Newtown Creek, a tributary to the Chemung River which is just over 3,000 feet to the south. The site is largely flat-lying, with a small topographic rise in the eastern corner, near the intersection of East Fifth and East Clinton Streets.

The MGP was constructed between 1865 and 1869 beside the Junction Canal, a waterway connecting the Chemung and North Branch Canals (see Figure 1 of the SRI Work Plan). The canal was backfilled and replaced by a railroad in the late 1800s. Given the site's substantial distance from major surface water bodies (i.e., Chemung River and Newtown Creek), it is assumed that water used in the operations of the MGP was likely obtained from an onsite well.

The site is believed to have initially produced coal gas, then water (or blue) gas, and finally carbureted water gas. Three gas holders were constructed; the latest and largest had a 1-million cubic foot capacity. At different stages of operation, the site also contained the following major structures: a gas house, coal house, purifier boxes, retorts, waste lagoons, and tar vessels.

With plant closure in 1947, most of the above-ground MGP structures were dismantled. The present site includes several of the original plant buildings (including the gas house), but none of the material handling components (e.g., holders or purifiers). The locations of the historical MGP structures are shown on Figure 1 of the SRI Work Plan.

NYSEG used the site as a service station until 1977, when it sold a portion of the property. The western portion of the site, including all the remaining buildings, was sold to I.D. Booth, Inc., an industrial supply wholesaler. I.D. Booth uses several of the old buildings as warehouses, augmenting their larger operations across the Madison Avenue to the west. The former gas house is leased to a bakery wholesale supplier. NYSEG retains ownership of the eastern potion of the site, where it maintains an electrical substation and a storage yard.

Land use in the area is mixed, with industrial and commercial operations immediately south and west, a public park to the northeast, and residential properties not immediately adjacent, but within 1000 feet of the site in all directions. The parcel immediately south of the site is owned by Trayer Products, Inc. (Trayer), a metal-parts manufacturer.

1.3 Policy Statement

The policy of Blasland, Bouck & Lee, Inc. (BBL) is to provide a safe and healthful work environment. No aspect of operations is of greater importance than injury and illness prevention. A fundamental principle of safety management is that all injuries, illnesses, and incidents are preventable. BBL will take every reasonable step to eliminate or control hazards in order to minimize the possibility of injury, illness, or incident.

This HASP prescribes the procedures that must be followed during activities at the site. Operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and the Health and Safety Officer (HSO). This document will be reviewed periodically to ensure that it is current and technically correct. Any changes in site conditions and/or the scope of work will require a review and modification to this HASP. Such changes will be completed in the form of an addendum or a revision to the plan.

The provisions of this plan are mandatory for all BBL personnel and BBL subcontractors assigned to the project. Subcontractors may prepare their own site-specific HASPs that must meet the basic requirements of this HASP. All visitors to BBL work areas at the site must abide by the requirements of this plan.

1.4 References

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, United States Environmental Protection Agency (USEPA) regulations, and BBL health and safety policies and procedures. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guides*, USEPA (Publication 9285.1-03, June 1992).
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH, OSHA, USCG, USEPA (86116, October 1985).
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1910.
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1926.
- *Pocket Guide to Chemical Hazards*, DHHS, PHS, CDC, NIOSH (1997).
- *Threshold Limit Values*, ACGIH (2002).

- *Guide to Occupational Exposure Values*, ACGIH (2002).

- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 2nd Ed. (1993).

- *Health and Safety Policies and Procedures Manual*, BBL.

1.5 Definitions

The following definitions (listed alphabetically) are applicable to this HASP:

- *Contamination Reduction Zone (CRZ)* - Area between the exclusion zone and support zone that provides a transition between contaminated and clean areas. Decontamination stations are located in this zone.

- *Exclusion Zone (EZ)* - Any portions of the site where hazardous substances are, or are reasonably suspected to be present, and pose an exposure hazard to on-site personnel.

- *Incident* - All losses, including first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions.

- *Near Miss* - An incident in which no injury, illness, motor vehicle accident, equipment or property damage, etc., occurred, but under slightly different circumstances, could have occurred.

- *On-Site Personnel* - All BBL and subcontractor personnel involved with the project.

- *Project* - All on-site work performed under the scope of work.

- *Site* - The area described in Section 1.2, Site and Facility Description, where the work is to be performed by BBL personnel and subcontractors.

- *Subcontractor* - Includes contractor personnel hired by BBL.

- *Support Zone (SZ)* - All areas of the site, except the EZ and CRZ. The SZ surrounds the CRZ and EZ. Support equipment and break areas are located in this zone.

- *Visitor* - All other personnel, except the on-site personnel.

- *Work Area* - The portion of the site where work activities are actively being performed. This area may change daily as work progresses and includes the SZ, CRZ, and EZ. If the work area is located in an area on the site that is not contaminated, or suspected of being contaminated, the entire work area may be a SZ.

1.6 Acronyms

The following acronyms (listed alphabetically) are applicable to this HASP:

- *ACGIH* - American Conference of Governmental Industrial Hygienists
- *BBL* - Blasland, Bouck & Lee, Inc.
- *BETX* – Benzene, Ethylbenzene, Toluene, Xylene
- *COC* - Constituent(s) of Concern
- *CRZ* - Contamination Reduction Zone
- *EZ* - Exclusion Zone
- *GFCI* - Ground Fault Circuit Interrupter
- *HASP* - Health and Safety Plan
- *HSO* - Health and Safety Officer
- *HSS* - Health and Safety Supervisor
- *JSA* - Job Safety Analysis
- *LEL* - Lower Explosive Limit
- *MGP* - Manufactured Gas Plant
- *MSDS* - Material Safety Data Sheet
- *NYSEG* - New York State Electric and Gas
- *OSHA* - Occupational Safety and Health Administration
- *PAH* - Polycyclic Aromatic Hydrocarbons
- *PEL* - Permissible Exposure Limit
- *PFD* - Personal Floatation Device
- *PID* - Photoionization Detector
- *PM* - Project Manager
- *PO* - Project Officer
- *PPE* - Personal Protective Equipment
- SWO - Safe Work Observation
- *SRI* - Supplemental Remedial Investigation
- *SS* - Site Supervisor
- *SZ* - Support Zone
- *TLV* - Threshold Limit Value
- *USCG* - United States Coast Guard
- *USEPA* - United States Environmental Protection Agency
- *VOC* - Volatile Organic Compound

2. Roles and Responsibilities

2.1 All Personnel

All BBL and subcontractor personnel must adhere to the procedures outlined in this HASP during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner that conflicts with these procedures. After due warnings, the PM will dismiss from the site any person or subcontractor who violates safety procedures.

All BBL and subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all personnel will attend an initial hazard briefing prior to beginning work at the site.

The roles of BBL personnel and subcontractors are outlined in the following sections. Key project personnel and contacts are summarized in Table 2-1.

2.2 BBL Personnel

2.2.1 Project Officer (PO)

The PO is responsible for providing resources to assure project activities are completed in accordance with this HASP, and for meeting all regulatory and contractual requirements.

2.2.2 Health and Safety Officer (HSO)

The HSO or his designee (the Manger, Safety and Health) has overall responsibility for the technical health and safety aspects of the project, including review and approval of this HASP. Inquiries regarding BBL health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSO or his designee must approve changes or addenda to this HASP.

2.2.3 Project Manager (PM)

The PM is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The PM is responsible for confirming that the Site Supervisor (SS) has the equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP, and/or that subcontractors assigned to this project meet the requirements established by BBL. It is also the responsibility of the PM to:

- Consult with the HSO on site health and safety issues;
- Verify that subcontractors meet health and safety requirements prior to commencing work;
- Review Incident Prevention Observation (IPO) forms;
- Verify that all incidents are thoroughly investigated;
- Approve, in writing, addenda or modifications of this HASP; and
- Suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.2.4 Health and Safety Supervisor (HSS)

The HSS is responsible for field health and safety issues, including the execution of this HASP. Questions in the field regarding health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSS will advise the PM on health and safety issues, and will establish and coordinate the project air monitoring program if one is deemed necessary (see Section 6.1, Air Monitoring). The HSS is the primary site contact on health and safety matters. It is the responsibility of the HSS to:

- Provide on-site technical assistance, if necessary;
- Participate in all incident investigations (IIs) and ensure that they are reported to the HSO and PM within 24 hours;
- Coordinate site and personal air monitoring as required, including equipment maintenance and calibration;
- Conduct site safety orientation training and safety meetings;
- Verify that BBL personnel and subcontractors have received the required physical examinations and medical certifications;
- Review site activities with respect to compliance with this HASP;
- Maintain required health and safety documents and records;
- Assist the SS in instructing field personnel on project hazards and protective procedures; and
- Review IPO forms.

2.2.5 Site Supervisor

The SS is responsible for implementing this HASP, including communicating requirements to on-site personnel and subcontractors. The SS will be responsible for informing the PM of changes in the work plan, procedures, or site conditions so that those changes may be addressed in this HASP. Other responsibilities are to:

- Consult with the HSS on site health and safety issues;
- Conduct IPOs at the site, and complete the IPO forms;
- Stop work, as necessary, for personal safety, protection of property, and regulatory compliance;
- Obtain a site map and determine and post routes to medical facilities and emergency telephone numbers;
- Notify local public emergency representatives (as appropriate) of the nature of the site operations, and post their telephone numbers (i.e., local fire department personnel who would respond for a confined space rescue);
- Observe on-site project personnel for signs of ill health effects;
- Investigate and report any incidents to the HSS;
- Verify that all on-site personnel have had applicable training;

- Verify that on-site personnel are informed of the physical, chemical, and biological hazards associated with the site activities, and the procedures and protective equipment necessary to control the hazards; and

- Issue/obtain any required work permits (hot work, confined space, etc.).

2.3 Subcontractors

Subcontractors and their personnel must understand and comply with applicable regulations and site requirements established in this HASP. Subcontractors may prepare their own site-specific HASP that must be consistent with the requirements of this HASP.

All subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. All subcontractor personnel will attend an initial hazard briefing prior to beginning work at the site. Additionally, on-site subcontractor personnel must attend and participate in the daily site safety meetings.

Subcontractors must designate individuals to function as the PM, HSO, HSS, and SS. In some firms, it is not uncommon for the duties of the HSO to be carried out by the PM. This is acceptable provided the PM has the required knowledge, training, and experience to properly address all hazards associated with the work, and to prepare, approve, and oversee the execution of the site-specific HASP. A subcontractor may designate the same person to perform the duties of both the HSS and the SS. However, depending on the level of complexity of a contractor's scope of work, it may be infeasible for one person to perform both functions satisfactorily.

2.4 All On-Site Personnel

All on-site personnel (including subcontractors) must read and acknowledge their understanding of this HASP before commencing work, and abide by the requirements of the plan. All on-site personnel shall sign the HASP Acknowledgement Form following their review of this HASP.

All BBL and subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all on-site personnel will attend an initial hazard briefing prior to beginning work at the site and the daily safety meetings.

All on-site personnel must immediately report the following to the SS or HSS:

- Personal injuries and illnesses no matter how minor;
- Unexpected or uncontrolled release of chemical substances;
- Symptoms of chemical exposure;
- Unsafe or hazardous situations;
- Unsafe or malfunctioning equipment;
- Changes in site conditions that may affect the health and safety of project personnel;
- Damage to equipment or property;
- Situations or activities for which they are not properly trained; and
- Near misses.

2.5 Visitors

All visitors to BBL work areas must check in with the SS. Visitors will be cautioned to avoid skin contact with surfaces, soils, groundwater, or other materials that may impacted or be suspected to be impacted by constituents of concern (COC).

Visitors requesting to observe work at the site must don appropriate personal protective equipment (PPE) prior to entry to the work area and must have the appropriate training and medical clearances to do so. If respiratory protective devices are necessary, visitors who wish to enter the work area must have been respirator-trained and fit tested for a respirator within the past 12 months.

TABLE 2-1
KEY PERSONNEL

BBL Personnel		
Role	**Name**	**Address/Telephone No.**
Project Officer	Frederick J. Kirschenheiter, P.E.	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120
Project Manager	Scott A. Powlin, P.G.	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120
Health and Safety Officer	Jay D. Keough, CIH	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Health and Safety Manager	Chuck Webster, CSP	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120
Site Supervisor	Jason C. Sents	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120
Health and Safety Supervisor	Jason C. Sents	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 (315) 446-9120
Subcontractors		
Company/Role	**Name**	**Address/Telephone No.**
Lyon Drilling	Harry Lyon	7426 Shackham Rd. Tully, NY 13159 (607) 842-6580
NYSEG Personnel		
Role	**Name**	**Address/Telephone No.**
Project Manager	John J. Ruspantini, CHMM	P.O. Box 5224 Binghamton, NY 13902-5224 (607) 762-8787
Agency Personnel		
Agency/Role	**Name**	**Address/Telephone No.**
New York State Department of Environmental Conservation Project Manager	Amen Omorogbe	Division of Hazardous Waste Remediation NYSDEC 625 Broadway Albany, NY 12233 (518) 402-9662

3. Project Hazards and Control Measures

3.1 Scope of Work

Field activities are expected to include the following general tasks:

- Mobilization;
- Installation of groundwater monitoring wells and soil borings;
- Groundwater sampling and monitoring;
- Surface and sub-surface soil sampling;
- Decontamination; and
- Demobilization.

3.2 Field Activities, Hazards, and Control Procedures

The following job safety analyses (JSAs) identify potential health, safety, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the site to identify hazards that may affect on-site personnel, the community, or the environment. The SS must be aware of these changing conditions and discuss them with the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The SS will keep on-site personnel informed of the changing conditions, and the PM will write and/or approve addenda or revisions to this HASP as necessary.

3.2.1 Mobilization

Site mobilization will include establishing drilling and excavation locations, determining the location of utilities and other installations, and establishing work areas. Mobilization may also include setting up equipment and establishing a temporary site office. A break area will be set up outside of regulated work areas. Mobilization may involve clearing areas for the SZ and CRZ. During this initial phase, project personnel will walk the site to confirm the existence of anticipated hazards, and identify safety and health issues that may have arisen since the writing of this plan.

The hazards of this phase of activity are associated with heavy equipment operation, manual materials handling, installation of temporary on-site facilities, and manual site preparation.

Manual materials handling and manual site preparation may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Installation of temporary field office and support facilities may expose personnel to electrical hazards, underground and overhead utilities, and physical injury due to the manual lifting and moving of materials. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.2.2 Installation of Groundwater Monitoring Wells and Soil Borings

This task includes the installation of groundwater monitoring wells and soil borings at specified locations. After the wells are completed, the wells will be developed using the standard operating procedures.

The collection of soil samples may also involve the use of direct push type boring equipment. The equipment poses a hazard if it is not properly operated. The equipment is hydraulically powered, and uses static force and dynamic percussion force to advance small-diameter sampling tools. The presence of overhead utilities and underground obstacles poses a hazard if boring equipment contacts them. As the hazards are similar to those encountered when using a conventional drill rig, the required control procedures are also the same as a conventional rig and are included in the following sections.

3.2.2.1 Drilling Hazards

The primary physical hazards for this activity are associated with the use of drilling equipment. Rig accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the rig prior to the start of operations. Underground and overhead utility lines can create hazardous conditions if contacted by drilling equipment. Tools and equipment, such as elevators, cat lines, and wire rope, have the potential for striking, pinning, or cutting personnel.

Wire Rope - Worn or frayed wire rope presents a laceration hazard if loose wires protrude from the main bundle.

Cat Lines - Cat lines are used on drilling rigs to hoist material. Accidents that occur during cat line operations may injure the employee doing the rigging, as well as injure the operator. Minimal hoisting control causes sudden and erratic load movements, which may result in hand and foot injuries.

Working Surfaces - Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls.

Materials Handling - The most common type of accident that occurs in material handling operations is the “caught between” situation when a load is being handled and a finger or toe gets caught between two objects. Rolling stock can shift and/or fall from a pipe rack or truck bed.

3.2.2.2 Drilling Safety Procedures

Drill Crews - All drillers must possess required state or local licenses to perform such work. All members of the drill crew shall receive site-specific training prior to beginning work.

The driller is responsible for the safe operation of the drill rig, as well as the crew’s adherence to the requirements of this HASP. The driller must ensure that all safety equipment is in proper condition and is properly used. The members of the crew must follow all instructions of the driller, wear all PPE, and be aware of all hazards and control procedures. The drill crews must participate in the Daily Safety Meetings and be aware of all emergency procedures.

Rig Inspection - Each day, prior to the start of work, the drill rig and associated equipment must be inspected by the driller and/or drill crew. The following items must be inspected:

- Vehicle condition;
- Proper storage of equipment;
- Condition of all wire rope and hydraulic lines;
- Fire extinguisher; and
- First aid kit.

Drill Rig Set Up - The drill rig must be properly blocked and leveled prior to raising the derrick. The wheels that remain on the ground must be chocked. The leveling jacks shall not be raised until the derrick is lowered. The rig shall be moved only after the derrick has been lowered.

Site Drilling Rules - Before drilling activities commence, the existence and location of underground pipe, electrical equipment, and gas lines shall be determined. Underground Facilities Protection Organization (UFPO) must be contacted at least one week, but no more than two weeks, prior to subsurface activities. BBL's SS will meet with electrical and natural gas locators on site prior to marking out the underground utilities. During this meeting, BBL's SS will provide the electric and natural gas locators with a site figure that shows the locations where drilling activities will be completed. BBL's SS will conduct a site walkover with the electrical and natural gas locators to visually identify each location where drilling activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Attachment G) shall be used to document that nearby utilities have been marked on the ground, and that the drilling areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencement of any intrusive investigation.

Combustible gas readings of the general work area will be made regularly (see Section 6).

Operations must be suspended and corrective action taken if the airborne flammable concentration reaches 10% of lower explosive limit (LEL) in the immediate area (a one-foot radius) of the point of drilling, or near any other ignition sources.

Under no circumstances will personnel be permitted to ride the traveling block or elevators, nor will the cat line be used as a personnel carrier.

Overhead Electrical Clearances - If drilling is conducted in the vicinity of overhead power lines, the power to the lines must be shut off or the equipment must be positioned and blocked such that no part, including cables, can come within the minimum clearances as follows:

Nominal System Voltage	Minimum Required Clearance
0-50Kv	10 feet
51-100kV	12 feet
101-200kV	15 feet
201-300kV	20 feet
301-500kV	25 feet
501-750kV	35 feet
751-1,000kV	45 feet

When the drill rig is in transit, with the boom lowered and no load, the equipment clearance must be at least 4 feet for voltages less than 50kV, 10 feet for voltages of 50kV to 345kV, and 16 feet for voltages above 345kV.

Rig Set Up - All well sites will be inspected by the driller prior to the location of the rig to verify a stable surface exists. This is especially important in areas where soft, unstable terrain is common.

All rigs will be properly blocked and leveled prior to raising the derrick. Blocking provides a more stable drilling structure by evenly distributing the weight of the rig. Proper blocking ensures that differential settling of the rig does not occur.

When the ground surface is soft or otherwise unstable, wooden blocks, at least 24 inches by 24 inches and 4 inches to 8 inches thick, shall be placed between the jack swivels and the ground. The emergency brake shall be engaged, and the wheels that are on the ground shall be chocked.

Hoisting Operations - Drillers should never engage the rotary clutch without watching the rotary table, and ensuring it is clear of personnel and equipment.

Unless the drawworks is equipped with an automatic feed control, the brake should not be left unattended without first being tied down.

Auger strings or casing should be picked up slowly.

During instances of unusual loading of the derrick or mast, such as when making an unusually hard pull, only the driller should be on the rig floor; no one else should be on the rig or derrick.

The brakes on the drawworks of the drill rig should be tested by the driller each day. The brakes should be thoroughly inspected by a competent individual each week.

A hoisting line with a load imposed should not be permitted to be in direct contact with any derrick member or stationary equipment, unless it has been specifically designed for line contact.

Workers should never stand near the borehole whenever any wire line device is being run.

Hoisting control stations should be kept clean and controls labeled as to their functions.

Cat Line Operations - Only experienced workers will be allowed to operate the cathead controls. The kill switch must be clearly labeled and operational prior to operation of the cat line. The cathead area must be kept free of obstructions and entanglements.

The operator should not use more wraps than necessary to pick up the load. More than one layer of wrapping is not permitted.

Personnel should not stand near, step over, or go under a cable or cat line that is under tension.

Employees rigging loads on cat lines shall:

- Keep out from under the load;
- Keep fingers and feet where they will not be crushed;
- Be sure to signal clearly when the load is being picked up;
- Use standard visual signals only and not depend on shouting to co-workers; and
- Make sure the load is properly rigged, since a sudden jerk in the cat line will shift or drop the load.

Wire Rope - When two wires are broken or rust or corrosion is found adjacent to a socket or end fitting, the wire rope shall be removed from service or resocketed. Special attention shall be given to the inspection of end fittings on boom support, pendants, and guy ropes.

Wire rope removed from service due to defects shall be cut up or plainly marked as being unfit for further use as rigging.

Wire rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope; the clip nuts shall be re-tightened immediately after initial load carrying use and at frequent intervals thereafter.

When a wedge socket fastening is used, the dead or short end of the wire rope shall have a clip attached to it or looped back and secured to itself by a clip; the clip shall not be attached directly to the live end.

Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

Except for eye splices in the ends of wires and for endless wire rope slings, wire rope used in hoisting, lowering, or pulling loads, shall consist of one continuous piece without knot or splice.

An eye splice made in any wire rope shall have not less than five full tucks.

Wire rope shall not be secured by knots. Wire rope clips shall not be used to splice rope.

Eyes in wire rope bridles, slings, or bull wires shall not be formed by wire clips or knots.

Auger Handling - Auger sections shall be transported by cart or carried by two persons. Individuals should not carry auger sections without assistance.

Workers should not be permitted on top of the load during loading, unloading, or transferring of rolling stock.

When equipment is being hoisted, personnel should not stand where the bottom end of the equipment could whip and strike them.

Augers stored in racks, catwalks, or on flatbed trucks should be secured to prevent rolling.

3.2.3 Groundwater Sampling and Monitoring

Groundwater sampling and monitoring will involve uncapping, purging (pumping water out of the well), and sampling and monitoring new and existing monitoring wells. A mechanical pump may be utilized to purge the wells and can be hand-, gas-, or electric-operated. Water samples taken from the wells are then placed in containers and shipped to analytical laboratory for analysis. The physical hazards of these operations are primarily associated with the sample collection methods and procedures utilized.

Hazards - Inhalation and absorption (contact) of COCs are the primary routes of entry associated with groundwater sampling due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During the course of this project, several different groundwater sampling methodologies may be utilized based on equipment accessibility and the types of materials to be sampled. These sampling methods may include hand or mechanical bailing. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with groundwater sampling procedures are generally limited to strains/sprains from hand bailing and potential eye hazards. Exposure to soil and water containing COCs is also possible.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Freezing weather hazards include frozen, slick, and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil.

Control - To control dermal exposure during groundwater sampling and monitoring activities, a minimum of Level D protection and sampling gloves (Modified Level D) will be worn. If necessary, based on field observations and site conditions, air monitoring may be conducted during groundwater sampling and monitoring activities to assess the potential for exposure to airborne COCs. If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Refer to Section 6.1, Air Monitoring, for a description of air monitoring requirements and action levels. A description of each level of personal protection is included in Section 5, Personal Protective Equipment. Control procedures for environmental and general hazards are discussed in Section 4, General Site Safety Procedures.

3.2.4 Surface and Sub-surface Soil Sampling

This task consists of collecting surface and sub-surface soil samples for subsequent analysis and evaluation of potential impact by COC. The physical hazards of these operations are primarily associated with the sample collection methods and procedures utilized. In addition, personnel may be exposed to hazards associated with working in or near excavations.

Hazards - Inhalation and absorption (contact) of COC are the primary routes of entry associated with soil sampling due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During the course of this project, several different soil sampling methodologies may be utilized based on equipment accessibility and the types of materials to be sampled. These sampling methods may include the use of hand-auger/sampling probes, sampling spoons, or trowels. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with soil sampling procedures are generally limited to strains/sprains and potential eye hazards. Exposure to soil and water containing COC is also possible. In addition to the safety hazards specific to sampling operations, hazards associated with the operation of vehicles, especially large vehicles with limited operator visibility, is a concern. Of particular concern will be the backing up of trucks, excavation equipment, and other support vehicles.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Freezing weather hazards include frozen, slick, and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil.

Control - To control dermal exposure during soil sampling activities, a minimum of Level D protection and sampling gloves (Modified Level D) will be worn. If necessary, based on field observations and site conditions, air monitoring may be conducted during soil sampling activities to assess the potential for exposure to airborne COC. Sub-surface soil samples will be collected and screened for volatile organic compounds (VOCs) using a photoionization detector (PID). If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Refer to Section 6.1, Air Monitoring for a description of air monitoring requirements and action levels. A description of each level of personal protection is included in Section 5, Personal Protective Equipment.

Personnel will collect samples remotely from outside of excavations when feasible. Control procedures for environmental and general hazards are discussed in Section 4, General Safety Practices.

The following sections discuss hazards and control procedures for excavations.

3.2.4.1 Excavation Hazards and Control Procedures

This task involves excavating at specified locations to obtain sub-surface soil samples from a designated area, thereby creating a man-made cut, trench, or depression in the earth's surface. Excavation activities will be conducted in accordance with this section and all OSHA regulations.

The physical hazards involved in the excavation of soils are related to the excavation itself and the operation of heavy equipment. The presence of overhead utilities such as power lines requires careful positioning of the excavating equipment in order to maintain a safe distance between the lines and the closest part of the equipment. The presence of underground utilities such as gas lines, power lines, water lines, and sewer pipes must be determined prior to beginning the excavation.

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse if it is not dug properly, sloped, benched, or shored as required by 29 CFR 1926 Subpart P. Protective systems, as required by 29 CFR 1926 Subpart P, must be utilized if the potential for hazardous cave-ins exist. The excavation also is a fall hazard, and employees must pay careful attention to what they are doing or they risk a fall into the excavation. Fall protection, as required by 29 CFR 1926 Subpart M, will be required.

Sampling activities shall be done remotely; entry into excavations is not permitted except in emergency situations...

Noise also may present a hazard. Heavy equipment operation frequently results in noise levels exceeding 85 dBA, requiring the use of hearing protection.

At the end of each workday, open test pit excavations will be backfilled and equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.

Airborne concentrations of COC in the site soil and the dust from the excavation procedure pose the potential for inhalation exposure. PPE for this phase is described in Section 5, Personal Protective Equipment. Airborne particulate generation will be controlled during site excavations. Dry, dusty soil will be wetted with a water spray from a potable water source to control the generation of dust. Soil will not be wetted to a degree that will cause runoff or erosion.

Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines shall be determined. Underground Facilities Protection Organization (UFPO) must be contacted at least one week, but no more than two weeks, prior to subsurface activities. BBL's SS will meet with electrical and natural gas locators on site prior to marking out the underground utilities. During this meeting, BBL's SS will provide the electric and natural gas locators with a site figure that shows the locations where excavation activities will be completed. BBL's SS will conduct a site walkover with the electrical and natural gas locators to visually identify each location where excavation activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Attachment G) shall be used to document that nearby utilities have been marked on the ground, and that the excavation areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencement of any intrusive investigation.

All excavation activities shall be conducted in accordance with 29 CFR 1926 Subpart P. If excavation operations are located near underground installations, the exact location of the installations must be determined by safe and acceptable means. While the excavation is open, underground installations must be protected, supported, or removed as necessary to safeguard employees.

3.2.4.2 Inspections by a Competent Person

Daily inspections of excavations, the adjacent areas, and protective systems must be made by the exaction contractor's competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection must be conducted by the competent person prior to the start of work and as needed throughout the shift (see attached Periodic Excavation Inspection Form in Attachment H).

Inspections also must be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated. Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees must be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

Walkways must be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with 1926.502(b) must be provided. Adequate barrier protection must be provided at all remotely located excavations. All wells, pits, shafts, etc., must be barricaded or covered. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc., must be backfilled.

3.2.4.3 Soil Classification

29 CFR 1926 Subpart P, Appendix A describes methods of classifying soil and rock deposits based on site and environmental conditions and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils. This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with Appendix C to Subpart P of Part 1926, and when aluminum hydraulic shoring is designed in accordance with 29 CFR Subpart P Appendix D. This appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in 1926.652(c), and the use of the data are predicated on the use of the soil classification system set forth in Appendix A of 29 CFR 1926.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H: V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from Table B-1. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope which is at least horizontal to one vertical (1/2H: 1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope, and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P Appendix B.

TABLE B-1
29 CFR 1926 SUBPART P APPENDIX B
MAXIMUM ALLOWABLE SLOPES

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]
Stable Rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1:½ (34 degrees)

Notes:

[1] Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

[2] Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.

[3] A short-term maximum allowable slope of 1/2H: 1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H: 1V (53 degrees).

3.2.4.4 Overhead Electrical Clearances

If excavation activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up/guaranteed, and grounded or the equipment must be positioned such that no part, including excavation boom, can come within the minimum clearances as follows:

Nominal System Voltage	Minimum Required Clearance
0-50kV	10 feet
51-100kV	12 feet
101-200kV	15 feet
201-300kV	20 feet
301-500kV	25 feet
501-750kV	35 feet
751-1,000kV	45 feet

3.2.4.5 Excavation Entry Procedure

Persons entering an excavation must do so under controlled conditions. The excavation must be properly sloped, benched, or shored, and ladders or ramps must be available every 25 feet laterally in the excavation. Each entry shall have an attendant who observes the entrant(s) and is prepared to render assistance.

Duties of Workers Entering an Excavation

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants;

- Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space;

- Alert the attendant whenever:

    - The entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
    - The entrant detects a prohibited condition;

- Exit from the excavation as quickly as possible whenever:

    - An order to evacuate is given by the attendant or the supervisor;
    - The entrant recognizes any warning sign or symptom of exposure to a dangers situation; or
    - The entrant detects a prohibited condition.

Duties of Attendants

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants;

- Continuously maintains a count of entrants in the excavation;

- Remains outside the excavation during entry operations until relieved by another attendant;

- Communicates with authorized entrants as necessary to monitor entrant status to alert entrants of the need to evacuate the excavation under any of the following conditions:

    - If the attendant detects a prohibited condition;
    - If the attendant detects the behavioral effects of hazard exposure in an entrant;
    - If the attendant detects a situation outside the excavation that could endanger the entrants; or
    - If the attendant cannot effectively and safely perform his duties;

- Summon rescue and other emergency services if the attendant determines that entrants may need assistance to evacuate the excavation.

3.2.5 Decontamination

All equipment will be decontaminated before leaving the site using visual inspection to verify that COCs have been removed. In addition, all operations that have the potential to generate or release hazardous material will be conducted in a controlled area using the appropriate engineering controls. Specific decontamination techniques will be established based on site conditions. Decontamination procedures will be reviewed with all personnel on-site. It is anticipated that a decontamination pad will be constructed on a suitable surface with polyethylene sheeting or other appropriate containment system. Pressure washing or manual scrub brushing will be used as needed to decontaminate equipment. COC-impacted equipment will be determined “clean” by using visual inspection of all equipment.

Personnel involved in decontamination activities may be exposed to skin contact with contaminated materials and chemicals brought to the site as part of the project work. All personnel will review the operating procedures and PPE prior to decontamination. The equipment used for decontamination and the decontamination containment facility will be inspected daily prior to use. Personnel involved in decontamination activities must wear PPE that is one level below the level worn by personnel working in the EZ.

3.2.5.1 Pressure Washing

Equipment will be decontaminated before leaving the site. Personnel involved in decontamination activities may be exposed to skin contact with residuals containing site constituents, volatile emissions from heavily soiled equipment, high pressure water spray, and noise.

Hydro blasting is the process of using a stream of water at high pressure to clean or prepare surfaces by removing foreign matter and contaminants. The hazards of high pressure water cleaning are related to the high pressure of the water, which may exceed 10,000 pounds per square inch (psi) at the nozzle. Contact with the water spray may cause severe lacerations, which may then be contaminated with hazardous material. Because of the high pressure involved, the opportunity for slicing or injecting the water stream through soft tissues of the body exists. Hydro blasters will also cut through bone at high enough pressures. A second hazard is repetitive motion, or cumulative trauma disorder. These serious disorders are related to repeatedly squeezing the trigger or constantly fighting the pressure of the spray gun with the forearm or wrist. When pressure washing, steaming, or hydro blasting, the health and safety precautions for hydro blasting outlined below must be observed.

Pressure washing presents a splash hazard. Protection against splash to face and skin is mandatory. The pressure washer is not to be pointed at a person at any time. Steam cleaning presents a thermal burn hazard in addition to the hazards presented by pressure washing. Adequate protection from the hot surfaces must be provided. Only persons trained in use and maintenance of a hydro blaster may use such equipment. Hydro blasting operations will conducted only by qualified subcontractor personnel.

The following general requirements are provided for high-pressure water cleaning activities:

- The gun, pressure piping, pressure hose ends, and couplings will have a burst pressure of at least four times the operating pressure.
- No equipment or component of such equipment will be operated beyond the manufacturer's specifications or beyond the rated working pressure.
- The maximum operating pressure will be permanently displayed on the pumping unit.
- Wear safety glasses, face-shield, hearing protection, and safety shoes.
- Alternate hands frequently during long periods of use.
- Rotate personnel periodically.
- Use a washer with a gun which supplies water to the wand in a straight line as opposed to supplying water through the grip. This eliminates the gun's twisting motion.
- Keep the equipment in good condition.
- Check to see that releasing the trigger stops the flow of water. Do not wire back the trigger.

- A hose safety shroud will be placed on hoses whenever operating pressure exceeds 2,000 psi.

- The pressure control will be a "deadman" type to safely reduce the nozzle discharge pressure when control is released.

- The pressure discharge gauge indicating pump pressure will be clearly visible for monitoring pump pressure.

- A pressure relief device set to relieve at 110% of the maximum working pressure of the unit or its components, whichever is lower, will be installed on the pump. The relief will be clearly marked and displayed on the device.

- A strainer or filter should be installed on the water supply system to prevent debris from entering the water blasting units and clogging the gun, control, or other device.

Pay close attention to the water line. It is under pressure, and may whip about if broken. If a water line breaks, relieve the pressure before trying to grab the line.

3.2.6 Demobilization

Demobilization involves the removal of all tools, equipment, supplies, and vehicles brought to the site. The hazards of this phase of activity are associated with heavy equipment operation and manual materials handling.

Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Heavy equipment operation presents noise and vibration hazards, and hot surfaces, to operators. Personnel in the vicinity of heavy equipment operation may be exposed to physical hazards resulting in fractures, contusions, and lacerations and may be exposed to high noise levels. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.3 Chemical Hazards

The chemical hazards associated with site operations are related to inhalation, ingestion, and skin exposure to site COCs. Concentrations of airborne COCs during site tasks may be measurable, and may require air monitoring during certain operations. Air monitoring requirements for site tasks are outlined in Section 6.1.

Site COCs may include: benzene, toluene, ethylbenzene, and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and cyanide.

The potential for inhalation of site COCs is low. The potential for dermal contact with soils and groundwater containing site COCs during excavation, drilling, and sampling operations is moderate. Table 3-1 lists the chemical, physical, and toxicological properties of site COCs. Material Safety Data Sheets (MSDS) for the COCs is included in Attachment A.

TABLE 3-1
CHEMICAL HAZARD INFORMATION

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
Benzene 71-43-2	9.24	1.5-5	Inh Abs Ing Con	Irritated eyes, skin, nose, respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone marrow depression; **carcinogenic**	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm 0.5 ppm (skin) 0.1 ppm	5 ppm 2.5 ppm 1 ppm	PEL TLV REL	**Ca** [500 ppm]
Benzo[a]pyrene (Coal tar pitch volatiles) 50-32-8			Inh Ing	Irritated eyes, skin, respiratory tract ; skin irritation with burning sensation, rash, and redness, dermatitis - **carcinogenic**	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3* none 0.1 mg/m^3* *Benzene soluble frac. **Cyclohexane extractable frac.	NE NE NE	PEL TLV REL	**Ca** [80 mg/m^3]
Cyanides: calcium, potassium, and sodium [592-01-8; 151-50-8; 143-33-9]	NA	ND	Inh Abs Ing Con	Asphyxiation and death can occur; weakness, headache, and confusion; nausea and vomiting; increased respiratory rate; slow respiratory gasping; irritated eyes and skin	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	5 mg/m^3 5 mg/m^3 (skin) NE	C5 mg/m^3* NE C5 mg/m^3 *10 min	PEL TLV REL	50 mg/m^3
Ethylbenzene [100-41-4]	8.76	0.09-0.6	Inh Ing Con	Irritated eyes, mucous membranes; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm
Toluene [108-88-3]	8.82	0.16-37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness; headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm NE 150 ppm	PEL TLV REL	500 ppm
Xylene (o-, m-, and p-isomers) [1330-20-7; 95-47-6; 108-38-3; 106-42-3]	8.56 8.56 8.44	1.1-20	Inh Abs Ing Con	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	150 ppm 150 ppm 150 ppm	PEL TLV REL	900 ppm

Notes:

[1] IP = Ionization potential (electron volts).
[2] Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; and Con, Skin and/or eye contact.
[3] TWA = Time-weighted average. The TWA concentration for a normal workday (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[4] STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the TWA is not exceeded.
[5] PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
[5] TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value – TWA.
[5] REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[6] IDLH (NIOSH) = Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = None established. No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990, 1997).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
ND = Not Determined.
LEL = Lower explosive limits.
LC_{50} = Lethal concentration for 50 percent of population tested.

TABLE 3-1
CHEMICAL HAZARD INFORMATION
(CONT'D.)

Notes (Cont'd.)

LD_{50} = Lethal dose for 50 percent of population tested.
NIC = Notice of intended change (ACGIH).

References:

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National Institute for Occupational Safety and health Pocket Guide to Chemicals, Pub. 1997, No. 90-117, National Institute for Occupational Safety and Health.
Odor Threshold for Chemicals with Established Occupational Health Standards, American industrial Hygiene Association, 1989.
Respirator Selection Guide, 3M Occupational Health and Safety Division, 1993.
Verschuseren, K., Handbook of Environmental Data on Organic Chemicals, Van Nostrand and Reinhold, 1977.
Warning Properties of Industrial Chemicals – Occupational Health Resource Center, Oregon Lung Association.
Workplace Environmental Exposure Levels, American Industrial Hygiene Association, 1992.

4. General Safety Practices

4.1 General Safety Rules

General safety rules for site activities include, but are not limited to, the following:

- At least one copy of this HASP must be in a location at the site that is readily available to personnel, and all project personnel shall review the plan prior to starting work.
- Practice contamination avoidance. Avoid contact with surfaces either suspected or known to be impacted by COC, such as standing water, mud, or discolored soil. Equipment must be stored on elevated or protected surfaces to reduce the potential for incidental contamination.
- Consume or use food, beverages, chewing gum, and tobacco products only in the SZ or other designated area outside the EZ and CRZ. Cosmetics shall not be applied in the EZ or CRZ.
- Wash hands before eating, drinking, smoking, or using toilet facilities.
- Wear all PPE as required, and stop work and replace damaged PPE immediately.
- Secure disposable coveralls, boots, and gloves at the wrists and legs and ensure closure of the suit around the neck.
- Upon skin contact with materials that may be impacted by COC, remove contaminated clothing and wash the affected area immediately. Contaminated clothing must be changed. Any skin contact with materials potentially impacted by COC must be reported to the SS or HSS immediately. If needed, medical attention should be sought.
- Remove PPE as required in the CRZ to limit the spread of COC-containing materials.
- At the end of each shift or as required, dispose of all single-use coveralls, soiled gloves, and respirator cartridges in designated receptacles designated for this purpose.
- Removing soil containing site COC from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited.
- Inspect all non-disposable PPE for contamination in the CRZ. Any PPE found to be contaminated must be decontaminated or disposed of appropriately.
- Recognize emergency signals used for evacuation, injury, fire, etc.
- Report all injuries, illnesses, near misses, and unsafe conditions or work practices to the SS or HSS.
- Use the “buddy system” during all operations requiring Level C PPE, and when appropriate, during Modified Level D operations.
- Obey all warning signs, tags, and barriers. Do not remove any warnings unless authorized to do so.

- Use, adjust, alter, and repair equipment only if trained and authorized to do so, and in accordance with the manufacturer's directions.

- Personnel are to perform only tasks for which they have been properly trained and will advise their supervisor if they have been assigned a task for which they are not trained.

- The presence or consumption of alcoholic beverages or illicit drugs during the workday (including breaks) is strictly prohibited. Do not take prescription or over-the-counter drugs when assigned to tasks with the potential for absorption, inhalation, or ingestion of hazardous substances, unless given written approval by an appropriate health care professional.

Remain upwind during site activities whenever possible.

4.1.1 Incident Investigation

An incident is any of the following events: first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions. All incidents shall be investigated within 24 hours and reported to the PM and the HSO.

The purpose of an II is to prevent the recurrence of a similar hazardous event. II investigates all incidents in the same manner. Using the information gathered during an II, appropriate measures will be taken to protect personnel from the hazard in question. The II form is included in Attachment B.

4.1.2 Safe Work Observation

The SS or the HSS will perform the SWO (see Attachment C for the SWO form). The purpose of the SWO is to identify and correct potential hazards, and to positively reinforce behaviors and practices that are correct. The SS or HSS must identify potential deviations from safe work practices that could possibly result in an incident, and take prompt corrective action. The SWO process steps are:

- Identify tasks that have the greatest potential for hazardous incidents;
- Review the standard procedure for completing the task;
- Discuss with the observed employee the task and the SS/HSS role in observing the task;
- Observe the employee completing the task;
- Complete the SWO form, documenting positive, as well as areas in need of improvement;
- Discuss the results of the SWO with the employee. Discuss corrective action necessary;
- Implement corrective action; and
- Communicate the results of the SWO and corrective action to the PM and the HSO.

4.1.3 Job Safety Analysis

A JSA is a tool used of identifying potential hazards and developing corrective or protective systems to eliminate the hazard. A JSA lists all the potential hazards associated with an activity. Hazards may be physical, such as lifting hazards or eye hazards, or environmental, such as weather or biological (stinging insects, snakes, etc.). Following the identification of the hazards associated with an activity, control measures are evaluated and protective measures or procedures are then instituted. JSAs are reviewed periodically to ensure that the procedures and protective equipment specified for each activity are current and technically correct. Any changes in site conditions and/or the scope of work may require a review and modification to the JSA in question. During this review process, comments on the JSA and its procedures should be obtained from personnel associated with the activity being analyzed.

4.2 Buddy System

On-site personnel must use the buddy system as required by operations. Use of the "buddy system" is required during all operations requiring Level C to Level A PPE, and when appropriate, during Level D operations. Crewmembers must observe each other for signs of chemical exposure, and heat or cold stress. Indications of adverse effects include, but are not limited to:

- Changes in complexion and skin coloration;
- Changes in coordination;
- Changes in demeanor;
- Excessive salivation and pupillary response; and
- Changes in speech pattern.

Crewmembers must also be aware of the potential exposure to possible safety hazards, unsafe acts, or non-compliance with safety procedures.

Field personnel must inform their partners or fellow crewmembers of non-visible effects of exposure to toxic materials that they may be experiencing. The symptoms of such exposure may include, but are not limited to:

- Headaches;
- Dizziness;
- Nausea;
- Blurred vision;
- Cramps; and
- Irritation of eyes, skin, or respiratory tract.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

4.3 Heat Stress

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Since heat stress is one of the most common illnesses associated with heavy outdoor work conducted with direct solar load and, in particular, because wearing PPE can increase the risk of developing heat stress, workers must be capable of recognizing the signs and symptoms of heat-related illnesses. Personnel must be aware of the types and causes of heat-related illnesses and be able to recognize the signs and symptoms of these illnesses in both themselves and their co-workers.

Heat rashes are one of the most common problems in hot work environments. Commonly known as prickly heat, a heat rash is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by too much or too little salt.

Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat exhaustion occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; headache, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment.

Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment, be given fluid replacement, and be encouraged to get adequate rest.

Heat stroke is the most serious form of heat stress. Heat stroke occurs when the body’s system of temperature regulation fails and the body’s temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict.

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of workload and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker’s skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim’s physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker’s protestations, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Heat Stress Safety Precautions

Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. A minimum work rest regimen and procedures for calculating ambient adjusted temperature are described in Table 4-1.

TABLE 4-1
WORK/REST SCHEDULE

Adjusted Temperature[b]	Work/Rest Regimen Normal Work Ensemble[c]	Work/Rest Regimen Impermeable Ensemble
90ºF (32.2ºC) or above	After each 45 minutes of work	After each 15 minutes of work
87.5º - 90ºF (30.8º-32.2ºC)	After each 60 minutes of work	After each 30 minutes of work
82.5º - 87.5ºF (28.1º - 30.8ºC)	After each 90 minutes of work	After each 60 minutes of work
77.5º - 82.5ºF (25.3º - 28.1ºC)	After each 120 minutes of work	After each 90 minutes of work
72.5º - 77.5ºF (30.8º - 32.2ºC)	After each 150 minutes of work	After each 120 minutes of work

Notes:

[a] For work levels of 250 kilocalories/hour (Light-Moderate Type of Work)

[b] Calculate the adjusted air temperature (ta adj) by using this equation: ta adj ºF = ta ºF + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

[d] The information presented above was generated using the information provided in the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) Handbook.

In order to determine if the work rest cycles are adequate for the personnel and specific site conditions, additional monitoring of individual heart rates will be conducted during the rest cycle. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

Additionally, one or more of the following control measures can be used to help control heat stress and are mandatory if any site worker has a heart rate (measure immediately prior to rest period) exceeding 115 beats per minute:

- Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day.
- On-site drinking water will be kept cool (50 to 60°F).
- A work regimen that will provide adequate rest periods for cooling down will be established, as required.
- All personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- Cooling devices, such as vortex tubes or cooling vests, should be used when personnel must wear impermeable clothing in conditions of extreme heat.
- Employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary.
- A shaded rest area must be provided. All breaks should take place in the shaded rest area.

- Employees must not be assigned to other tasks during breaks.

- Employees must remove impermeable garments during rest periods. This includes white Tyvek®-type garments.

All employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

4.4 Cold Stress

Cold stress normally occurs in temperatures at or below freezing, or under certain circumstances, in temperatures of 40°F. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body that have high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. Two factors influence the development of a cold weather injury: ambient temperature and the velocity of the wind. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at 18°F. An equivalent chill temperature chart relating the actual dry bulb temperature and wind velocity is presented in Table 4-2.

TABLE 4-2
CHILL TEMPERATURE CHART

Estimated Wind Speed (in mph)	**Actual Temperature Reading (ºF)**											
	50	**40**	**30**	**20**	**10**	**0**	**-10**	**-20**	**-30**	**-40**	**-50**	**-60**
	Equivalent Chill Temperature (ºF)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	**LITTLE DANGER** **Maximum danger of false sense of security.**				**INCREASING DANGER** **Danger from freezing of exposed flesh within one minute.**			**GREAT DANGER** **Flesh may freeze within 30 seconds.**				
	Trench foot and immersion foot may occur at any point on this chart.											

[This chart was developed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA (Source: ACGIH Threshold Limit Values for Chemical Substances and Physical Agents)].

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of tissue damage associated with frostbite. Frostbite of the extremities can be categorized into:

- *Frost Nip or Incipient Frostbite* - characterized by sudden blanching or whitening of skin.
- *Superficial Frostbite* - skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- *Deep Frostbite* - tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. It can be fatal. Its symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and 5) death. Trauma sustained in freezing or sub-zero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment. To avoid cold stress, site personnel must wear protective clothing appropriate for the level of cold and physical activity. In addition to protective clothing, preventive safe work practices, additional training, and warming regimens may be utilized to prevent cold stress.

Safety Precautions for Cold Stress Prevention

For air temperature of 0°F or less, mittens should be used to protect the hands. For exposed skin, continuous exposure should not be permitted when air speed and temperature results in a wind chill temperature of -25°F.

At air temperatures of 36°F or less, field personnel who become immersed in water or whose clothing becomes wet must be immediately provided with a change of clothing and be treated for hypothermia.

If work is done at normal temperature or in a hot environment before entering the cold, the field personnel must ensure that their clothing is not wet as a consequence of sweating. If wet, field personnel must change into dry clothes prior to entering the cold area.

If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work must be modified or suspended until adequate clothing is made available or until weather conditions improve.

Field personnel handling evaporative liquid (e.g., gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F must take special precaution to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling.

Safe Work Practices

Direct contact between bare skin and cold surfaces (< 20°F) should be avoided. Metal tool handles and/or equipment controls should be covered by thermal insulating material.

For work performed in a wind chill temperature at or below 10°F, workers should be under constant protective observation (buddy system). The work rate should be established to prevent heavy sweating that will result in wet clothing. For heavy work, rest periods must be taken in heated shelters and workers should be provided with an opportunity to change into dry clothing if needed.

Field personnel should be provided the opportunity to become accustomed to cold-weather working conditions and required protective clothing.

Work should be arranged in such a way that sitting or standing still for long periods is minimized.

During the warming regimen (rest period), field personnel should be encouraged to remove outer clothing to permit sweat evaporation or to change into dry work clothing. Dehydration, or loss of body fluids, occurs insidiously in the cold environment and may increase susceptibility to cold injury due to a significant change in blood flow to the extremities. Fluid replacement with warm, sweet drinks and soups is recommended. The intake of coffee should be limited because of diuretic and circulatory effects.

4.5 Biological Hazards

Biological hazards may include poison ivy, snakes, thorny bushes and trees, ticks, mosquitoes, and other pests.

4.5.1 Tick Borne Diseases

Lyme Disease - The disease commonly occurs in summer and is transmitted by the bite of infected ticks. “Hot spots” in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

Erlichiosis - The disease also commonly occurs in summer and is transmitted by the bite of infected ticks. “Hot spots” in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

These diseases are transmitted primarily by the deer tick, which is smaller and redder than the common wood tick. The disease may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull’s eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, and swelling and pain in the joints, and eventually, arthritis. Symptoms of erlichiosis include muscle and joint aches, flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever (RMSF) - This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (Rickettsia rickettsii) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for two to three weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death, if untreated, but if identified and treated promptly, death is uncommon.

Control - Tick repellant containing diethyltoluamide (DEET) should be used when working in tick-infested areas, and pant legs should be tucked into boots. In addition, workers should search the entire body every three or four hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

4.5.2 Poisonous Plants

Poisonous plants may be present in the work area. Personnel should be alerted to its presence, and instructed on methods to prevent exposure.

Control - The main control is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance. If skin contact is made, the area should be washed immediately with soap and water, and observed for signs of reddening.

4.5.3 Snakes

The possibility of encountering snakes exists, specifically for personnel working in wooded/vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snakebites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control - To minimize the threat of snakebites, all personnel walking through vegetated areas must be aware of the potential for encountering snakes, and the need to avoid actions potentiating encounters, such as turning over logs, etc. If a snakebite occurs, an attempt should be made to safely kill the snake for identification. The victim must be transported to the nearest hospital within 30 minutes; first aid consists of applying a constriction band, and washing the area around the wound to remove any unabsorbed venom.

4.5.4 Spiders

Personnel may encounter spiders during work activities.

Two spiders are of concern, the black widow and the brown recluse. Both prefer dark sheltered areas such as basements, equipment sheds and enclosures, and around woodpiles or other scattered debris. The black widow is shiny black, approximately one inch long, and found throughout the United States. There is a distinctive red hourglass marking on the underside of the black widows body. The bite of a black widow is seldom fatal to healthy adults, but effects include respiratory distress, nausea, vomiting, and muscle spasms. The brown recluse is smaller than the black widow and gets its name from its brown coloring and behavior. The brown recluse is more prevalent in the southern United States. The brown recluse has a distinctive violin shape on the top of its body. The bite of the brown recluse is painful and the bite site ulcerates and takes many weeks to heal completely.

Control - To minimize the threat of spider bites, all personnel walking through vegetated areas must be aware of the potential for encountering these arachnids. Personnel need to avoid actions that may result in encounters, such as turning over logs, and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures. If a spider bite occurs, the victim must be transported to the nearest hospital as soon as possible; first aid consists of applying ice packs and washing the area around the wound to remove any unabsorbed venom.

4.6 Noise

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on site.

Control - All personnel must wear hearing protection, with a Noise Reduction Rating (NRR) of at least 20, when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Section 6.2, Noise Monitoring.

Whenever possible, equipment that does not generate excessive noise levels will be selected for this project. If the use of noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, if feasible.

4.7 Spill Control

All personnel must take every precaution to minimize the potential for spills during site operations. All on-site personnel shall immediately report any discharge, no matter how small, to the SS.

Spill control equipment and materials will be located on the site at locations that present the potential for discharge. All sorbent materials used for the cleanup of spills will be containerized and labeled appropriately. In the event of a spill, the SS will follow the provisions in Section 9, Emergency Procedures, to contain and control released materials and to prevent their spread to off-site areas.

4.8 Sanitation

Site sanitation will be maintained according to OSHA requirements.

4.8.1 Break Area

Breaks must be taken in the SZ, away from the active work area after site personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in any area other than the SZ.

4.8.2 Potable Water

The following rules apply to all field operations:

- An adequate supply of potable water will be provided at each project site. Potable water must be kept away from hazardous materials or media, and contaminated clothing or equipment.

- Portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be consumed directly from the container (drinking from the tap is prohibited) nor may it be removed from the container by dipping.

- Containers used for drinking water must be clearly marked and shall not be used for any other purpose.

- Disposable drinking cups must be provided. A sanitary container for dispensing cups and a receptacle for disposing of used cups is required.

4.8.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking, or alternate methods such as waterless hand-cleaner and paper towels will be provided.

4.8.4 Lavatory

If permanent toilet facilities are not available, an appropriate number of portable chemical toilets will be provided. This requirement does not apply to mobile crews or to normally unattended site locations so long as employees at these locations have transportation immediately available to nearby toilet facilities.

4.9 Emergency Equipment

Adequate emergency equipment for the activities being conducted on site and as required by applicable sections of 29 CFR 1910 and 29 CFR 1926 will be on site prior to the commencement of project activities. Personnel will be provided with access to emergency equipment, including, but not limited to, the following:

- Fire extinguishers of adequate size, class, number, and location as required by applicable sections of 29 CFR 1910 and 1926;
- Industrial first aid kits of adequate size for the number of personnel on site; and
- Emergency eyewash and/or shower if required by operations being conducted on site.

4.10 Lockout/Tagout Procedures

Only fully qualified and trained personnel will perform maintenance procedures. Before maintenance begins, lockout/tagout procedures per OSHA 29 CFR 1910.147 will be followed.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy or material-isolating device such that the equipment cannot be operated until the lockout device is removed. If a device cannot be locked out, a tagout system shall be used. Tagout is the placement of a warning tag on an energy or material isolating device indicating that the equipment controls may not be operated until the tag is removed by the personnel who attached the tag.

4.11 Electrical Safety

Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. If wiring or other electrical work is needed, a qualified electrician must perform it.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations.
- Portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle.

- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double insulated tools must be distinctly marked and listed by UL or FM.

- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them.

- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.

- All circuits must be protected from overload.

- Temporary power lines, switchboxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage.

- Plugs and receptacles must be kept out of water unless of an approved submersible construction.

- All extension cord outlets must be equipped with ground fault circuit interrupters (GFCI).

- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment.

- Extension cords or cables must be inspected prior to each use, and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire.

- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

4.12 Lifting Safety

Using proper lifting techniques may prevent back strain or injury. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone.

- The hands and the object should be free of dirt or grease that could prevent a firm grip.

- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces.

- Fingers must be kept away from points that could crush or pinch them, especially when putting an object down.

- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.

- The load should be kept as low as possible, close to the body with the knees bent.

- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.

- A worker should not carry a load that he or she cannot see around or over.

- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

4.13 Ladder Safety

When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet (.9 m) above the upper landing surface to which the ladder is used to gain access; or, when such an extension is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder deflection under a load would, by itself, cause the ladder to slip off its support.

- Ladders shall be maintained free of oil, grease, and other slipping hazards.

- Ladders shall not be loaded beyond the maximum intended load for which they were built, nor beyond their manufacturer's rated capacity.

- Ladders shall be used only for the purpose for which they were designed.

- Non-self-supporting ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder (the distance along the ladder between the foot and the top support).

- Wood job-made ladders with spliced side rails shall be used at an angle such that the horizontal distance is one-eighth the working length of the ladder.

- Fixed ladders shall be used at a pitch no greater than 90 degrees from the horizontal, as measured to the back side of the ladder.

- Ladders shall be used only on stable and level surfaces unless secured to prevent accidental displacement.

- Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces, including, but not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery.

- Ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, shall be secured to prevent accidental displacement, or a barricade shall be used to keep the activities or traffic away from the ladder.

- The area around the top and bottom of ladders shall be kept clear.

- The top of a non-self-supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment.

- Ladders shall not be moved, shifted, or extended while occupied.

- Ladders shall have non-conductive siderails if they are used where the employee or the ladder could contact exposed energized electrical equipment.

- The top, top step, or the step labeled that it or any step above it should not be used as a step.

- Cross-bracing on the rear section of stepladders shall not be used for climbing unless the ladders are designed and provided with steps for climbing on both front and rear sections.

- Ladders shall be inspected by the HSO for visible defects on a daily basis and after any occurrence that could affect their safe use.

- Portable ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; corroded components; or other faulty or defective components shall either be immediately marked in a manner that readily identifies them as defective, or be tagged with “Do Not Use” or similar language, and shall be withdrawn from service.

- Fixed ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; or corroded components; shall be withdrawn from service.

- Ladder repairs shall restore the ladder to a condition meeting its original design criteria, before the ladder is returned to use.

- Single-rail ladders shall not be used.

- When ascending or descending a ladder, the user shall face the ladder.

- Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder.

- An employee shall not carry any object or load that could cause the employee to lose balance and fall.

4.14 Traffic Safety

The project site may be located adjacent to a public roadway where exposure to vehicular traffic is likely. Traffic may also be encountered as vehicles enter and exit the area. To minimize the likelihood of project personnel and activities being affected by traffic, the following procedures will be implemented.

Cones must be placed along the shoulder of the roadway starting 100 feet from the work area to alert passing motorists to the presence of personnel and equipment. A “Slow” or “Men Working” sign must be placed at the first cone. Barricades with flashing lights should be placed between the roadway and the work area.

During activities along a roadway, equipment will be aligned parallel to the roadway to the extent feasible, facing into the oncoming traffic so as to place a barrier between the work crew and the oncoming traffic. All crewmembers must remain behind the equipment and the traffic barrier.

All site personnel who are potentially exposed to vehicular traffic must wear an outer layer of orange warning garments, such as vests, jackets, or shirts. If work is performed in hours of dusk or darkness, workers will be outfitted with reflective garments either orange, white (including silver-coated reflective coatings or elements that reflect white light), yellow, fluorescent red-orange, or fluorescent yellow-orange.

The flow of traffic into and out of the adjacent business must be assessed, and precautions taken to warn motorists of the presence of workers and equipment. Where possible, vehicles should be aligned to provide physical protection of people and equipment.

5. Personal Protective Equipment

5.1 Levels of Protection

PPE is required to safeguard site personnel from various hazards. Varying levels of protection may be required depending on the levels of COC and the degree of physical hazard. This section presents the various levels of protection and defines the conditions of use for each level. A summary of the levels is presented in Table 5-1 in this section.

5.1.1 Level D Protection

The minimum level of protection that will be required of BBL personnel and subcontractors at the site will be Level D, which will be worn when site conditions or air monitoring indicates no inhalation hazard exists. The following equipment will be used:

- Work clothing as prescribed by weather;
- Steel toe work boots, meeting ANSI Z41;
- Safety glasses or goggles, meeting ANSI Z87;
- Hard hat, meeting ANSI Z89, when falling object hazards are present; and
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used).

5.1.2 Modified Level D Protection

Modified Level D will be used when airborne contaminants are not present at levels of concern, but site activities present an increased potential for skin contact with contaminated materials. Modified Level D consists of Level D plus any of the following:

- Nitrile outer gloves worn over nitrile surgical gloves;
- Tyvek® coveralls (polyethylene coated Tyvek® suits for handling liquids) when body contact with COC-impacted media is anticipated;
- Latex/PVC overboots when contact with COC-impacted media is anticipated; or
- Face shield in addition to safety glasses or goggles when projectiles or splash hazards exist.

5.1.3 Level C Protection

Level C protection will be required when the airborne concentration of COC reaches one-half of the OSHA Permissible Exposure Limit (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). The following equipment will be used for Level C protection:

- Full-face, air-purifying respirator with combination organic vapor, acid gas, and HEPA cartridges;
- Polyethylene-coated Tyvek® suit, with ankles and cuffs taped to boots and gloves;
- Nitrile gloves worn over nitrile surgical gloves;
- Steel toe work boots, meeting ANSI Z41;
- Chemical resistant boots with steel toes or latex/PVC overboots over steel toe boots;
- Hard hat, meeting ANSI Z89; and
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used).

5.2 Selection of PPE

Equipment for personal protection will be selected based on the potential for contact, site conditions, ambient air quality, and the judgment of supervising site personnel and health and safety professionals. The PPE used will be chosen to be effective against the COC present on the site.

5.3 Site Respiratory Protection Program

Respiratory protection is an integral part of employee health and safety at the site due to potentially hazardous concentrations of airborne COC. The site respiratory protection program will consist of the following (as a minimum):

- All on-site personnel who may use respiratory protection will have an assigned respirator.
- All on-site personnel who may use respiratory protection will have been fit tested and trained in the use of a full-face air-purifying respirator within the past 12 months.
- All on-site personnel who may use respiratory protection must within the past year have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSS, prior to commencement of site work.
- Only cleaned, maintained, NIOSH-approved respirators will be used.
- If respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs.
- Contact lenses are not to be worn when a respirator is worn.

- All on-site personnel who may use respiratory protection must be clean-shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator.

- Respirators will be inspected, and a negative pressure test performed prior to each use.

- After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the face piece.

5.4 Using PPE

Depending upon the level of protection selected, specific donning and doffing procedures may be required. The procedures presented in this section are mandatory if Modified Level D or Level C PPE is used. All personnel entering the EZ must put on the required PPE in accordance with the requirements of this HASP. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of COC.

5.4.1 Donning Procedures

These procedures are mandatory only if Modified Level D or Level C PPE is used on the site:

- Remove bulky outerwear. Remove street clothes and store in clean location;
- Put on work clothes or coveralls;
- Put on the required chemical protective coveralls;
- Put on the required chemical protective boots or boot covers;
- Tape the legs of the coveralls to the boots with duct tape;
- Put on the required chemical protective gloves;
- Tape the wrists of the protective coveralls to the gloves;
- Don the required respirator and perform appropriate fit check (Level C);
- Put hood or head covering over head and respirator straps and tape hood to facepiece (Level C); and
- Don remaining PPE, such as safety glasses or goggles and hard hat.

When these procedures are instituted, one person must remain outside the work area to ensure that each person entering has the proper protective equipment.

5.4.2 Doffing Procedures

The following procedures are only mandatory if Modified Level D or Level C PPE is required for the site. Whenever a person leaves the work area, the following decontamination sequence will be followed:

- Upon entering the CRZ, rinse contaminated materials from the boots or remove contaminated boot covers;

- Clean reusable protective equipment;

- Remove protective garments, equipment, and respirator (Level C). All disposable clothing should be placed in plastic bags, which are labeled with contaminated waste labels;

- Wash hands, face, and neck (or shower if necessary);
- Proceed to clean area and dress in clean clothing; and
- Clean and disinfect respirator for next use.

All disposable equipment, garments, and PPE must be bagged in plastic bags, labeled for disposal. See Section 7, Decontamination, for detailed information on decontamination stations.

5.5 Selection Matrix

The level of personal protection selected will be based on air monitoring of the work environment and an assessment by the SS and HSS of the potential for skin contact with COC. The PPE selection matrix is presented in Table 5-1. This matrix is based on information available at the time this plan was written. The Airborne Contaminant Action Levels in Table 8-1 should be used to verify that the PPE prescribed in these matrices is appropriate.

TABLE 5-1
PPE SELECTION MATRIX

Task	Anticipated Level of Protection
Mobilization	Level D
Installation of Groundwater Monitoring Wells and Soil Borings	Level D/Modified Level D
Groundwater Sampling and Monitoring	Level D/Modified Level D
Surface and Sub-surface Soil Sampling	Level D/Modified Level D
Decontamination	Level D/Modified Level D
Demobilization	Level D

6. Air Monitoring

6.1 Air Monitoring

If necessary, based on field observations and site conditions, air monitoring may be conducted to determine employee exposure to airborne constituents. The monitoring results will dictate work procedures and the selection of PPE. The monitoring devices to be used are an MIE Mini RAM particulate monitor (or equivalent) and a Rae Systems MultiRAE detector (PID with a 10.2 eV lamp/oxygen/LEL/Hydrogen Sulfide Sensors). The BBL HSS will be responsible for utilizing the air monitoring results to determine appropriate health and safety precautions for BBL personnel and subcontractors. Air monitoring results will be recorded in the field notebook or on an air monitoring log (see Attachment F).

Monitoring for oxygen, flammable vapors, and organic vapors will be conducted during excavation entry, should such entry become necessary.

Air monitoring will be conducted continuously with the LEL/Oxygen meter during drilling and excavation in areas where flammable vapors or gases are suspect. All work activity must stop where tests indicate the concentration of flammable vapors exceeds 10% of the LEL at a location with a potential ignition source. Such an area must be ventilated to reduce the concentration to an acceptable level. In areas where petroleum hydrocarbons are suspected, benzene detector tube readings must be taken if PID readings exceed 1ppm, and are sustained for 15 minutes in the breathing zone.

6.2 Noise Monitoring

Noise monitoring may be conducted as required. Hearing protection is mandatory for all employees in noise hazardous areas, such as around heavy equipment. As a general rule, sound levels that cause speech interference at normal conversation distance should require the use of hearing protection.

6.3 Monitoring Equipment Maintenance and Calibration

All direct-reading instrumentation calibrations should be conducted under the approximate environmental conditions the instrument will be used. Instruments must be calibrated before and after use, noting the reading(s) and any adjustments that are necessary. All air monitoring equipment calibrations, including the standard used for calibration, must be documented on a calibration log or in the field notebook. All completed HS documentation/forms must be reviewed by the HSS and maintained by the SS.

All air monitoring equipment will be maintained and calibrated in accordance with the specific manufacturer's procedures. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturer's procedures. When applicable, only manufacturer-trained and/or authorized personnel will be allowed to perform instrument repairs or preventive maintenance.

If an instrument is found to be inoperative or suspected of giving erroneous readings, the HSS must be responsible for immediately removing the instrument from service and obtaining a replacement unit. If the instrument is essential for safe operation during a specific activity, that activity must cease until an appropriate replacement unit is obtained. The HSS will be responsible for ensuring a replacement unit is obtained and/or repairs are initiated on the defective equipment.

6.4 Action Levels

Table 6-1 presents airborne contaminant action levels that will be used to determine the procedures and protective equipment necessary based on conditions as measured at the site.

TABLE 6-1
AIRBORNE CONTAMINANT ACTION LEVELS

Parameter	Reading	Action
Total Hydrocarbons	0 ppm to ≤ 1 ppm	Normal operations; continue hourly breathing zone monitoring
	> 1 ppm to 5 ppm	Increase monitoring frequency to every 15 minutes and use benzene detector tube to screen for the presence of benzene
	≥ 5 ppm to ≤ 50 ppm	Upgrade to Level C PPE; continue screening for benzene
	> 50 ppm	Stop work; investigate cause of reading
Benzene	≥ 1 ppm to 5 ppm	Upgrade to Level C PPE
	> 5 ppm	Stop work; investigate cause of reading, take action and resample
Airborne Particulates	0 to < 2.5 mg/m^3	Normal operations; continue hourly breathing zone monitoring
	≥ 2.5 mg/m^3 to 5 mg/m^3	Initiate dust suppression measures; if suppression measures are insufficient to reduce particulates below 5 mg/m^3, upgrade to Level C and increase monitoring frequency to every 15 minutes
Oxygen	≤ 19.5%	Stop work, evacuate work area, investigate cause of reading, and ventilate area
	> 19.5% to < 23.5%	Normal operations
	≥ 23.5%	Stop work, evacuate work area, investigate cause of reading, and ventilate area
Carbon Monoxide	0 ppm to ≤ 20 ppm	Normal operations
	> 20 ppm	Stop work, evacuate work area, investigate cause of reading, and ventilate area
Hydrogen Sulfide	0 ppm to ≤ 5 ppm	Normal operations
	> 5 ppm	Stop work, evacuate work area, investigate cause of reading, and ventilate area
Flammable Vapors (LEL)	< 10% LEL	Normal operations
	≥ 10% LEL	Stop work, ventilate area, investigate source of vapors

7. Work Zones and Decontamination

7.1 Work Zones

7.1.1 Authorization to Enter

Only personnel with the appropriate training and medical certifications (if respirators are required) will be allowed to work at the project site. The SS will maintain a list of authorized persons; only personnel on the authorized persons list will be allowed to enter the site work areas.

7.1.2 Site Orientation and Hazard Briefing

No person will be allowed in the work area during site operations without first being given a site orientation and hazard briefing. This orientation will be presented by the SS or HSS, and will consist of a review of this HASP. This review must cover the chemical, physical, and biological hazards, protective equipment, safe work procedures, and emergency procedures for the project. Following this initial meeting, daily safety meetings will be held each day before work begins.

All people entering the site work areas, including visitors, must document their attendance at this briefing, as well as the daily safety meetings on the forms included with this plan.

7.1.3 Certification Documents

A training and medical file may be established for the project and kept on site during all site operations. Specialty training, such as first aid/cardiopulmonary resuscitation (CPR) certificates, as well as current medical clearances for all project field personnel required to wear respirators, will be maintained within that file. All BBL and subcontractor personnel must provide their training and medical documentation to the HSS prior to starting work.

7.1.4 Entry Log

A log-in/log-out sheet will be maintained at the site by the SS. Personnel must sign in and out on a log sheet as they enter and leave the work area, and the SS may document entry and exit in the field notebook.

7.1.5 Entry Requirements

In addition to the authorization, hazard briefing, and certification requirements listed above, no person will be allowed in any BBL work area unless they are wearing the minimum PPE as described in Section 5, Personal Protective Equipment.

7.1.6 Emergency Entry and Exit

People who must enter the work area on an emergency basis will be briefed of the hazards by the SS. All activities will cease in the event of an emergency. People exiting the work area because of an emergency will gather in a safe area for a head count. The SS is responsible for ensuring that all people who entered the work area have exited in the event of an emergency.

7.1.7 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas.

7.1.7.1 Exclusion Zone

An EZ may consist of a specific work area, or may be the entire area of potential contamination. All employees entering an EZ must use the required PPE, and must have the appropriate training and medical clearance for hazardous waste work. The EZ is the defined area where there is a possible respiratory and/or contact health hazard. Cones, caution tape, or a site diagram will identify the location of each EZ.

7.1.7.2 Contamination Reduction Zone

The CRZ or transition area will be established, if necessary, to perform decontamination of personnel and equipment. All personnel entering or leaving the EZ will pass through this area to prevent any cross-contamination. Tools, equipment, and machinery will be decontaminated in a specific location. The decontamination of all personnel will be performed on site adjacent to the EZ. Personal protective outer garments and respiratory protection will be removed in the CRZ and prepared for cleaning or disposal. This zone is the only appropriate corridor between the EZ and the SZ.

7.1.7.3 Support Zone

The SZ is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the support area only after proper decontamination. Smoking may be permitted in the SZ, subject to site requirements.

7.1.8 Posting

Work areas will be prominently marked and delineated using cones, caution tape, or a site diagram.

7.1.9 Site Inspections

The SS will conduct a daily inspection of site activities, equipment, and procedures to verify that the required elements are in place. The Safety Inspection Form in Attachment D may be used as a guide for daily inspections. A monthly IPO must also be completed and forwarded to the PM for review.

7.2 Decontamination

7.2.1 Personnel Decontamination

All personnel wearing Modified Level D or Level C protective equipment in the EZ must undergo personal decontamination prior to entering the SZ. The personnel decontamination area will consist of the following stations at a minimum:

- *Station 1*: Personnel leaving the contaminated zone will remove the gross contamination from their outer clothing and boots.

- *Station 2*: Personnel will remove their outer garment and gloves and dispose of it in properly labeled containers. Personnel will then decontaminate their hard hats, and boots with an aqueous solution of detergent or other appropriate cleaning solution. These items are then hand carried to the next station.

- *Station 3*: Personnel will thoroughly wash their hands and face before leaving the CRZ. Respirators will be sanitized and then placed in a clean plastic bag.

7.2.2 Equipment Decontamination

All vehicles that have entered the EZ will be decontaminated at the decontamination pad prior to leaving the zone. If the level of vehicle contamination is low, decontamination may be limited to rinsing of tires and wheel wells with water. If the vehicle is significantly contaminated, steam cleaning or pressure washing of vehicles and equipment may be required.

7.2.3 Personal Protective Equipment Decontamination

Where and whenever possible, single-use, external protective clothing must be used for work within the EZ or CRZ. This protective clothing must be disposed of in properly labeled containers. Reusable protective clothing will be rinsed at the site with detergent and water. The rinsate will be collected for disposal.

When removed from the CRZ, the respirator will be thoroughly cleaned with soap and water. The respirator face piece, straps, valves, and covers must be thoroughly cleaned at the end of each work shift, and ready for use prior to the next shift. Respirator parts may be disinfected with a solution of bleach and water, or by using a spray disinfectant.

8. Training and Medical Surveillance

8.1 Training

8.1.1 General

All on-site project personnel who work in areas where they may be exposed to site contaminants must be trained as required by OSHA Regulation 29 CFR 1910.120 (HAZWOPER). Field employees exposed or potentially exposed over the permissible exposure limit (PEL) receive 40 hours of initial training and three days of actual field experience under the direct supervision of a trained, experienced supervisor. Field employees on site for a specific limited task such as groundwater monitoring/sampling, surveying, etc. and who are unlikely to be exposed over the PEL receive 24 hours of initial training and one day of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their initial training more than 12 months prior to the start of the project must have completed an eight-hour refresher course within the past 12 months. The SS must have completed an additional eight hours of supervisory training, and must have a current first-aid/CPR certificate.

8.1.2 Basic 40-Hour Course

The following is a list of the topics typically covered in a 40-hour HAZWOPER training course:

- General safety procedures;
- Physical hazards (fall protection, noise, heat stress, cold stress);
- Names and job descriptions of key personnel responsible for site health and safety;
- Safety, health, and other hazards typically present at hazardous waste sites;
- Use, application, and limitations of PPE;
- Work practices by which employees can minimize risks from hazards;
- Safe use of engineering controls and equipment on site;
- Medical surveillance requirements;
- Recognition of symptoms and signs which might indicate overexposure to hazards;
- Worker right-to-know (Hazard Communication OSHA 1910.1200);
- Routes of exposure to contaminants;
- Engineering controls and safe work practices;
- Components of a health and safety program and a site-specific HASP;
- Decontamination practices for personnel and equipment;
- Confined-space entry procedures; and
- General emergency response procedures.

8.1.3 Supervisor Course

Management and supervisors must receive an additional eight hours of training, which typically includes:

- General site safety and health procedures;
- PPE programs; and
- Air monitoring techniques.

8.1.4 Site-Specific Training

Site-specific training will be accomplished by on-site personnel reading this HASP, or through a thorough site briefing by the PM, SS, or HSS on the contents of this HASP before work begins. The review must include a discussion of the chemical, physical, and biological hazards; the protective equipment and safety procedures; and emergency procedures.

8.1.5 Daily Safety Meetings

Daily safety meetings will be held to cover the work to be accomplished, the hazards anticipated, the PPE and procedures required to minimize site hazards, and emergency procedures. The SS or HSS should present these meetings prior to beginning the day's fieldwork. No work will be performed in an EZ before the daily safety meeting has been held. The daily safety meeting must also be held prior to new tasks, and repeated if new hazards are encountered. The Daily Safety Meeting Log is included in Attachment E.

8.1.6 First Aid and CPR

At least one employee current in first aid/CPR will be assigned to the work crew and will be on the site during operations. Refresher training in first aid (triennially) and CPR (annually) is required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

8.2 Medical Surveillance

8.2.1 Medical Examination

All personnel who are potentially exposed to site contaminants must participate in a medical surveillance program as defined by OSHA at 29 CFR 1910.120 (f).

8.2.2 Pre-placement Medical Examination

All potentially exposed personnel must have completed a comprehensive medical examination prior to assignment, and periodically thereafter as defined by applicable regulations. The pre-placement and periodic medical examinations typically include the following elements:

- Medical and occupational history questionnaire;
- Physical examination;
- Complete blood count, with differential;
- Liver enzyme profile;
- Chest X-ray, at a frequency determined by the physician;
- Pulmonary function test;
- Audiogram;
- Electrocardiogram for persons older than 45 years of age, or if indicated during the physical examination;
- Drug and alcohol screening, as required by job assignment;
- Visual acuity; and
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director.

The examining physician provides the employee with a letter summarizing his findings and recommendations, confirming the worker's fitness for work and ability to wear a respirator. Documentation of medical clearance will be available for each employee during all project site work.

Subcontractors will certify that all their employees have successfully completed a physical examination by a qualified physician. The physical examinations must meet the requirements of 29 CFR 1910.120 and 29 CFR 1910.134. Subcontractors will supply copies of the medical examination certificate for each on-site employee.

8.2.3 Other Medical Examinations

In addition to pre-employment, annual, and exit physicals, personnel may be examined:

- At employee request after known or suspected exposure to toxic or hazardous materials; and

- At the discretion of the HSS, HSO, or occupational physician in anticipation of, or after known or suspected exposure to toxic or hazardous materials.

8.2.4 Periodic Exam

Following the placement examination, all employees must undergo a periodic examination, similar in scope to the placement examination. For employees potentially exposed over 30 days per year, the frequency of periodic examinations will be annual. For employees potentially exposed less than 30 days per year, the frequency for periodic examinations will be 18 months.

8.2.5 Medical Restriction

When the examining physician identifies a need to restrict work activity, the employee's supervisor must communicate the restriction to the employee and the HSS. The terms of the restriction will be discussed with the employee and the supervisor.

9. Emergency Procedures

9.1 General

Prior to the start of operations, the work area will be evaluated for the potential for fire, contaminant release, or other catastrophic event. Unusual conditions or events, activities, chemicals, and conditions will be reported to the SS/HSS immediately.

The SS/HSS will establish evacuation routes and assembly areas for the site. All personnel entering the site will be informed of this route and the assembly area.

9.2 Emergency Response

If an incident occurs, the following steps will be taken:

- The SS/HSS will evaluate the incident and assess the need for assistance and/or evacuation;
- The SS/HSS will call for outside assistance as needed;
- The SS/HSS will ensure the PM is notified promptly of the incident; and
- The SS/HSS will take appropriate measures to stabilize the incident scene.

9.2.1 Fire

In the case of a fire at the site, the SS/HSS will assess the situation and direct fire-fighting activities. The SS/HSS will ensure that the PM is immediately notified of any fires. Site personnel will attempt to extinguish the fire with available extinguishers, if safe to do so. In the event of a fire that site personnel are unable to safely extinguish with one fire extinguisher, the local fire department will be summoned.

9.2.2 Contaminant Release

In the event of a contaminant release, the following steps will be taken:

- Notify SS/HSS immediately;
- Evacuate immediate area of release;
- Conduct air monitoring to determine needed level of PPE; and
- Don required level of PPE and prepare to implement control procedures.

The SS/HSS has the authority to commit resources as needed to contain and control released material and to prevent its spread to off-site areas.

9.3 Medical Emergency

All employee injuries must be promptly reported to the HSS/SS, who will:

- Ensure that the injured employee receives prompt first aid and medical attention;
- In emergency situations, the worker is to be transported by appropriate means to the nearest urgent care facility (normally a hospital emergency room); and
- If the injured person is a BBL employee, notify Continuum Healthcare, BBL's medical surveillance consultant, as soon as possible after an injured worker has left the site. The caller should dial 1-800-229-3674 and follow the instructions for reaching the Injury Management Office. When the Case Manager answers, the caller should provide the information requested by the Case Manager.

9.3.1 Emergency Care Steps

Survey the scene. Determine if it is safe to proceed. Try to determine if the conditions that caused the incident are still a threat. Protect yourself from exposure before attempting to rescue the victim.

- Do a primary survey of the victim. Check for airway obstruction, breathing, and pulse. Assess likely routes of chemical exposure by examining the eyes, mouth, nose, and skin of the victim for symptoms.
- Phone Emergency Medical Services (EMS). Give the location, telephone number used, caller's name, what happened, number of victims, victim's condition, and help being given.
- Maintain airway and perform rescue breathing as necessary.
- Perform CPR as necessary.
- Do a secondary survey of the victim. Check vital signs and do a head-to-toe exam.

Treat other conditions as necessary. If the victim can be moved, take him/her to a location away from the work area where EMS can gain access.

9.4 First Aid - General

All persons must report any injury or illness to their immediate supervisor or the SS. Trained personnel will provide first aid. Injuries and illnesses requiring medical treatment must be documented. The SS and HSS must conduct an II as soon as emergency conditions no longer exist and first aid and/or medical treatment has been ensured. IIs must be completed and submitted to the PM within 24 hours after the incident.

If first-aid treatment is required, first aid kits are kept at the CRZ. If treatment beyond first aid is required, the injured person(s) should be transported to the medical facility. If the injured person is not ambulatory, or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.

9.4.1 First Aid - Inhalation

Any employee complaining of symptoms of chemical overexposure as described in Section 4, General Site Safety Procedures, will be removed from the work area and transported to the designated medical facility for examination and treatment.

9.4.2 First Aid - Ingestion

Call EMS and consult a poison control center for advice. If available, refer to the MSDS for treatment information. If the victim is unconscious, keep them on their side and clear the airway if vomiting occurs.

9.4.3 First Aid - Skin Contact

Project personnel who have had skin contact with contaminants will, unless the contact is severe, proceed through the CRZ, to the wash area. Personnel will remove any contaminated clothing, and then flush the affected area with water for at least 15 minutes. The worker should be transported to the medical facility if he/she shows any sign of skin reddening, irritation, or if he/she requests a medical examination.

9.4.4 First Aid - Eye Contact

Project personnel who have had contaminants splashed in their eyes or who have experienced eye irritation while in the EZ, must immediately proceed to the eyewash station in the CRZ. Do not decontaminate prior to using the eyewash. Remove whatever protective clothing is necessary to use the eyewash. Flush the eye with clean running water for at least 15 minutes. Arrange prompt transport to the designated medical facility.

9.5 Reporting Injuries, Illnesses, and Near Miss Incidents

Injuries and illnesses, however minor, will be reported to the SS immediately. The SS will complete an injury report and submit it to the HSO and the PM within 24 hours.

Near miss incidents are situations in which no injury or property damage occurred, but under slightly different circumstances an injury or property damage could have occurred. Near misses are caused by the same factors as injuries; therefore, they must be reported and investigated in the same manner. A SPSA must be done immediately after an injury, illness, near miss, or other incident to determine if it is safe to proceed with the work.

9.6 Emergency Information

The means to summon local public response agencies such as police, fire, and ambulance will be reviewed in the daily safety meeting. These agencies are identified in Table 9-1.

TABLE 9-1
EMERGENCY CONTACTS

Local Emergency Contacts	Telephone No.
Fire	911
Police	911
Ambulance	911
Hospital: St. Joseph's Hospital	(607) 737-1123
Project Emergency Contacts	**Telephone No.**
BBL Project Manager:	(315) 446-9120 ext. 456
BBL Site Supervisor:	(315) 446-9120 ext. 323
BBL Health and Safety Supervisor:	(315) 446-9120 ext. 323
Client:	(607) 762-8787
Agency:	(518) 457-4343

9.6.1 Directions to Hospital (Non-emergency)

See Figure 1.

Figure

Figure 1 – Hospital Route Map

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engineers & scientists

MAPQUEST

Send To Printer Back To Directions

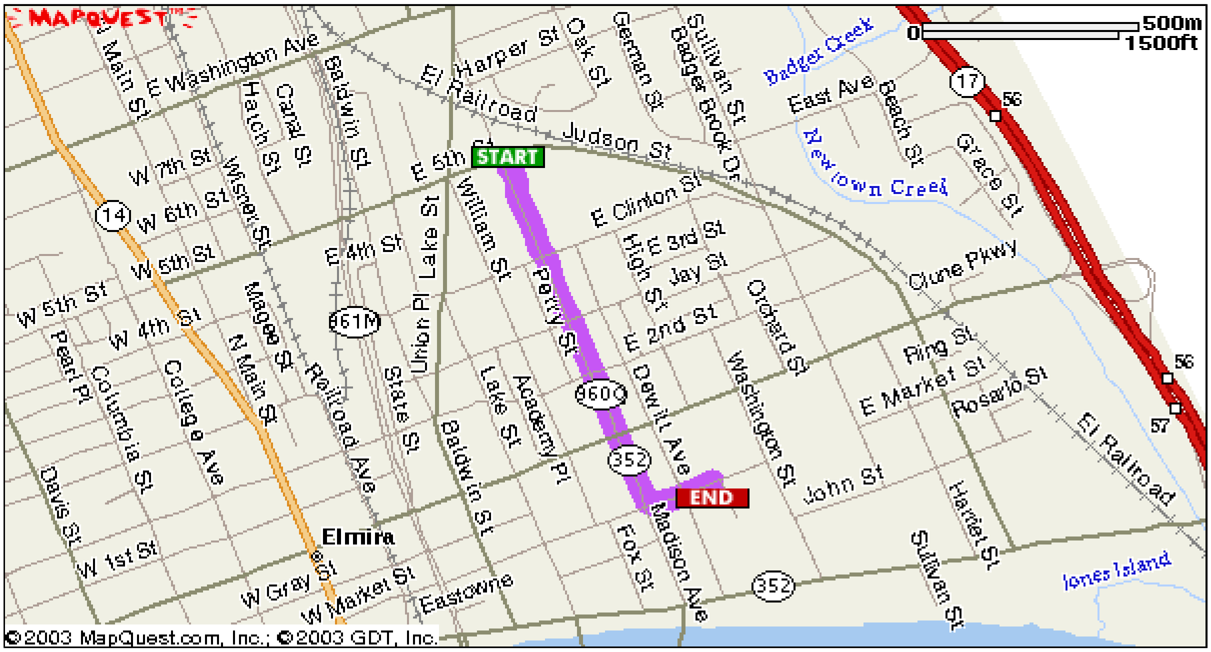
Start: Madison Ave & E 5th St
Elmira, NY
14901 US

End: 555 E Market St
Elmira, NY
14901-3223 US

Distance: 0.66 miles

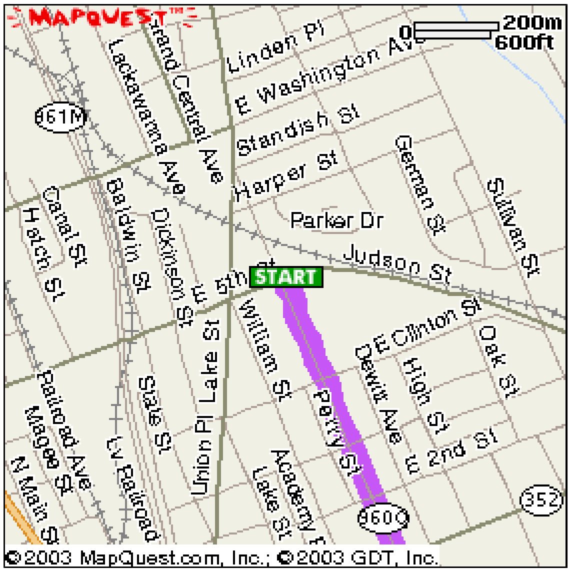
Total Estimated Time: 2 minutes

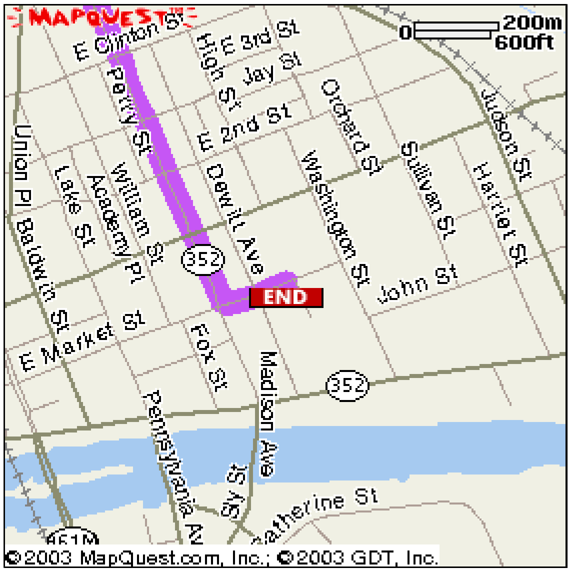
	✔ **Driving Directions**	**Distance**
☐	**1.** Start out going South on MADISON AVE toward E CLINTON ST.	0.56 Miles
☐	**2.** Turn LEFT onto E MARKET ST.	0.10 Miles



Start:
Madison Ave & E 5th St
Elmira, NY
14901 US

End:
555 E Market St
Elmira, NY
14901-3223 US





NAVTECH ON BOARD

Notes: ....

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Attachments

Attachment A

Material Safety Data Sheets

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2002-02

Benzene
BEN2200

Section 1 - Chemical Product and Company Identification 54

Material Name: Benzene **CAS Number:** 71-43-2
Chemical Formula: C_6H_6
Structural Chemical Formula: C_6H_6
Synonyms: Benzene; BENZENE; (6)ANNULENE; BENZEEN; BENZEN; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
General Use: Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzene	71-43-2	99.9

OSHA PEL
TWA: 1 ppm; 3 mg/m^3; STEL: 5 ppm.

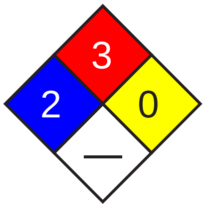
ACGIH TLV
TWA: 0.5 ppm, 1.6 mg/m^3; STEL: 2.5 ppm, 8 mg/m^3; skin.

NIOSH REL
TWA: 0.1 ppm; STEL: 1 ppm.

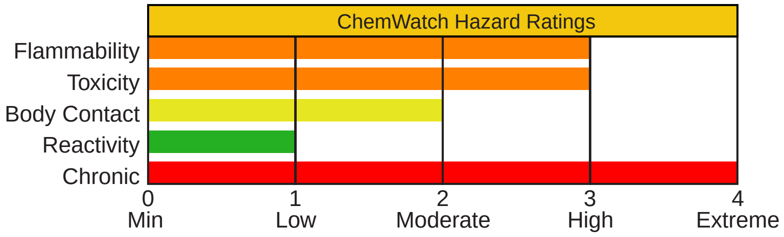
IDLH Level
500 ppm.

DFG (Germany) MAK
Skin

Section 3 - Hazards Identification



Fire Diamond



HMIS
③ Health
③ Flammability
⓪ Reactivity

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Also causes: headache, dizziness, drowsiness. Absorbed through the skin. Chronic: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

Potential Health Effects

Target Organs: blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

Inhalation hazard is increased at higher temperatures.

The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.

Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks.

Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.

Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.

Exposure to toxic levels has also produced chromosome damage.

Eye: The liquid is highly discomforting to the eyes, may be harmful following absorption and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is moderately discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.

Toxic effects may result from skin absorption.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.

Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.

Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals.

Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue.

Leukemia may develop.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

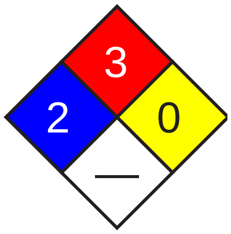
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Consider complete blood count. Evaluate history of exposure.

Section 5 - Fire-Fighting Measures

Flash Point: -11 °C Closed Cup
Autoignition Temperature: 562 °C
LEL: 1.3% v/v
UEL: 7.1% v/v



Fire Diamond

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

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

Large Spills: Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Storage Requirements: Store in original containers in approved flame-proof area.
No smoking, bare lights, heat or ignition sources.
DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.
Store away from incompatible materials in a cool, dry well ventilated area.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Nitrile gloves; Neoprene gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Note: must change cartridge at beginning of each shift

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
TEFLON	Best selection
VITON	Best selection
VITON/NEOPRENE	Best selection
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion

BUTYL	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER	Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

Physical State: Liquid
Vapor Pressure (kPa): 9.95 at 20 °C
Vapor Density (Air=1): 2.77
Formula Weight: 78.12
Specific Gravity (H_2O=1, at 4 °C): 0.879 at 20 °C
Water Solubility: 0.18 g/100 g of water at 25 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 80.1 °C (176 °F)
Freezing/Melting Point Range: 5.5 °C (41.9 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

TOXICITY
Oral (man) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 930 mg/kg
Inhalation (rat) LC_{50}: 10000 ppm/7h
Inhalation (human) LC_{Lo}: 2000 ppm/5m
Inhalation (man) TC_{Lo}: 150 ppm/1y - I
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

IRRITATION
Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See NIOSH, *RTECS* CY 1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

Ecotoxicity: LC_{50} Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); LD_{50} Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.3 x10^{-3}
BCF: eels 3.5
Biochemical Oxygen Demand (BOD): 1.2 lb/lb, 10 days
Octanol/Water Partition Coefficient: log K_{ow} = 2.13
Soil Sorption Partition Coefficient: K_{oc} = woodburn silt loam 31 to 143

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: BENZENE
Hazard Class: 3.1
ID No.: 1114
Packing Group: II
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U019 Toxic Waste, Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Issue Date: 2003-02

Benzo(a)pyrene
BEN5560

Section 1 - Chemical Product and Company Identification 43/57

Material Name: Benzo(a)pyrene **CAS Number:** 50-32-8
Chemical Formula: $C_{20}H_{12}$
EINECS Number: 200-028-5
Synonyms: B(A)P; BAP; BENZO(D,E,F)CHRYSENE; 3,4-BENZOPIRENE; 1,2-BENZOPYRENE; 3,4-BENZOPYRENE; 6,7-BENZOPYRENE; BENZO(A)PYRENE; 3,4-BENZPYREN; 3,4-BENZ(A)PYRENE; 3,4-BENZPYRENE; BENZ(A)PYRENE; BENZ[A]PYRENE; 3,4-BENZYLPYRENE; 3,4-BENZYPYRENE; 3,4-BP; BP; COAL TAR PITCH VOLATILES: BENZO(A)PYRENE
Derivation: Synthesized from pyrene and succinic anhydride.
General Use: Benzo(a)pyrene is no longer used or produced commercially in the US. In its pure form, benzo(a)pyrene may be used as a research laboratory reagent. It also occurs in combustion products of coal, oil, petroleum, wood and other biological matter; in motor vehicle and other gasoline and diesel engine exhaust; in charcoal-broiled foods; in cigarette smoke and general soot and smoke of industrial, municipal, and domestic origin. It occurs naturally in crude oils, shale oils, coal tars, gases and fly ash from active volcanoes and forest fires.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Benzo(a)pyrene	50-32-8	ca 100% wt

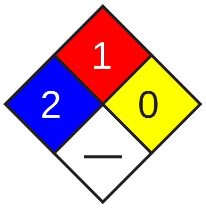
Except in laboratories, benzo(a)pyrene is usually mixed with other coal tar pitch chemicals. Consider exposure limits for coal tar pitch volatiles as a guideline. However, because benzo(a)pyrene is considered a probable carcinogen to humans, it is recommended that exposures to carcinogens be limited to the lowest feasible concentration.

OSHA PEL
TWA: 0.2 mg/m^3.

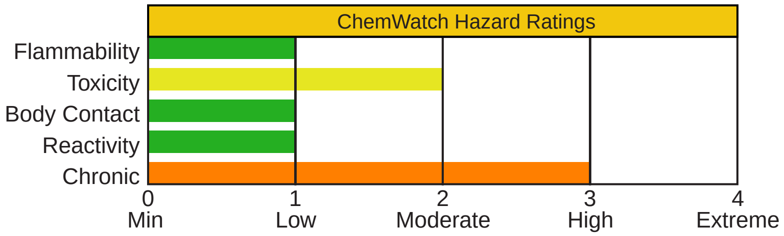
NIOSH REL
No data found.

ACGIH TLV
Exposure by all routes should be carefully controlled to levels as low as possible.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
1 Flammability
0 Reactivity

ANSI Signal Word
Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Benzo(a)pyrene is a pale yellow, crystalline solid or powder that is irritating to the skin, eyes, and respiratory tract. It is a carcinogen and mutagen. Handle with extreme caution!

Potential Health Effects

Target Organs: Respiratory system, bladder, kidneys, skin.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects
Inhalation: Respiratory tract irritation. Pregnant women may be especially susceptible to exposure effects of benzo(a)pyrene; exposure may damage the fetus. In general, polyaromatic hydrocarbons such as benzo(a)pyrene tend to localize primarily in body fat and fatty tissues (for ex. breasts) and are excreted in breast milk. Benzo(a)pyrene may also affect the male reproductive system (testes and sperm).
Eye: Irritation and/or burns on contact.

Skin: Irritation with burning sensation, rash, and redness; dermatitis on prolonged exposure. Sunlight enhances effects (photosensitization).

Ingestion: None reported.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Medical Conditions Aggravated by Long-Term Exposure: Respiratory system, bladder, kidney, and skin disorders.

Chronic Effects: Inhalation: Cough and bronchitis. Eye: Photosensitivity and irritation. Skin: Skin changes such as thickening, darkening, pimples, loss of color, reddish areas, thinning of the skin, and warts. Sunlight enhances effects (photosensitization). Other: Gastrointestinal (GI) effects include leukoplakia (a pre-cancerous condition characterized by thickened white patches of epithelium on mucous membranes, especially of the mouth). Cancer of the lung, skin, kidneys, bladder, or GI tract is also possible. Smoking in combination with exposure to benzo(a)pyrene increases the chances of developing lung cancer. Persons with a high degree of inducibility of the enzyme aryl hydrocarbon hydroxylase may be a high risk population.

Section 4 - First Aid Measures

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

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of tepid water for at least 15 min. Consult an ophthalmologist if irritation or pain persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water (less than 15 min). Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water to dilute. Inducing vomiting is not necessary since benzo(a)pyrene has a low acute toxicity and therefore, is generally an unnecessary procedure. Consider activated charcoal/cathartic.

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

Note to Physicians: Monitor CBC and arterial blood gases, conduct liver, renal, and pulmonary function tests (if respiratory tract irritation is present), and urinalysis. Biological monitoring techniques testing for metabolites in blood or urine, or DNA adducts in blood or tissues are useful for epidemiological studies that determine if exposure has occurred. Because neither normal nor toxic levels have been established, those techniques may not be useful for evaluating individual patients.

Special Precautions/Procedures: Emergency personnel should protect against exposure.

Section 5 - Fire-Fighting Measures

Flash Point: None reported. Benzo(a)pyrene may burn, but does *not* readily ignite.

Autoignition Temperature: None reported.

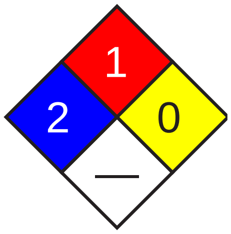
LEL: None reported.

UEL: None reported.

Extinguishing Media: For small fires, use dry chemical, sand, water spray, or foam. For large fires, use water spray, fog, or foam.

General Fire Hazards/Hazardous Combustion Products: Carbon monoxide and carbon dioxide.

Fire-Fighting Instructions: Isolate hazard and deny entry. If feasible and without undue risk, move containers from fire hazard area. Otherwise, cool fire-exposed containers with water spray until well after fire is extinguished. Do not release runoff from fire control methods to sewers or waterways. Because 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 and full protective clothing.



Fire Diamond

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel of large spills, remove heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and skin or eye contact. Clean up spills promptly.

Small Spills: Carefully scoop up spilled material and place into appropriate containers for disposal. For liquid spills, take up with a noncombustible, inert absorbent and place into appropriate containers for disposal.

Large Spills: For large spills, dike far ahead of liquid spill or contain dry spill for later disposal. Do not release into sewers or waterways. *Do not* dry sweep! Use a vacuum with a HEPA filter or a wet method to reduce dust. After cleanup is complete, thoroughly decontaminate all surfaces. *Do not* reuse contaminated cleaning materials.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Handle with extreme caution and take all necessary measures to avoid exposure to benzo(a)pyrene because it is a carcinogen and mutagen. Follow good personal hygiene procedures and thoroughly wash hands with soap and water after handling. Use safety pipettes for all pipetting.

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.

Recommended Storage Methods: Store in tightly closed and properly labeled containers in a cool, well-ventilated area.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use a Class I, Type B, biological safety hood when working with benzo(a)pyrene in a laboratory. Decrease the rate of air extraction, so that benzo(a)pyrene can be handled without powder being blown around the hood. Keep glove boxes under negative pressure. Use vertical laminar-flow, 100% exhaust, biological safety cabinets for containment of in vitro procedures. The exhaust air flow should be sufficient to provide an inward air flow at the face opening of the cabinet. Ensure contaminated air sheaths that are under positive pressure are leak-tight. Never use horizontal laminar-flow hoods or safety cabinets where filtered air is blown across the working area towards the operator. Test cabinets before work begins to ensure they are functioning properly. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical examinations with emphasis on the oral cavity, bladder, kidneys, skin, and respiratory tract. Conduct urinalysis including specific gravity, albumin, glucose, and microscopic examination of centrifuged sediment for red blood cells. Also, include 14" x 17" chest roentgenogram, FVC + FEV1, and CBC to detect any leukemia or aplastic anemia. It is recommended that this exam be repeated on an annual basis and semiannual basis for employees 45 yr of age or older or with 10 or more years of exposure to coal tar pitch volatiles. Train workers about the hazards of benzo(a)pyrene and the necessary protective measures to prevent exposure. Periodically inspect lab atmospheres, surfaces such as walls, floors, and benches, and interior of fume hoods and air ducts for contamination. Post appropriate signs and labels on doors leading into areas where benzo(a)pyrene is used.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. In animal laboratories, wear protective suits (disposable, one-piece and close-fitting at ankles and wrists), gloves, hair covering, and overshoes. In chemical laboratories, wear gloves and gowns. Wear protective eyeglasses or chemical safety, gas-proof goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. The following respirator recommendations are for coal tar pitch volatiles. For any unknown concentration, wear any SCBA with a full facepiece and operated in a pressure- demand or other positive pressure mode, or any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive pressure mode. For escape, wear any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter, or any appropriate escape-type SCBA. Select respirator based on its suitability to provide adequate worker protection for 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.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Shower and change clothes after exposure or at the end of the workshift. Separate contaminated work clothes from street clothes. Launder before reuse. Remove benzo(a)pyrene from your shoes and clean personal protective equipment. Use procedures to ensure laundry personnel are not exposed. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Pale yellow monoclinic needles with a faint, aromatic odor.

Physical State: Solid

Vapor Pressure (kPa): >1 mm Hg at 68 °F (20 °C)

Formula Weight: 252.30

Specific Gravity (H_2O=1, at 4 °C): 1.351

Boiling Point: >680 °F (>360 °C); 540 °F (310 °C) at 10 mm Hg

Freezing/Melting Point: 354 °F (179 °C)

Water Solubility: Insoluble; 0.0038 mg (+/- 0.00031 mg) in 1 L at 77 °F (25 °C)

Other Solubilities: Ether, benzene, toluene, xylene, concentrated hydrosulfuric acid; sparingly soluble in alcohol, methanol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Benzo(a)pyrene is stable at room temperature in closed containers under normal storage and handling conditions. It undergoes photo-oxidation when exposed to sunlight or light in organic solvents and is also oxidized by chromic acid and ozone. Hazardous polymerization cannot occur. Avoid heat and ignition sources and incompatibles.

Storage Incompatibilities: Strong oxidizers (chlorine, bromine, fluorine) and oxidizing chemicals (chlorates, perchlorates, permanganates, and nitrates).

Hazardous Decomposition Products: Thermal oxidative decomposition of benzo(a)pyrene can produce carbon monoxide and carbon dioxide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral: 15 mg/kg produced gastrointestinal and musculoskeletal tumors.

Irritation Effects:

Mouse: 14 µg caused mild irritation.

Other Effects:

Rat, oral: 40 mg/kg on the 14th day of pregnancy caused changes in the extra embryonic structures.

Rat, oral: 2 g/kg administered 28 days prior to mating and 1-22 days of pregnancy produced a stillbirth.

Tumorgenicity, mouse, oral: 75 mg/kg administered to the female during the 12- 14 day of pregnancy produced biochemical and metabolic effects on the newborn.

Mouse, inhalation: 200 ng/m^3/6 hr administered intermittently over 13 weeks produced tumors of the lungs.

Human, HeLa cell: 1500 nmol/L caused DNA inhibition.

Human, lung cell: 1 µmol/L caused DNA damage.

Human, liver cell: 100 nmol/L caused DNA damage.

Rabbit, skin: 17 mg/kg administered intermittently over 57 weeks produced tumors of the skin and appendages.

See NIOSH, *RTECS* DJ3675000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to water, benzo(a)pyrene adsorbs very strongly to particulate matter and sediments, bioconcentrates in aquatic organisms which cannot metabolize it, but does not hydrolyze. Direct photolysis at the water surface, evaporation, or biodegradation may be important, but adsorption may significantly retard these processes. Adsorption to particulates may also retard direct photolysis when benzo(a)pyrene is released to air. Benzo(a)pyrene may be removed from air by reaction with nitrogen dioxide (half-life, 7 days) or ozone (half-life, 37 min), or photochemically produced hydroxyl radicals (estimated half-life, 21.49 hr). It will adsorb very strongly to the soil. Although it is not expected to appreciably leach to the groundwater, groundwater samples indicate that it can be transported there. It is not expected to significantly evaporate or hydrolyze from soils and surfaces. However, it may be subject to appreciable biodegradation in soils. It will adsorb very strongly to the soil. Although it is not expected to appreciably leach to the groundwater, groundwater samples indicate that it can be transported there. It is not expected to significantly evaporate or hydrolyze from soils and surfaces. However, it may be subject to appreciable biodegradation in soils.

Ecotoxicity: Oysters, BCF (bioconcentration factor): 3000; rainbow trout, BCF: 920; *Daphnia pulex*, BCF: 13,000.

BCF: Some marine organisms such as phytoplankton, certain zooplankton, scallops (*Placopecten sp*), snails (*Litternia littorea*), and mussels (*Mytilus edulis*) lack a metabolic detoxification enzyme system to metabolize benzo(a)pyrene and therefore, tend to accumulate benzo(a)pyrene. Humic acid in solution may decrease bioconcentration.

Octanol/Water Partition Coefficient: log K_{ow} = 6.04

Section 13 - Disposal Considerations

Disposal: Small quantities: 10 mL of a solution containing 0.3 mol/L of potassium permanganate and 3 mol/L of sulfuric acid will degrade 5 mg of benzo(a)pyrene. Also, can treat with sodium dichromate in strong sulfuric acid (1-2 days). Benzo(a)pyrene is also a good candidate for fluidized bed incineration at a temperature range of 842 to 1796 °F (450 to 980 °C) or rotary kiln incineration at 820 to 1600°C. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Environmentally hazardous substances, solid, n.o.s.*
Hazard Class: 9
ID No.: UN3077
Packing Group: III
Label: Class 9

Additional Shipping Information: * If it is in a quantity, in one package, which equals or exceeds the reportable quantity (RQ) of 1 lb (0.454 kg).

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U022 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per RCRA Section 3001, per CWA Section 307(a) 1 lb (0.454 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Issue Date: 2003-02

Calcium Cyanide
CAL4040

Section 1 - Chemical Product and Company Identification 48/57

Material Name: Calcium Cyanide **CAS Number:** 592-01-8
Chemical Formula: C_2CaN_2
Structural Chemical Formula: $Ca(CN)_2$
EINECS Number: 209-740-0
Synonyms: CALCID; CALCIUM CYANIDE; CALCIUM CYANIDE MIXTURE,SOLID; CALCIUM CYANIDE,SOLID; CALCYAN; CALCYANIDE; CYANIDE OF CALCIUM; CYANOGAS; CYANURE DE CALCIUM; CYMAG; DEGESCH CALCIUM CYANIDE A-DUST; EPA PESTICIDE CHEMICAL CODE 074001
Derivation: Produced by fusing calcium cyanamide with sodium chloride to give a crude mixture of calcium cyanide and sodium cyanide or by treating powdered calcium oxide with boiling anhydrous hydrocyanic acid in the presence of an accelerator such as ammonia or water.
General Use: Used as a rodenticide; fumigant for greenhouses, grain, seed, and citrus fruits; for leaching gold and silver ores; as a stabilizer for cements; and in the manufacture of other cyanides and steel.

Section 2 - Composition / Information on Ingredients

Name	**CAS**	**%**
Calcium Cyanide	592-01-8	ca 40-58% wt (commercial preparation)

Trace Impurities: May contain up to 3% calcium carbide.

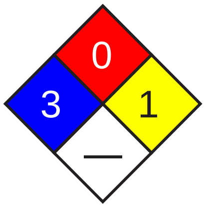
OSHA PEL
TWA: 5 mg/m^3; skin, as CN.

ACGIH TLV
Ceiling: 5 mg/m^3; skin.

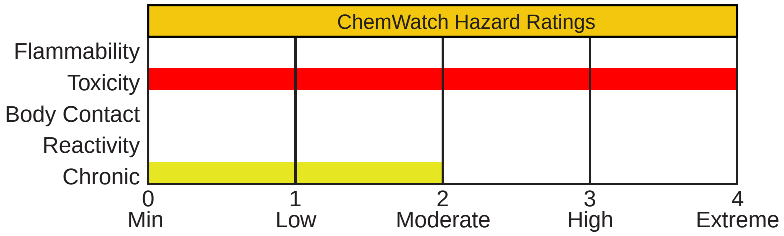
NIOSH REL
Ceiling: 4.7 ppm, 5 mg/m^3; 10 min.

DFG (Germany) MAK
TWA: 1 mg/m^3; PEAK: 1 mg/m^3; skin, ceiling, measured as inhalable fraction of the aerosol; substances with systemic effects, onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word

Danger!

Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Calcium cyanide exists as colorless crystals or white powder with a slight almond odor. It is a chemical asphyxiant which prevents tissue utilization of oxygen by inhibiting the enzyme involved (cytochrome oxidase). Exposure generally results in a bright-pink coloration of the skin due to high blood-oxygen content. Death is possible due to respiratory arrest. It is nonflammable, but releases flammable hydrogen cyanide gas upon heating or contact with water or acids.

Potential Health Effects

Target Organs: Eyes, skin, blood, thyroid, cardiovascular system, central nervous system.
Primary Entry Routes: Inhalation, eye contact, skin contact/absorption, ingestion.
Acute Effects
Inhalation: Irritation of the respiratory tract, flushing, weakness, headache, confusion, dizziness. Heavy exposures can lead to difficulty breathing, convulsions and cardiac difficulties (hypertension, arrythmias, etc.). Death may occur due to respiratory arrest. Inhalation of 200 to 300 ppm can be rapidly fatal. The maximum exposure with documented survival was 500 mg/m^3.

Eye: Irritation.

Skin: Itching, redness, and irritation. Calcium cyanide can be absorbed through the skin in toxic amounts.

Ingestion: Irritation of the gastrointestinal tract, nausea and vomiting, salivation, anxiety, confusion, and dizziness. In severe cases, symptoms may progress to convulsions, paralysis, coma, cardiac arrythmias, and death due to respiratory arrest.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Thyroid disorders.

Chronic Effects: There are reports of enlarged thyroids in workers exposed to cyanide salts. It is thought that the cyanide is metabolized to thiocyanate, which competes with iodine in the body resulting in goiter. Other chronic effects include appetite loss, headache, weakness, vitamin B12 and folate abnormalities, and insomnia.

Section 4 - First Aid Measures

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

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.

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

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not* induce vomiting. If available, obtain and prepare the Lilly cyanide antidote kit [Eli Lilly Co. (stock No. M76)] for use. Alternately, break an amyl nitrite ampule in a cloth and hold under nose for 15 seconds.

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

Note to Physicians: If the victim is conscious, bradycardia and absence of cyanosis may be key diagnostic signs. Consider administration of amyl nitrite followed by sodium nitrite and sodium thiosulfate. Obtain blood cyanide levels.

Section 5 - Fire-Fighting Measures

Flash Point: Calcium cyanide is nonflammable itself but releases flammable hydrogen cyanide gas upon exposure to heat, water, or acids. Calcium carbide (an impurity in calcium cyanide) also releases flammable acetylene gas on contact with water.

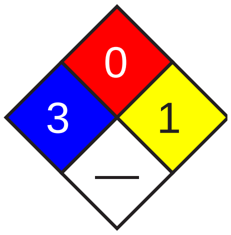
Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Flammability Classification: Nonflammable solid.

Extinguishing Media: Use agents suitable for surrounding fire, except water. Water should not be used due to formation of flammable hydrogen cyanide gas.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Carbon and nitrogen oxide(s). Release of flammable hydrogen cyanide gas on contact with heat, water, or acids.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because 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. Sructural firefighters' protective clothing is *not* effective protection against calcium cyanide exposure.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all heat and water sources. Cleanup personnel should protect against exposure.

Small Spills: Carefully scoop up or vacuum (with appropriate filter). *Do not* sweep!

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Damp mop with calcium or sodium hypochlorite solution.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with sufficient ventilation to prevent hazardous air levels and wear appropriate PPE. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using calcium cyanide, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and water sources and incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, enclose processes to prevent dispersion of dusts into work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the central nervous system and thyroid. Educate workers about the hazards of calcium cyanide exposure and train in safe work practices.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. One study has shown butyl rubber or polycarbonate to be suitable materials for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 25 mg/m^3, wear any supplied-air respirator or any SCBA with a full facepiece. 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.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove calcium cyanide from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless crystals or white powder with a slight bitter almond odor (genetically undetectable by 20 to 60% of the population).

Physical State: Solid

Vapor Pressure (kPa): ~ 0 mm Hg

Formula Weight: 92.12

Specific Gravity (H_2O=1, at 4 °C): 1.853 at 68 °F (20 °C)

Freezing/Melting Point: > 350 °C (decomposes). An estimated M.P. of 640 °C was calculated (extrapolated because of decomposition).

Water Solubility: Soluble (liberates hydrogen cyanide gas).

Other Solubilities: Soluble in alcohol and very weak acids.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Calcium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, water, and incompatibles.

Storage Incompatibilities: Acids and water (releases flammable hydrogen cyanide gas), magnesium, fluorine, nitrates, nitrites, nitric acid; violent explosion when heated with chlorate or nitrite to 842 °F (450 °C).

Hazardous Decomposition Products: Thermal oxidative decomposition of calcium cyanide can produce carbon and nitrogen oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 39 mg/kg.

See NIOSH, *RTECS* EW0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: Sunfish, TL_m = 0.12 ppm/96 hr; Cockle, LC_{50} = > 25 ppm/48 hr.

Section 13 - Disposal Considerations

Disposal: Calcium cyanide is *not* a good candidate for incineration. Never treat with acid (hydrogen cyanide gas release). Treat with calcium or sodium hypochlorite to pH 10 to 11.5 and let stand for 24 hr. Dilute with water and await disposal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Calcium Cyanide
Hazard Class: 6.1
ID No.: UN1575
Packing Group: I
Label: Poison

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed P021
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 10 lb (4.535 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Issue Date: 2003-02

Potassium Cyanide
POT3380

Section 1 - Chemical Product and Company Identification

Material Name: Potassium Cyanide **CAS Number:** 151-50-8
Chemical Formula: CKN
Structural Chemical Formula: KCN
EINECS Number: 205-792-3
Synonyms: M-44 CAPSULES (POTASSIUM CYANIDE); CYANIDE OF POTASSIUM; CYANURE DE POTASSIUM; EPA PESTICIDE CHEMICAL CODE 599600; HYDROCYANIC ACID,POTASSIUM SALT; KALIUM CYANID; POTASSIUM CYANIDE; POTASSIUM SALT OF HYDROCYANIC ACID
Derivation: By absorption of hydrogen cyanide in potassium hydroxide.
General Use: In the extraction of gold and silver from ores; metal cleaning; heat treatment of metals; electroplating; as a reagent in analytical chemistry; raw material in the manufacture of dyes, pigments, nylon, and chelating agents; an insecticide; and a fumigant.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Potassium Cyanide		ca 95 % wt (commercial); other grades include pure, solution, and reagent. Trace Impurities: potassium carbonate, formate, and hydroxide.

OSHA PEL
TWA: 5 mg/m^3; skin, as CN.

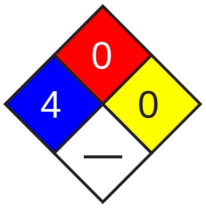
ACGIH TLV
Ceiling: 5 mg/m^3; skin.

NIOSH REL
Ceiling: 4.7 ppm, 5 mg/m^3; 10-minute, as CN.

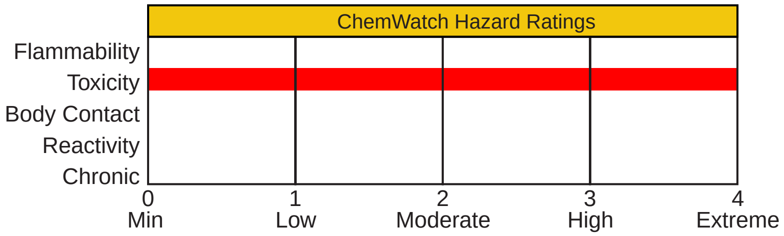
IDLH Level
25 mg/m^3; as CN.

DFG (Germany) MAK
TWA: 1 mg/m^3; PEAK: 1 mg/m^3; skin, ceiling, measured as inhalable fraction of the aerosol; substances with systemic effects, onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond



ANSI Signal Word
Danger!

Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Potassium cyanide occurs as white, amorphous, deliquescent lumps or a crystalline mass with a faint odor of bitter almonds. It is poisonous and corrosive (causes severe skin and eye burns). Potassium cyanide reacts with water or any acid-releasing flammable and highly toxic hydrogen cyanide gas.

Potential Health Effects

Target Organs: Eyes; skin; upper respiratory, cardiovascular, and central nervous systems; thyroid; blood.
Primary Entry Routes: Inhalation; skin absorption; skin and/or eye contact; ingestion.
Acute Effects
Inhalation: Irritation of the nose and throat and systemic symptoms like those seen via ingestion may also be caused by absorption through the mucous membranes. Nose irritation leading to obstruction, bleeding, sloughs, and in some cases septum perforation has been reported in workers in the electroplating industry.
Eye: Irritation and possible burns. Dilated pupils are common in severe poisoning. Corneal edema (swelling) may occur. Human poisoning cases due to eye exposure only have not been reported.

Skin: Itching, irritation, discoloration (bright pink color), dermatitis, rash, or corrosion (burns) may occur. Systemic symptoms like those seen via ingestion may also be caused by skin absorption. Mild systemic symptoms such as headache and dizziness have been caused by solutions as dilute as 0.5% potassium cyanide.

Ingestion: Chemical asphyxia and death may occur without warning from severe exposure. Initial symptoms of lesser exposure include burning, acrid, bitter taste upon ingestion, weakness, headache, flushing, dizziness, confusion, salivation, nausea and vomiting, hyperventilation, bradycardia (slowed heart beat), hypertension (high blood pressure), and anxiety. These may progress to increased rate and depth of respiration, slow and gasping respiration, pulmonary edema (fluid in lungs), lactic acidosis (abnormal accumulation of lactic acid in the blood resulting in a metabolic derangement), stupor, seizures, coma, apnea (absence of breathing), tachycardia (rapid heart beat), hypotension (low blood pressure), and death.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Disorders of the skin, thyroid, and cardiovascular, upper respiratory, and central nervous systems.

Chronic Effects: Dermatitis, scarlet rash and papules, and itching have been reported in workers in the electroplating industry. Other symptoms may include headache, weakness, nausea, dizziness, loss of appetite, insomnia, memory loss, tremors, functional changes in hearing, enlarged thyroid gland, folate abnormalities, palpitations, chest discomfort, upper respiratory tract irritation, nose bleeds, and eye irritation.

Section 4 - First Aid Measures

Inhalation: *Note!* The odor of bitter almonds may be noted on the breath or vomitus. Remove exposed person to fresh air and immediately begin therapy with 100% oxygen.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist immediately if irritation or pain develop.

Skin Contact: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area extremely thoroughly with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, *do not* induce vomiting.

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

Note to Physicians: Determine hemoglobin, arterial blood gases, venous pO_2 or measured versus %O_2 saturation, serum lactate, electrolytes, and whole blood cyanide levels. If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. For cases of ingestion, perform gastric lavage with a large bore tube after endotracheal intubation.

Special Precautions/Procedures: To prevent self-poisoning, avoid mouth-to-mouth resuscitation during CPR. To avoid becoming secondary victims, do not enter areas with high potential airborne concentrations without donning a self-contained breathing apparatus (SCBA). Give specific and detailed instructions on the use of cyanide antidote kits to all persons working with and around potassium cyanide.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible

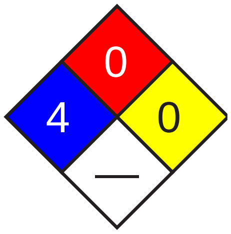
Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use extinguishing media suitable for surrounding fire. Do not use carbon dioxide extinguisher; this can liberate hydrogen cyanide by the action of the dissolved carbon dioxide. Water may be used on surrounding fires *not* involving potassium cyanide. Use alkali dry chemical. Keep fire-exposed containers cool with water spray.

General Fire Hazards/Hazardous Combustion Products: Nitrogen oxides and cyanide. Potassium cyanide reacts with water or any acid-releasing flammable hydrogen cyanide.



Fire Diamond

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because 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. Structural firefighter's protective clothing is *not* effective for potassium cyanide.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel immediately, evacuate all unnecessary personnel, and isolate and ventilate area. Cleanup personnel should wear fully-encapsulating protective clothing to protect against inhalation, skin and eye contact.

Small Spills: Carefully scoop up the spilled potassium cyanide and place in dry containers for disposal or reclamation. For potassium cyanide solution spills, take up with a noncombustible, absorbent material such as sand or vermiculite and place in containers for later disposal. Neutralize with a strong alkali solution of calcium hypochlorite.

Large Spills: For large dry spills, cover with a plastic sheet to avoid dust dispersion until later disposal. For large solution spills, dike far ahead for later disposal. Do not release into sewers or waterways. Prompt cleanup and removal are necessary. To avoid generating dust, *do not* sweep! Remove residue by vacuuming (with an appropriate HEPA filter) or mopping with a liberal quantity of water.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all contact with potassium cyanide. Use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Wear appropriate personal protective equipment to protect against skin and eye contact. Make cyanide antidote kits readily available in all areas where potassium cyanide is used. Replace ingredients of kits every 1-2 yr to ensure freshness. Practice good personal hygiene procedures to avoid inadvertently ingesting potassium cyanide.

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

Recommended Storage Methods: Store in tightly closed containers in a cool, dry, well-ventilated area away from light, acids, water, carbon dioxide, and other incompatibles (Sec. 10). Outside or detached storage is preferred. Protect from physical damage. Keep containers covered or in an exhausted hood when not in use.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose all operations to avoid dust dispersion into the workplace. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the cardiovascular, upper respiratory, and nervous systems, skin, and thyroid. Maintain pertinent medical records for 5 years following the last exposure. Educate workers about the hazards of potassium cyanide and train in emergency first aid procedures for cyanide poisoning.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl chloride, Neoprene, butyl rubber, fluoronitrile carbon rubber, nitrile rubber, and chlorinated polyethylene are recommended materials for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations <= 25 mg/m^3, wear a supplied-air respirator or any SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure- demand or other positive-pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove potassium cyanide from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White lumps or colorless crystals; faint odor of bitter almonds.

Physical State: Solid

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

Formula Weight: 65.11

Specific Gravity (H_2O=1, at 4 °C): 1.55

Refractive Index: 1.410

pH: (0.1N aqueous solution) 11.0

Boiling Point: 2957 °F (1625 °C)

Freezing/Melting Point: 1173 °F (634 °C)

Water Solubility: Soluble

Other Solubilities: Soluble in 100 parts alcohol, soluble in 25 parts methanol, and soluble in 2 parts glycerol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Potassium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. It absorbs moisture and carbon dioxide from the air and slowly decomposes. Hazardous polymerization cannot occur. Avoid contact with acids, water, and other incompatibles.

Storage Incompatibilities: Potassium cyanide is incompatible with acids (releases highly toxic hydrogen cyanide gas), metallic salts, permanganates, peroxides, perchloryl fluoride, chlorates (potassium cyanide and sodium chlorate explode when heated), nitrites, oxidizing agents, nitrogen trichloride, iodine, alkaloids, ammoniacal silver, mercury (II) nitrate, and chromium tetraoxide. Hydrogen cyanide gas is also released when sodium cyanide is dissolved in and reacts with water. However, unless this occurs in a closed space, the amount is too small to be hazardous. Potassium cyanide also reacts with carbon dioxide in the air to release hydrogen cyanide gas.

Hazardous Decomposition Products: Thermal oxidative decomposition of potassium cyanide can produce nitrogen oxides and cyanide gas.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5 mg/kg.

Man, oral, TD_{Lo}: 13699 µg/kg caused convulsions or effect on seizure threshold, coma, and metabolic acidosis.

Woman, oral, TD_{Lo}: 100 mg/kg caused convulsions or effect on seizure threshold, increased pulse rate without fall in blood pressure, and blood pressure lowering not characterized in autonomic section.

Human, oral, LD_{Lo}: 2857 µg/kg.

Other Effects:

Rat, oral: 31500 mg/kg/50 weeks/continuous caused changes in urine composition and thyroid weight and weight loss or decreased weight gain.

Rat, oral: 65 g/kg administered to a female 14 days prior to mating and during the 1-22 day of pregnancy caused toxic effects on fertility.

Mouse, lymphocyte: 1 mmol/L caused DNA inhibition.

See NIOSH, *RTECS* TS8750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Potassium cyanide will readily dissociate in water and may then form hydrogen cyanide or react with various metals present in natural water. Complex metallocyanides may form if the cyanide ion is present in excess, but if metals are prevalent, simple metal cyanides may form. Bioconcentration: 0.3 (calculated from water solubility by regression equations). 3.0 (calculated from water solubility by regression equations).

Ecotoxicity: TL_m (fresh water Bluegill): 0.16 ppm for 48 hr; TL_m (salt water adult Zebrafish): 0.49 ppm for 48 hr

Section 13 - Disposal Considerations

Disposal: Add potassium cyanide with stirring to a strong alkaline solution of calcium hypochlorite. Let stand 24 hr and route to sewage plant (only with approval from local municipality). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Potassium cyanide
Hazard Class: 6.1
ID No.: UN1680
Packing Group: I
Label: Poison

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed P098
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 10 lb (4.535 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Listed
RQ: 10 lb
TPQ: 100 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

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Issue Date: 2003-02

Sodium Cyanide
SOD3100

Section 1 - Chemical Product and Company Identification 49/57

Material Name: Sodium Cyanide **CAS Number:** 143-33-9
Chemical Formula: CNNa
Structural Chemical Formula: NaCN
EINECS Number: 205-599-4
Synonyms: CIANURO DI SODIO; M-44 CYANIDE CAPSULES; CYANIDE OF SODIUM; CYANOBRIK; CYANOGRAN; CYANURE DE SODIUM; CYMAG; EPA PESTICIDE CHEMICAL CODE 074002; HYDROCYANIC ACID,SODIUM SALT; KYANID SODNY; SODIUM CYANIDE; SODIUM SALT OF HYDROCYANIC ACID
Derivation: By absorption of hydrogen cyanide in a solution of sodium hydroxide with subsequent vacuum evaporation; by heating sodium amide with carbon; or by melting sodium chloride and calcium cyanamide together in an electric furnace.
General Use: In the heat treatment of metals (case-hardening), the extraction of gold and silver from ores, electroplating operations (coppering, zincing), the manufacture of dyes, pigments, hydrogen cyanide, hydrocyanic acid, and mirrors; cleaning metals; insecticides; formerly for fumigation of citrus and other fruit trees, railway cars, ships, and warehouses; nylon intermediates; for ore flotation; and as a chelating compound.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Sodium Cyanide	143-33-9	95-98% wt

Mixtures of sodium cyanide with sodium chloride or carbonate for special uses are also marketed, as well as other grades, including 30% solution; 73-75%; 96-98%; reagent; technical; and granular briquettes.

OSHA PEL
TWA: 5 mg/m^3; skin, as CN.

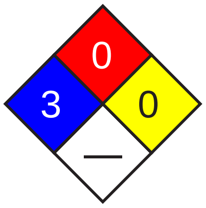
ACGIH TLV
Ceiling: 5 mg/m^3; skin.

NIOSH REL
Ceiling: 4.7 ppm, 5 mg/m^3; 10-minute, as CN.

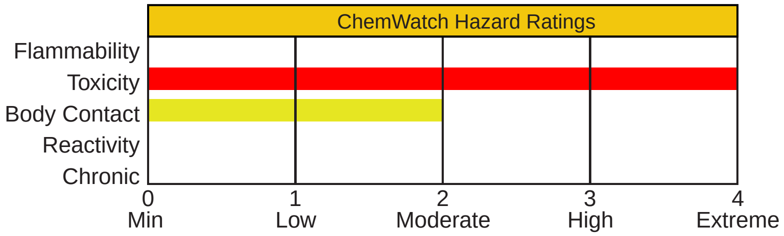
IDLH Level
25 mg/m^3; as CN.

DFG (Germany) MAK
TWA: 1 mg/m^3; PEAK: 1 mg/m^3; skin, ceiling, measured as inhalable fraction of the aerosol; substances with systemic effects, onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond



HMIS	
3	Health
0	Flammability
0	Reactivity

ANSI Signal Word
Danger!


Poison


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Sodium cyanide occurs as a white, granular or crystalline solid with a faint, almond-like odor; it is odorless when dry. It is highly toxic and exposure to high concentrations may produce death within minutes. Sodium cyanide is corrosive and may cause severe skin and eye burns and is irritating to the upper respiratory tract. Sodium cyanide produces highly toxic and flammable vapors of hydrogen cyanide gas upon contact with acid, acid fumes, water, or steam.

Potential Health Effects

Target Organs: Eyes; skin; upper respiratory, cardiovascular, and central nervous systems; thyroid; blood.
Primary Entry Routes: Inhalation; skin absorption; skin and/or eye contact; ingestion.

Acute Effects

Inhalation: Irritation of the nose and throat. Systemic symptoms like those seen via ingestion may also be caused by absorption through the mucous membranes. Nose irritation leading to obstruction, bleeding, sloughs, and in some cases septum perforation has been reported in workers in the electroplating industry.

Eye: Irritation and possible burns. Dilated pupils are common in severe poisoning. Corneal edema (swelling) may occur. Human poisoning cases due to eye exposure only have not been reported.

Skin: Itching, irritation, discoloration (bright pink color), dermatitis, rash, or corrosion (burns) may occur. Systemic symptoms like those seen via ingestion may also be caused by skin absorption. Mild systemic symptoms such as headache and dizziness have been caused by solutions as dilute as 0.5% sodium cyanide.

Ingestion: Chemical asphyxia and death may occur without warning from severe exposure. Initial symptoms of lesser exposure include burning, acrid, bitter taste upon ingestion, weakness, headache, flushing, dizziness, confusion, salivation, nausea and vomiting, hyperventilation, bradycardia (slowed heart beat), hypertension (high blood pressure), and anxiety. These may progress to increased rate and depth of respiration, slow and gasping respiration, pulmonary edema (fluid in lungs), lactic acidosis (abnormal accumulation of lactic acid in blood resulting in a metabolic derangement), stupor, seizures, coma, apnea (absence of breathing), tachycardia (rapid heart beat), hypotension (low blood pressure), and death.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Disorders of the skin, thyroid, and cardiovascular, upper respiratory, and central nervous systems.

Chronic Effects: Dermatitis, scarlet rash and papules, and itching have been reported in workers in the electroplating industry. Other symptoms may include headache, weakness, nausea, dizziness, loss of appetite, insomnia, memory loss, tremors, functional changes in hearing, enlarged thyroid gland, folate abnormalities, palpitations, chest discomfort, upper respiratory tract irritation, nose bleeds, and eye irritation.

Section 4 - First Aid Measures

Inhalation: *Note!* The odor of bitter almonds may be noted on the breath or vomitus. Remove exposed person to fresh air and immediately begin therapy with 100% oxygen.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist immediately if irritation or pain develop.

Skin Contact: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area extremely thoroughly with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, *do not* induce vomiting.

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

Note to Physicians: Determine hemoglobin, arterial blood gases, venous pO_2 or measured versus %O_2 saturation, serum lactate, electrolytes, and whole blood cyanide levels. If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. For cases of ingestion, perform gastric lavage with a large bore tube after endotracheal intubation.

Special Precautions/Procedures: Note! *In all cases of exposure where absorption may occur (i.e. inhalation, skin contact, and ingestion), administer 100% oxygen immediately and obtain and prepare the cyanide antidote kit for use in symptomatic patients.*

To prevent self-poisoning, avoid mouth-to-mouth resuscitation during CPR. To avoid becoming a secondary victim, *do not* enter areas with high potential airborne concentrations without donning a self-contained breathing apparatus (SCBA). Give specific and detailed instructions on the use of cyanide antidote kits to all persons working with and around sodium cyanide.

Section 5 - Fire-Fighting Measures

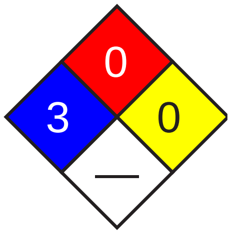
Flash Point: Noncombustible

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use extinguishing media suitable for the surrounding fire. Do not use water directly on spilled sodium cyanide. *Do not* use carbon dioxide extinguishers; this can liberate hydrogen cyanide by the action of the dissolved carbon dioxide.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Nitrogen and sodium oxides and cyanide. Containers may explode violently in the heat of fire. Material may be transported in a molten form.

Fire-Fighting Instructions: If feasible and without undue risk, move containers from fire hazard area. *Do not* release runoff from fire control methods to sewers or waterways. Because 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. Structural firefighters' protective clothing is *not* effective for sodium cyanide. Remove and isolate contaminated clothing at the site.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel immediately, evacuate all unnecessary personnel, and isolate and ventilate area. Cleanup personnel should wear fully-encapsulating protective clothing to protect against inhalation and skin and eye contact.

Small Spills: Neutralize with a strong alkali solution of calcium hypochlorite. Carefully scoop up the spilled sodium cyanide and place in dry containers for disposal or reclamation. For sodium cyanide solution spills, take up with a noncombustible, absorbent material such as sand or vermiculite and place in containers for later disposal.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Prompt cleanup and removal are necessary. To avoid generating dust, *do not* sweep! Remove residue by vacuuming (with an appropriate HEPA filter) or flushing with a liberal quantity of water.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all contact with sodium cyanide. Use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Wear appropriate personal protective equipment to protect against skin and eye contact. Make cyanide antidote kits readily available in all areas where sodium cyanide is used. Replace ingredients of kits every 1-2 yr to ensure freshness. Practice good personal hygiene procedures to avoid inadvertently ingesting sodium cyanide.

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

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from water, acids, carbon dioxide, oxidizers, and other incompatibles (Sec. 10). Protect from physical damage. Keep containers covered or in exhausted hood when not in use.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose all operations to avoid dust dispersion into the workplace. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the cardiovascular, upper respiratory, and nervous systems, skin, and thyroid. Maintain pertinent medical records for 5 years following the last exposure. Educate workers about the hazards of sodium cyanide and train in emergency first aid procedures for cyanide poisoning.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. With breakthrough times of > 8 hr, natural rubber, Neoprene, nitrile rubber, and polyvinyl chloride are recommended materials for PPE for sodium cyanide (solid). Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations <= 25 mg/m^3, wear a supplied-air respirator or any SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure- demand or other positive-pressure mode. If respirators are used, OSHA requires a written respiratory protection program.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove sodium cyanide from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White, deliquescent, powder, granular, egg-shaped, or flake form. It is odorless when dry, but may have the characteristic cyanide almond odor when wet.

Physical State: Solid

Vapor Pressure (kPa): ~0 mm Hg at 68 °F (20 °C); 1 mm Hg at 1503 °F (817 °C); 0.76 mm Hg at 1472 °F (800 °C)

Formula Weight: 49.01

Specific Gravity (H_2O=1, at 4 °C): 1.60 at 77 °F (25 °C) (solid)

Refractive Index: 1.452
pH: Aqueous solutions are strongly alkaline.
Boiling Point: 2725 °F (1496 °C)
Freezing/Melting Point: 1047 °F (563 °C)
Viscosity: 26% aqueous solution: 4 cP at 86 °F (30 °C)
Water Solubility: Soluble
Other Solubilities: Slightly soluble in alcohol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Sodium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. A solution of sodium cyanide in water slowly decomposes to release ammonia. Hazardous polymerization cannot occur. Avoid contact with acids and acid fumes and other incompatibles.

Storage Incompatibilities: Violent reactions occur with fluorine, magnesium, nitrates, nitric acid, and nitrites. It explodes when melted with nitrite or chlorate at about 842 °F (450 °C). Sodium cyanide reacts with acids (even weak) or acid fumes to release highly toxic hydrogen cyanide gas and sodium oxide. Hydrogen cyanide gas is also released when sodium cyanide is dissolved in and reacts with water. However, unless this occurs in a closed space, the amount is too small to be hazardous. Sodium cyanide also reacts with carbon dioxide in the air to release hydrogen cyanide gas. It is corrosive to aluminum.

Hazardous Decomposition Products: Thermal oxidative decomposition of sodium cyanide can produce nitrogen and sodium oxides and cyanide.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 6440 µg/kg.
Man, TD_{Lo}: 714 µg/kg caused hallucinations, distorted perceptions, and muscle weakness.
Human, LD_{Lo}: 2857 µg/kg.

Other Effects:
Hamster, implant: 5999 mg/kg administered to a female during 6-9 days of pregnancy caused fetotoxicity and specific developmental abnormalities of the musculoskeletal and cardiovascular systems.
D. melanogaster: 200 ppb inhaled caused sex chromosome loss/nondisjunction.

See NIOSH, *RTECS* VZ7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: Fathead minnows, TL_m, 96 hr: 0.23 ppm. Bluegill, TL_m, 96 hr: 0.15 ppm. Trout, lethal, 1 hr: 2 ppm.

Section 13 - Disposal Considerations

Disposal: Add sodium cyanide with stirring to a strong alkaline solution of calcium hypochlorite. Let stand 24 hr and route to sewage plant (only with approval from local municipality). Sodium cyanide is a poor candidate for incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Sodium cyanide
Hazard Class: 6.1
ID No.: UN1689
Packing Group: I
Label: Poison

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed P106
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 10 lb (4.535 kg)
- **SARA 40 CFR 372.65:** Not listed
- **SARA EHS 40 CFR 355:** Listed
  - **RQ:** 10 lb
  - **TPQ:** 100 lb
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Issue Date: 2002-02

Ethylbenzene
ETH3050

Section 1 - Chemical Product and Company Identification

54

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5{\bullet}C_2H_5$
Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE
General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.
Component of many petroleum hydrocarbon solvents, thinners.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 125 ppm; 545 mg/m^3.

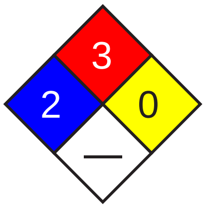
ACGIH TLV
TWA: 100 ppm, 434 mg/m^3;
STEL: 125 ppm, 543 mg/m^3.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 125 ppm, 545 mg/m^3.

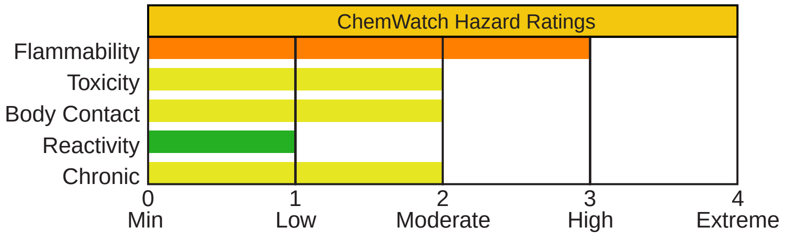
IDLH Level
800 ppm; 10% LEL.

DFG (Germany) MAK
Skin

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent odor. Irritating to eyes/skin/respiratory tract. Also causes: chest constriction, vertigo, narcosis, cramps, respiratory paralysis. Chronic: fatigue, sleepiness, headache, blood disorders, lymphocytosis. Flammable.

Potential Health Effects

Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Primary Entry Routes: inhalation, skin contact, eye contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.

When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.

Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).

Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.

Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce considerable gastrointestinal discomfort and may be harmful or toxic if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.

Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.

Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.

Transport to hospital or doctor without delay.

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

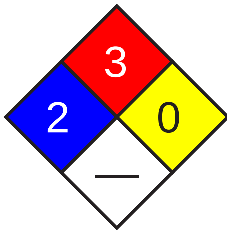
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.
Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Eyewash unit.
Glove Selection Index:

VITON	Best selection
TEFLON	Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.
Physical State: Liquid
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Water Solubility: 0.01% by weight
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 3500 mg/kg	Skin (rabbit): 15 mg/24h mild
Inhalation (human) TC_{Lo}: 100 ppm/8h	Eye (rabbit): 500 mg - SEVERE
Inhalation (rat) LC_{Lo}: 4000 ppm/4h	
Intraperitoneal (mouse) LD_{50}: 2642 mg/kg~	
Dermal (rabbit) LD_{50}: 17800 mg/kg~	

Liver changes, utheral tract, effects on fertility, specific developmental abnormalities (musculoskeletal system) recorded.

NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

See NIOSH, *RTECS* DA 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it exist predominantly in the vapor phase based on its vapor pressure where it will photochemically degrade by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially return to earth in rain. It will not be subject to direct photolysis. Releases into water will decrease in concentration by evaporation and biodegradation. The time for this decrease and the primary loss processes will depend on the season, and the turbulence and microbial populations in the particular body of water. Representative half-lives are several days to 2 weeks. Some may be adsorbed by sediment but significant bioconcentration in fish is not expected to occur based upon its octanol/water partition coefficient. It is only adsorbed moderately by soil. It will not significantly hydrolyze in water or soil.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 275 mg/l 96 hr in a static unmeasured bioassay; LC_{50} Pimephales promelas (fathead minnow) 12.1 mg/l/96 hr (confidence limit 11.5 - 12.7 mg/l), flow-through bioassay with measured concentrations, 26.1 °C, dissolved oxygen 7.0 mg/l, hardness 45.6 mg/l calcium carbonate, alkalinity 43.0 mg/l; Toxicity threshold (cell multiplication inhibition test): Pseudomonas putida (bacteria) 12 mg/l ; LC_{50} Palaemonetes pugio (grass shrimp, adult) 14,400 ug/l/24 hr in a static unmeasured bioassay; LC_{50} Palaemonetes pugio (grass shrimp, larva) 10,200 ug/l/24 hr in a static unmeasured bioassay; Toxicity threshold (cell multiplication inhibition test): Microcystis aeruginosa (algae) 33 mg/l; Scenedesmus quadricauda (green algae) > 160 mg/l

Henry's Law Constant: 8.44×10^{-3}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 3.15$

Soil Sorption Partition Coefficient: $K_{oc} = 164$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: ETHYLBENZENE
Hazard Class: 3.1
ID No.: 1175
Packing Group: II
Label: Flammable Liquid [3]

Additional Shipping Information: PHENYL ETHANE

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Material Safety Data Sheet Collection
Genium Publishing Corp.
1171 RiverFront Center
Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2002-02

Toluene
TOL2320

Section 1 - Chemical Product and Company Identification 54

Material Name: Toluene **CAS Number:** 108-88-3
Chemical Formula: C_7H_8
Structural Chemical Formula: $C_6H_5CH_3$
Synonyms: ANTISAL 1A; BENZENE,METHYL-; CP 25; METHACIDE; METHANE,PHENYL-; METHYL BENZENE; METHYL BENZOL; METHYLBENZENE; METHYLBENZOL; PHENYL METHANE; PHENYLMETHANE; TOLUEEN; TOLUEN; TOLUENE; TOLUENO; TOLUOL; TOLUOLO; TOLU-SOL
General Use: Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners; in gasoline and aviation fuel. Used in the manufacture of chemicals, dyes, explosives, benzoic acid.
Some grades of toluene may contain traces of xylene and benzene.
Odor threshold: 2 ppm approx. Odor is not a reliable warning property due to olfactory fatigue.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
toluene	108-88-3	> 99.5

OSHA PEL
TWA: 200 ppm; Ceiling: 300 ppm, 500 ppm, 10-minute maximum peak.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 375 mg/m^3; STEL: 150 ppm; 560 mg/m^3.

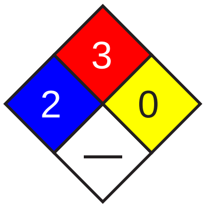
ACGIH TLV
TWA: 50 ppm, 188 mg/m^3; skin.

NIOSH REL
TWA: 100 ppm, 375 mg/m^3; STEL: 150 ppm, 560 mg/m^3.

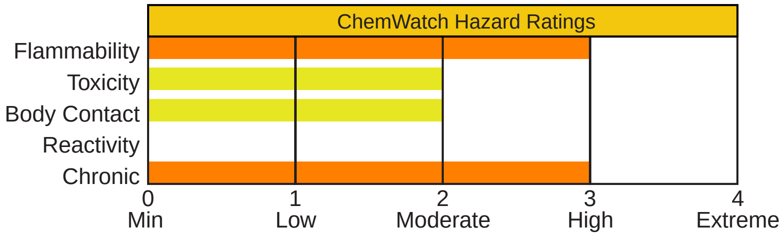
IDLH Level
500 ppm.

DFG (Germany) MAK
TWA: 50 ppm, 190 mg/m^3; skin, ceiling, substances with systemic effects, onset of effects within 2 hours, half-life two hours to shift length.

Section 3 - Hazards Identification



Fire Diamond



HMIS
② Health
③ Flammability
⓪ Reactivity

ANSI Signal Word
Danger!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sickly, sweet odor. Irritating to the eyes/skin/respiratory tract. Also causes: weakness, headache, dizziness, confusion, and insomnia. Chronic: liver and kidney damage. May cause birth defects. Flammable.

Potential Health Effects

Target Organs: Skin, liver, kidneys, central nervous system.
Primary Entry Routes: Inhalation, skin contact/absorbtion.
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal.

Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis.

Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes if exposure is prolonged.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis and it is absorbed by skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Chronic toluene habituation occurs following intentional abuse (glue-sniffing) or from occupational exposure. Ataxia, incoordination and tremors of the hands and feet (as a consequence of diffuse cerebral atrophy), headache, abnormal speech, transient memory loss, convulsions, coma, drowsiness, reduced color perception, frank blindness, nystagmus (rapid, involuntary eye-movements), decreased hearing leading to deafness and mild dementia have all been associated with chronic abuse.

Peripheral nerve damage, encephalopathy, giant axonopathy, electrolyte disturbances in the cerebrospinal fluid and abnormal computer tomographic (CT) scans are common amongst toluene addicts. Although toluene abuse has been linked with kidney disease, this does not commonly appear in cases of occupational toluene exposures. Cardiac and hematological toxicity are however associated with chronic toluene exposure. Cardiac arrhythmia, multifocal and premature ventricular contractions and supraventricular tachycardia are present in 20% of patients who abused toluene-containing paints.

Previous suggestions that chronic toluene inhalation produced human peripheral neuropathy have largely been discounted. However central nervous system (CNS) depression is well documented where blood toluene levels exceed 2.2 mg%. Toluene abusers can achieve transient circulating concentrations of 6.5 mg%. Amongst workers exposed for a median time of 29 years to toluene no subacute effects on neurasthenic complaints and pyschometric test results could be established.

The prenatal toxicity of very high toluene concentrations has been documented for several animal species and man. Malformations indicative of specific teratogenicity have not generally been found. The toxicity described in the literature takes the form of embryo death or delayed fetal growth and delayed skeletal system development. Permanent damage of children has been seen only when mothers had suffered from chronic intoxication as a result of "sniffing".

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

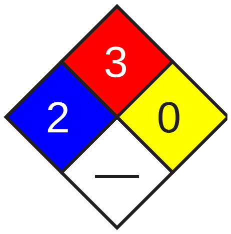
Note to Physicians: Following acute or short-term repeated exposures to toluene:

1. Toluene is absorbed across to alveolar barrier, the blood/air mixture being 11.2/15.6 (at 37 °C) The order of toluene, in expired breath, is of the order of 18 ppm following sustained exposure to 100 ppm.
The tissue/blood proportion is 1/3 except in adipose where the proportion is 8/10.
2.Metabolism by microsomal mono-oxygenation, results in the production of hippuric acid. This may be detected in the urine in amounts between 0.5 and 2.5 g/24hr which represents, on average 0.8 gm/gm of creatinine.
The biological half life of hippuric acid is in the order of 1-2 hours.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
8.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Hippuric acid in urine	2.5 gm/gm creatinine	End of shift Last 4 hrs of shift	B,NS
Toluene in venous blood	1 mg/L	End of shift	SQ
Toluene in end-exhaled air		End of shift	SQ

NS: Non-specific determinant; also observed after exposure to other material
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 4 °C Closed Cup
Autoignition Temperature: 480 °C
LEL: 1.2% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Nitric acid with toluene, produces nitrated compounds which are explosive.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.

If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; Metal drum; Metal safety cans. Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area; local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:
Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE	Best selection
VITON/CHLOROBUTYL	Best selection
VITON	Best selection
PVA	Best selection
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23 2-PLY	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 2.93 at 20 °C
Vapor Density (Air=1): 3.2
Formula Weight: 92.14
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 20 °C
Water Solubility: < 1 mg/mL at 18 °C
Evaporation Rate: 2.4 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 111 °C (232 °F) at 760 mm Hg
Freezing/Melting Point Range: -95 °C (-139 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (human) LD_{Lo}: 50 mg/kg	Skin (rabbit): 20 mg/24h-moderate
Oral (rat) LD_{50}: 636 mg/kg	Skin (rabbit): 500 mg - moderate
Inhalation (human) TC_{Lo}: 100 ppm	Eye (rabbit): 0.87 mg - mild
Inhalation (man) TC_{Lo}: 200 ppm	Eye (rabbit): 2 mg/24h - SEVERE
Inhalation (rat) LC_{50}: > 26700 ppm/1h	Eye (rabbit): 100 mg/30sec - mild
Dermal (rabbit) LD_{50}: 12124 mg/kg	
Reproductive effector in rats	

See NIOSH, *RTECS* XS 5250000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be lost by evaporation from near-surface soil and by leaching to the groundwater. Biodegradation occurs both in soil and groundwater, but it is apt to be slow especially at high concentrations, which may be toxic to microorganisms. The presence of acclimated microbial populations may allow rapid biodegradation. It will not significantly hydrolyze in soil or water under normal environmental conditions. If released into water, its concentration will decrease due to evaporation and biodegradation. This removal can be rapid or take several weeks, depending on temperature, mixing conditions, and acclimation of microorganisms. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. If released to the atmosphere, it will degrade by reaction with photochemically produced hydroxyl radicals (half-life 3 hr to slightly over 1 day) or be washed out in rain. It will not be subject to direct photolysis.

Ecotoxicity: LC_{50} Aedes aegypti-4th instar (mosquito larvae) 22 mg/l /Conditions of bioassay not specified; LC_{50} Cyprinodon variegatus (sheepshead minnow) 277-485 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Calandra granaria (grain weevil) 210 mg/l /in air; LC_{50} Cancer magister (crab larvae stage I) 28 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 4.3 ppm 96 hr /Conditions of bioassay not specified; LC_{50} Artemia salina (brine shrimp) 33 mg/l 24 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (striped bass) 7.3 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnows) 55-72 mg/l (embryos), 25-36 mg/l (1-day posthatch protolarvae), and 26-31 mg/l (30-day-old minnows)/ 96 hour /Conditions of bioassay not specified

Henry's Law Constant: 0.0067

BCF: eels 13.2

Biochemical Oxygen Demand (BOD): 0%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.69

Soil Sorption Partition Coefficient: K_{oc} = silty loam 37

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: TOLUENE
Hazard Class: 3.1
ID No.: 1294
Packing Group: II
Label: Flammable Liquid[3]

Additional Shipping Information: TOLUOL

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U220 Toxic Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Issue Date: 2002-02

Xylene
XYL2260

Section 1 - Chemical Product and Company Identification 54

Material Name: Xylene **CAS Number:** 1330-20-7
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
Synonyms: BENZENE,DIMETHYL-; COMPONENT 1 (83%): XYLENES; COMPONENT 2 (17%): ETHYL BENZENE; DIMETHYLBENZENE; DIMETHYLBENZENES; EPA PESTICIDE CHEMICAL CODE 086802; KSYLEN; METHYL TOLUENE; METHYLTOLUENE; VIOLET 3; XILOLI; XYLENE; XYLENEN; XYLOL; XYLOLE
General Use: A strong solvent for general use in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

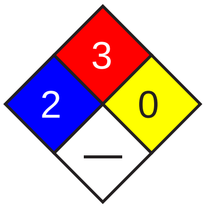
OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

ACGIH TLV
TWA: 100 ppm, 434 mg/m^3;
STEL: 150 ppm, 651 mg/m^3.

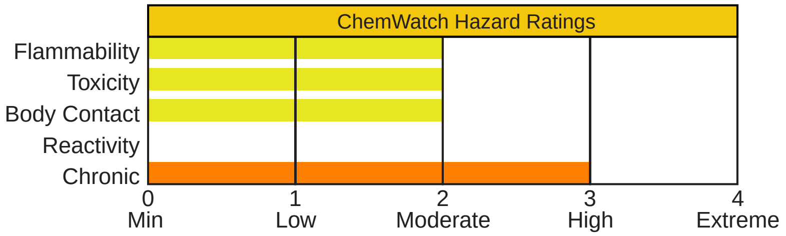
NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

DFG (Germany) MAK
TWA: 100 ppm, 440 mg/m^3;
PEAK: 200 ppm, 880 mg/m^3;
skin, simple asphyxiant, substances with systemic effects, onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported amongst women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: For acute or short-term repeated exposures to xylene:

1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended.

The use of charcoal and cathartics is equivocal.

2.Pulmonary absorption is rapid with about 60-65% retained at rest.

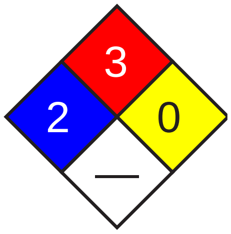
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 25.6 °C
Autoignition Temperature: 241 °C
LEL: 1.0% v/v
UEL: 7.0% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.

Collect solid residues and seal in labeled drums for disposal.

Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.

Wear protective clothing when risk of overexposure occurs.

Use in a well-ventilated area. Prevent concentration in hollows and sumps.

DO NOT enter confined spaces until atmosphere has been checked.

Avoid smoking, bare lights or ignition sources.

Avoid generation of static electricity. DO NOT use plastic buckets.

Ground all lines and equipment. Use spark-free tools when handling.

Avoid contact with incompatible materials.

When handling, DO NOT eat, drink or smoke.

Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.

Work clothes should be laundered separately.

Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.

Check all containers are clearly labeled and free from leaks.

Plastic containers may only be used if approved for flammable liquids.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.

CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.

General exhaust is adequate under normal operating conditions.

Local exhaust ventilation may be required in specific circumstances.

If risk of overexposure exists, wear NIOSH-approved respirator.

Correct fit is essential to obtain adequate protection.

Provide adequate ventilation in warehouse or closed storage areas.

In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.

Safety footwear.

Do NOT use this product to clean the skin.

Other: Overalls. Impervious protective clothing.

Eyewash unit.

Ensure there is ready access to an emergency shower.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
VITON	Best selection
TEFLON	Best selection
PVDC/PE/PVDC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear colorless flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Water Solubility: Practically insoluble in water
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point Range: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point Range: -47 °C (-53 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

TOXICITY
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 4300 mg/kg
Inhalation (human) TC_{Lo}: 200 ppm
Inhalation (man) LC_{Lo}: 10000 ppm/6h
Inhalation (rat) LC_{50}: 5000 ppm/4h
Reproductive effector in rats

IRRITATION
Skin (rabbit):500 mg/24h moderate
Eye (human): 200 ppm irritant
Eye (rabbit): 87 mg mild
Eye (rabbit): 5 mg/24h SEVERE

See NIOSH, *RTECS* ZE 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most of the xylenes are released into the atmosphere where they may photochemically degrade by reaction with hydroxyl radicals (half-life 1-18 hr). The dominant removal process in water is volatilization. Xylenes are moderately mobile in soil and may leach into groundwater where they are known to persist for several years, despite some evidence that they biodegrade in both soil and groundwater. Bioconcentration is not expected to be significant.
Ecotoxicity: LC_{50} Rainbow trout 13.5 mg/l/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 13 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: 0.22
BCF: estimated at 2.14 to 2.20
Octanol/Water Partition Coefficient: log K_{ow} = 3.12 to 3.20
Soil Sorption Partition Coefficient: K_{oc} = 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3]

Additional Shipping Information: XYLOLS

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U239 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Issue Date: 2002-02

o-Xylene
XYL1000

Section 1 - Chemical Product and Company Identification 54

Material Name: o-Xylene **CAS Number:** 95-47-6
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
Synonyms: BENZENE,1,2-DIMETHYL-; 1,2-DIMETHYLBENZENE; O-DIMETHYLBENZENE; O-METHYLTOLUENE; 1,2-XYLENE; O-XYLENE; 2-XYLENE; O-XYLENE; ORTHO-XYLENE; O-XYLOL
General Use: Used as a general solvent in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
o-xylene	95-47-6	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 150 ppm; 655 mg/m^3.

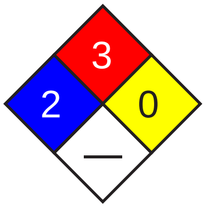
ACGIH TLV
TWA: 100 ppm, 434 mg/m^3;
STEL: 150 ppm, 651 mg/m^3.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

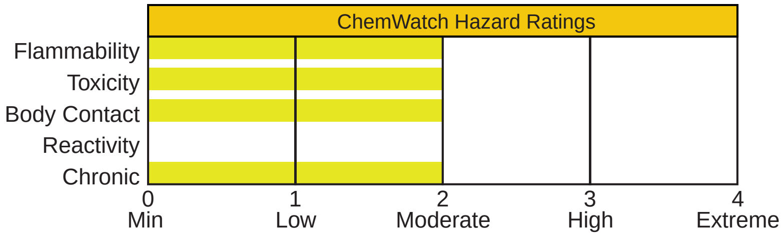
IDLH Level
900 ppm.

DFG (Germany) MAK
TWA: 100 ppm, 440 mg/m^3;
PEAK: 200 ppm, 880 mg/m^3;
skin, simple asphyxiant,
substances with systemic effects,
onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting and toxic if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported among women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: For acute or short-term repeated exposures to xylene:

1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.

2.Pulmonary absorption is rapid with about 60-65% retained at rest.

3.Primary threat to life from ingestion and/or inhalation is respiratory failure.

4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

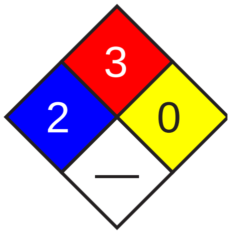
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 32 °C Closed Cup
Autoignition Temperature: 463 °C
LEL: 1.0% v/v
UEL: 7% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.
Glove Selection Index:

PVA	Best selection
VITON	Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless flammable liquid with aromatic odor. Miscible in most organic solvents. Odor threshold: 0.2 to 2 ppm.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Water Solubility: 0.02% by weight
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 144.4 °C (292 °F) at 760 mm Hg
Freezing/Melting Point Range: -25 °C (-13 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Inhalation (human) LC_{Lo}: 6125 ppm/12h Intraperitoneal (mouse) LD_{50}: 1364 mg/kg Paternal effects recorded.	Nil reported

See NIOSH, *RTECS* ZE 2450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most is released into the atmosphere where it may photochemically degrade by reaction with hydroxyl radicals (half-life 1.5-15 hr). The dominant removal process in water is volatilization. It is moderately mobile in soil and may leach into groundwater where it has been known to be detectable for several years, although there is some evidence that it biodegrades in both soil and groundwater. Bioconcentration is not expected to be significant.

Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 35 ppm/7 days /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 11.0 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae stage I) 6 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 1.3 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.1×10^{-3}

BCF: eels 1.33

Biochemical Oxygen Demand (BOD): 0 lb/lb, 5 days

Octanol/Water Partition Coefficient: $\log K_{ow} = 3.12$

Soil Sorption Partition Coefficient: K_{oc} = soils 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3]

Additional Shipping Information: XYLOLS

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 1000 lb (453.5 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Amsterdam, NY 12010
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Issue Date: 2002-02

m-Xylene
XYL1840

Section 1 - Chemical Product and Company Identification 54

Material Name: m-Xylene **CAS Number:** 108-38-3
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
Synonyms: BENZENE,1,3-DIMETHYL-; 1,3-DIMETHYLBENZENE; M-DIMETHYLBENZENE; M-METHYLTOLUENE; 1,3-XYLENE; M-XYLENE; M-XYLENE; META-XYLENE; M-XYLOL
General Use: Used as a general solvent in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
m-xylene	108-38-3	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 150 ppm; 655 mg/m^3.

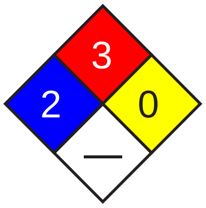
ACGIH TLV
TWA: 100 ppm, 434 mg/m^3;
STEL: 150 ppm, 651 mg/m^3.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

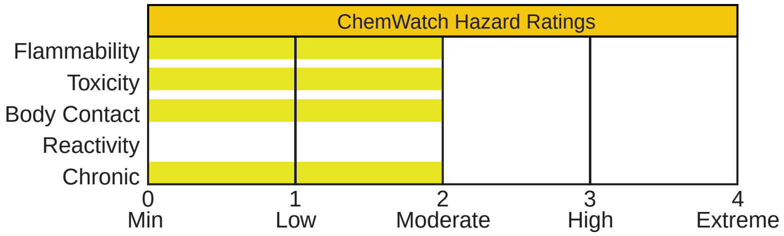
IDLH Level
900 ppm.

DFG (Germany) MAK
TWA: 100 ppm, 440 mg/m^3;
PEAK: 200 ppm, 880 mg/m^3;
skin, simple asphyxiant,
substances with systemic effects,
onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted amongst workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).

This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.

Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting and toxic if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported among women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: For acute or short-term repeated exposures to xylene:

1. Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended.

The use of charcoal and cathartics is equivocal.

2.Pulmonary absorption is rapid with about 60-65% retained at rest.

3.Primary threat to life from ingestion and/or inhalation is respiratory failure.

4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

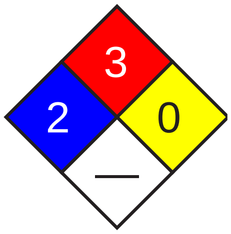
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 27 °C Closed Cup

Autoignition Temperature: 527 °C

LEL: 1.1% v/v

UEL: 7.0% v/v

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.

Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.

Moderate fire hazard when exposed to heat or flame.

Vapor forms an explosive mixture with air.

Moderate explosion hazard when exposed to heat or flame.

Vapor may travel a considerable distance to source of ignition.

Heating may cause expansion or decomposition leading to violent rupture of containers.

On combustion, may emit toxic fumes of carbon monoxide (CO).

Other combustion products include carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

If safe, switch off electrical equipment until vapor fire hazard removed.

Use water delivered as a fine spray to control fire and cool adjacent area.

Avoid spraying water onto liquid pools.

Do not approach containers suspected to be hot.

Cool fire-exposed containers with water spray from a protected location.

If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.

Avoid breathing vapors and contact with skin and eyes.

Control personal contact by using protective equipment.

Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Clear area of personnel and move upwind.

Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.

No smoking, bare lights or ignition sources. Increase ventilation.

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.

Use only spark-free shovels and explosion proof equipment.

Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >100 to <900 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 900 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.

Glove Selection Index:

PVA	Best selection
VITON	Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless flammable liquid with aromatic odor. Miscible in most organic solvents. Odor threshold: 0.2 to 2 ppm. Vapor is heavier than air.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18

Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Water Solubility: Slight
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable

pH (1% Solution): Not applicable.
Volatile Component (% Vol): 100
Boiling Point Range: 139.3 °C (283 °F)
Freezing/Melting Point Range: -47.8 °C (-54.04 °F)

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 5000 mg/kg	Skin (rabbit): 0.01 mg/24h(open) SEVERE
Intraperitoneal (mouse) LD_{50}: 1739 mg/kg	Skin (rabbit): 20 mg/24h - mod
Dermal (rabbit) LD_{50}: 14100 mg/kg	Eye (rabbit): 5 mg/24h - SEVERE

Effects on fertility, specific developmental abnormalities (craniofacial) recorded.

See NIOSH, *RTECS* ZE 2275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most is released into the atmosphere where it may photochemically degrade by reaction with hydroxyl radicals (half-life 1-10 hr). The dominant removal process in water is volatilization. It is moderately mobile in soil and may leach into groundwater where it is known to persist for several years despite some evidence that it biodegrades in both soil and groundwater. Bioconcentration is not expected to be significant.

Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 38 ppm/14 days /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 3.77 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 3.7 ppm/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 16 mg/l/24 hr /Modified ASTM D 1345 method; LC_{50} Morone saxatilis (striped bass) 9.2 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae-stage I) 12 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 0.314
BCF: eels 1.37
Biochemical Oxygen Demand (BOD): 0 lb/lb, 5 days
Octanol/Water Partition Coefficient: log K_{ow} = 3.20

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3]

Additional Shipping Information: XYLOLS

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Material Safety Data Sheet Collection
Genium Publishing Corp.
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Amsterdam, NY 12010
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Issue Date: 2002-02

p-Xylene
XYL1420

Section 1 - Chemical Product and Company Identification 54

Material Name: p-Xylene **CAS Number:** 106-42-3
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
Synonyms: BENZENE,1,4-DIMETHYL-; CHROMAR; 1,4-DIMETHYLBENZENE; P-DIMETHYLBENZENE; P-METHYLTOLUENE; SCINTILLAR; 1,4-XYLENE; P-XYLENE; 4-XYLENE; P-XYLENE; PARA-XYLENE; P-XYLOL
General Use: Used as a general solvent.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
p-xylene	106-42-3	100

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 150 ppm; 655 mg/m^3.

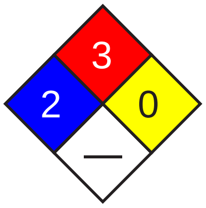
ACGIH TLV
TWA: 100 ppm, 434 mg/m^3;
STEL: 150 ppm, 651 mg/m^3.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

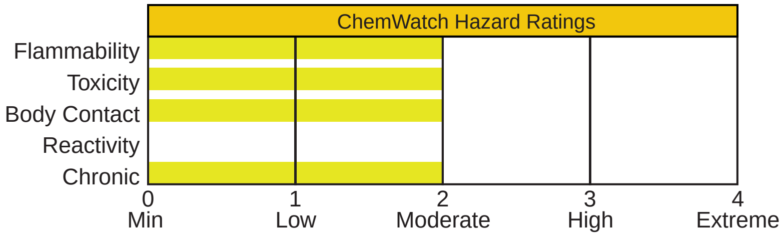
IDLH Level
900 ppm.

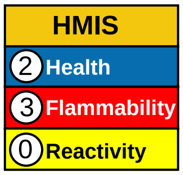
DFG (Germany) MAK
TWA: 100 ppm, 440 mg/m^3;
PEAK: 200 ppm, 880 mg/m^3;
skin, simple asphyxiant,
substances with systemic effects,
onset of effect within 2 hours.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to the eyes/skin/respiratory tract. Also causes: dizziness, nausea, and drowsiness. Chronic: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid is highly discomforting and toxic if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported among women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.

Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

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

Note to Physicians: For acute or short-term repeated exposures to xylene:

1. Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.

2.Pulmonary absorption is rapid with about 60-65% retained at rest.

3.Primary threat to life from ingestion and/or inhalation is respiratory failure.

4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.

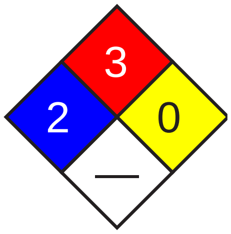
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: 27 °C Closed Cup
Autoignition Temperature: 528 °C
LEL: 1.1% v/v
UEL: 7.0% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i.e., to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Respiratory Protection:
Exposure Range >100 to <900 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 900 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.
Glove Selection Index:

PVA	Best selection
VITON	Best selection
NITRILE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless liquid with sweet, aromatic odor. Miscible in most organic solvents. Odor threshold 0.05 ppm.

Physical State: Liquid
Vapor Pressure (kPa): 0.90 at 20 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.86
Water Solubility: Insoluble in water
Evaporation Rate: 9.9 Ether=1

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point Range: 138.37 °C (281 °F)
Freezing/Melting Point Range: 13.3 °C (55.94 °F)
Volatile Component (% Vol): 100

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

TOXICITY	IRRITATION
Oral (rat) LD_{50}: 5000 mg/kg	Nil reported
Inhalation (rat) LC_{50}: 4550 ppm/4h	

See NIOSH, *RTECS* ZE 2625000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most is released into the atmosphere where it may photochemically degrade by reaction with hydroxyl radicals (half-life 1.7-18 hr). The dominant removal process in water is volatilization. It is moderately mobile in soil and may leach into groundwater where it is known to persist for several years despite some evidence that it biodegrades in both soil and groundwater. Bioconcentration is not expected to be significant.

Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 35 ppm/7 day /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 2.0 ppm/96 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 3.77 mmole/l/24 hr /Conditions of bioassay not specified; LD_{50} Goldfish 18 mg/l/24 hr /Modified ASTM D 1345 method; LC_{50} Crangon franciscorum (shrimp) 2.0 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 0.314

BCF: eels 1.37

Biochemical Oxygen Demand (BOD): 0 lb/lb, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 3.15

Soil Sorption Partition Coefficient: K_{oc} = 3.15

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: XYLENES
Hazard Class: 3.2
ID No.: 1307
Packing Group: III
Label: Flammable Liquid[3]

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Not listed
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

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Attachment B

Incident/Near Miss Investigation Form

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Incident/Near-Miss Investigation Report

☐ OSHA Recordable	☐ First Aid Injury	☐ Fire	Date of Incident:
☐ Lost Workday Injury	☐ Vehicle Accident	☐ Spill/Leak	
☐ Restricted Duty Injury	☐ Equipment Damage	☐ Near Miss	Incident Number:

Every employee injury, accident, and near miss must be reported within twenty-four hours of the injury. If the incident results in hospitalization, an immediate report must be made by telephone to the Project Manager and the Health and Safety Officer.

Project Information

Project Name: | Project #

Location of Incident:

Employee

Name: | Employee Number:

Employment Status: ☐ Regular ☐ Part Time | How long in present job?

Injury or Illness Info

Where did incident / near miss occur? (number, street, city, state, zip):

Employee's specific activity at the time of the incident / near miss:

Equipment, materials, or chemicals the employee was using when the incident / near miss occurred (e.g., the equipment employee struck against or which struck employee; the vapor inhaled or material swallowed; what the employee was lifting, pulling, etc.):

Describe the specific injury or illness (e.g., cut, strain, fracture, etc.):

Body part(s) affected (e.g., back, left wrist, right eye, etc.):

Name and address of treatment provider (e.g., physician or clinic): | Phone No.:

If hospitalized, name and address of hospital: | Phone No.:

Date of injury or onset of illness / / | Time of event or exposure: ☐ AM ☐ PM

Did employee miss at least one full shift's work? ☐ No ☐ Yes, 1st date absent (MM/DD/YYYY) / /

Has employee returned to work? ☐ Regular work ☐ Restricted work ☐ No

☐ Yes, date returned (MM/DD/YYYY) / /

To whom reported: | Other workers injured/made ill in this event? ☐ Yes ☐ No

Description of Incident / Near Miss: (Describe what happened and how it happened.)

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Incident/Near-Miss Investigation Report

Motor Vehicle Accident (MVA)

Company Vehicle?	☐ Yes ☐ No	

Accident Location (street, city, state)	

Vehicle Towed?	☐ Yes ☐ No	Other Vehicle?	☐ Yes ☐ No	# Vehicles Towed		# of Injuries			

Spill

Material Spilled	Quantity	Source

Agency Notifications	
Cost of Incident $	

Third Party Incidents

Name of Owner		Address	Telephone

Description of Damage:

Witness Name	Address	Telephone
Witness Name	Address	Telephone

#	Root Cause and Contributing Factors: Conclusion (Describe in Detail Why Incident / Near Miss Occurred)
1	
2	
3	
4	
5	

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge
2. Lack of or inadequate operational procedures or work standards
3. Inadequate communication of expectations regarding procedures or work standards
4. Inadequate tools or equipment
5. Correct way takes more time and/or requires more effort
6. Short-cutting standard procedures is positively reinforced or tolerated
7. Person thinks there is no personal benefit to always doing the job according to standards
8. Uncontrollable

#	RCA #	Solution(s): How to Prevent Incident / Near Miss From Reoccurring	Person Responsible	Due Date	Closure Date

Investigation Team Members

Name	Job Title	Date

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Incident/Near-Miss Investigation Report

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date
	Project Manager	
	Health and Safety Reviewer	

Attachment C

Incident Prevention Observation Form

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Incident Prevention Observation (IPO) Form

Observer Name:	**Observer Title:**	**Contractor Company Name:**

Date: _____________ **Time:** ____ ☐ **AM** ☐ **PM**	**Project Type / Task Observed:**

Background Information and Miscellaneous Comments

Observer's Positive Comments

Feedback Conducted By		**Date**		**Time**	☐ **AM** ☐ **PM**

Conclusion (Describe in Detail Why the Questionable Item Occurred). Add Any Employee Comments.

Root Cause(s) Analysis (RCA):

1. Lack of skill or knowledge
2. Lack of or inadequate operational procedures or work standards
3. Inadequate communication of expectations regarding procedures or work standards
4. Inadequate tools or equipment
5. Correct way takes more time and/or requires more effort
6. Short-cutting standard procedures is positively reinforced or tolerated
7. Person thinks there is no personal benefit to always doing the job according to standards
8. Uncontrollable.

Questionable Item #	RCA #	Solution(s): How to Prevent Questionable Behavior From Reoccurring	Person Responsible	Due Date	Closure Date

Results of Solution Verification and Validation

Reviewed by	Date	Reviewed by	Date

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Incident Prevention Observation (IPO) Form

Environmental Operations

	PRE-TASK PREPARATION	Correct	Questionable	Comments
1.	Health and Safety Plan / MSDSs on site			
2.	Employee familiar / trained on task			
3.	OSHA-required training/medical surveillance			
4.	Utility mark out / check performed			
5.	Traffic hazard addressed / work area marked			
6.	Walking / working surfaces free of hazards			
7.	Tailgate safety meeting performed			
8.	SPSA performed prior to beginning work			
9.	Communicates intentions to other personnel			
10.	Knowledge of emergency procedures			
11.	Distance between equipment and power lines			
12.	Personal protective equipment			
13.	Air monitoring equipment on site, calibrated			
14.	First aid kit / fire extinguisher on site			
15.	One person trained in first aid / CPR			
16.	Work zones established and marked			
	PERFORMING TASK			
17.	SPSA before beginning new task			
18.	Correct body positioning			
19.	Proper lifting / pushing / pulling techniques			
20.	Keep hands / body away from pinch points			
21.	Walking / working surfaces kept clear of debris			
22.	Faces traffic as appropriate			
23.	Vehicles/ barricades to protect against traffic			
24.	Drill rig located properly, blocked / chocked			
25.	Drill rig moved only with derrick lowered			
26.	Excavator located on stable ground			
27.	Eye contact made with equipment			

	operator			
28.	Spoil at least 2 feet back from edge of excavation			
29.	Excavation shored/sloped/benched			
30.	Excavation entry controlled			
31.	Equipment/tools used properly			
32.	Electrical equipment connected through GFCI			
33.	Power tools handled properly			
34.	Electrical cords inspected / in good condition			
35.	Follows lockout / tagout procedures			
36.	Air monitoring conducted/action levels understood			
37.	Equipment decontaminated properly			
38.	Personnel decon prior to eating/drinking/smoking			
39.	Decontamination effective			
	POST – TASK			
40.	Procedures / JSA adequate			
41.	Equipment / tools stored properly			
42.	Proper storage of soil / water / waste material			
43.	Work area secured			
44.	Other			
	Total #			**% Safe:** [(Total Correct/(Total Correct + Total Questionable)) * 100]

Attachment D

Health and Safety Inspection Form

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Health and Safety Inspection Form

Project Name:
Date:
Project Number:
Location:
Prepared By:
Project Manager:
Auditor:
HSS on Site:

	YES	NO	N/A	COMMENTS
GENERAL				
HASP on site?				
HASP finalized and approved?				
OSHA poster displayed?				
Emergency telephone numbers posted?				
Emergency eyewash immediately avaliable?				
Emergency shower immediately available?				
Emergency Notification Means available (radio, telephone)?				
First-Aid kit immediately available?				
First-Aid kit adequately stocked?				
Proper sanitation facility on site?				
DOCUMENTATION AND RECORDKEEPING				
Only personnel listed and approved in HASP on site?				
All personnel properly trained? (Check company-issued wallet cards.)				
Daily field log kept by the Site Manager?				
Levels of PPE recorded?				
Contaminant levels recorded?				
Site surveillance records kept by HSS?				
Copy of current fit test records on site?				
Calibration records maintained for air monitoring equipment?				
Accident/incident forms on site?				
Field team review sheets signed?				
Additional hospital route directions available?				
Visitors' logbook being accurately maintained?				
MSDSs available for all chemicals on site?				
HASP revisions recorded?				
First-Aid kit inspected weekly?				
Daily safety meetings held?				
Emergency procedures discussed during safety meetings?				

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Health and Safety Inspection Form

	YES	NO	N/A	COMMENTS
EMERGENCY RESPONSES				
Vehicle available on site for transportation to the hospital?				
Fire extinguishers on site and immediately available at designated work areas?				
At least one person trained in CPR and First Aid on site at all times during work activities?				
All personnel know who is trained in CPR/First Aid?				
PERSONAL PROTECTIVE EQUIPMENT (PPE)				
Proper PPE being worn as specified in HASP?				
Level of PPE being worn.				
PPE adequate for work conditions?				
If not, give reason.				
Upgrade/downgrade to PPE level.				
Does any employee have facial hair that would interfere with fit of respirators?				
If yes, willing to shave, as necessary?				
Fit-tested within the last year? (Documentation present)				
If Level B, back-up/emergency person suited up (except for air)?				
HSS periodically inspects PPE and equipment?				
PPE not in use properly stored?				
All equipment required in HASP on site?				
Properly calibrated?				
In good condition?				
Used properly?				
Other equipment needed?				
List.				
Monitoring equipment covered with plastic to minimize contamination?				
PERSONNEL AND EQUIPMENT DECONTAMINATION				
Decon area properly designated?				
Appropriate cleaning fluid used for known or suspected contaminants?				
Appropriate decon procedures used?				
Decon personnel wearing proper PPE?				
Equipment decontaminated?				

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Health and Safety Inspection Form

	YES	NO	N/A	COMMENTS
PERSONNEL AND EQUIPMENT DECONTAMINATION (continued)				
Sample containers decontaminated?				
Disposable items replaced as required?				
WORK PRACTICES				
Proper collection and disposal of potentially contaminated PPE?				
Proper collection and disposal of decon fluid?				
Water available for decon?				
Buddy system used?				
Equipment kept off drums and ground?				
Kneeling or sitting on drums or ground prohibited?				
Personnel avoid standing or walking through puddles or stained soil?				
Work zones established?				
If night work is conducted, is there adequate illumination?				
Smoking, eating, or drinking in the exclusion or CRZ prohibited?				
To the extent feasible, contaminated materials handled remotely?				
Contact lenses not allowed on site?				
Entry into excavations not allowed unless properly shored or sloped?				
Competent person on site during excavation?				
All unusual situations on site listed in HASP?				
If not, when?				
Action taken?				
HASP revised?				
CONFINED SPACE ENTRY				
Employees trained according to 1910.146 – Confined Space Entry?				
All confined spaces identified? If not, list:				
All appropriate equipment available and in good working order?				
Equipment properly calibrated?				
Confined space permits used?				
Confined space permits completely and correctly filled out?				

*N/A = Not Applicable

Attachment E

Safety Meeting Log

BBL®
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engineers & scientists

Safety Meeting Log

Project:	**Location:**
Date/Time:	**Activity:**

1. Work Summary

2. Physical Chemical Hazards

3. Protective Equipment/Procedures

4. Emergency Procedures

5. Signatures of Attendees

Attachment F

Air Monitoring Log

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Air Monitoring Log

Project: **Date:**

Monitoring Instruments:

Air Monitor: **Activity:**

Level of Protection:

Time	Location	Instrument Reading	Comments

Attachment G

Underground/Overhead Utilities Checklist

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Underground/Overhead Utility Checklist

Project Name:	**Date:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist must be completed for any intrusive subsurface work such as excavation or drilling. It documents that overhead and underground utilities in the work are identified and located. The Project Manager shall request utility markouts before the start of field operations to allow the client and utility companies sufficient time to provide them. If complete information is not available, a magnetometer or other survey shall be performed to locate obstacles prior to intrusive subsurface activities.

Procedure: A diagram of the work area depicting the proposed location of intrusive subsurface work sites (i.e., boring locations, excavation locations) must be attached to this form. The diagram must clearly indicate the areas checked for underground structures/utilities, and overhead power lines. This form and the diagram must be signed by the BBL Project Manager (if present), the BBL Site Supervisor, and the client representative.

Type of Structure	Present	Not Present	Method of Markout
Electric Power Line			
Natural Gas Line			
Telephone Line			
Water Line			
Product Line			
Sewer Line			
Steam Line			
Drain Line			
Underground Tank			
Underground Cable			
Overhead Power Line			
Overhead Product Line			
Other (Specify)			

Reviewed By

Name	Job Title	Date
	Client Representative	
	BBL Project Manager	
	BBL Site Supervisor	

Attachment H

Periodic Excavation Inspection Checklist

BBL®
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engineers & scientists

Daily/Periodic Excavation Inspection Checklist

Project Name:

Date/Time:

Project Number:

Location:

Prepared By:

Project Manager:

This checklist must be completed for all excavations. It documents that daily and post event/periodic inspections are conducted.

Soil Classified As: Stable Rock Type A Type B Type C

Soil Classified On:

By:

Type of Protective System in Use: Sloping Shoring Other ________________

Description:

Inspection Item	YES	NO	Comments
Is the underground/overhead utilities checklist completed?			
Are underground installations protected from damage?			
Adequate means of entry/exit available in the excavation?			
If exposed to traffic, are personnel wearing reflective vests?			
Barriers to prevent equipment rolling into excavation?			
Air monitoring conducted prior and during excavation entry?			
Stability of adjacent structures reviewed by registered P.E.?			
Are spoil piles at least 2 feet from the excavation edge?			
Fall protection in use near excavations deeper that 6'.			
Are work tasks completed remotely if feasible?			
Protective system in place and in good repair?			
Emergency rescue (lifeline/body harness) equipment utilized due to potential atmospheric hazard?			
Is excavation exposed to vibration?			
Are employees protected from falling/elevated material			
Is soil classification adequate for current environmental/weather conditions?			
Portable ladders extend at least 4' above excavation?			
Portable ladders or ramps secured in place?			
All personnel have attended safety meeting on excavation hazards?			
Support systems for adjacent structures are in place?			
Is excavation free from standing water?			
Water control and diversion of surface runoff is adequate?			
Are employees wearing required protective equipment?			

BBL Excavation Competent Person:

Date/Time:

Appendix D

Community Air Monitoring Plan

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Community Air Monitoring Plan

Supplemental Remedial Investigation
Elmira (Madison Avenue)
Former MGP Site

New York State Electric & Gas Corporation
Binghamton, New York

August 2003

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Table of Contents

Appendices

1. Introduction

This *Community Air Monitoring Plan* (CAMP) has been prepared by Blasland, Bouck & Lee, Inc. (BBL) to support the Supplemental Remedial Investigation (SRI) activities at the Former Manufactured Gas Plant (MGP) Site located in Elmira, New York (the site). This CAMP fulfills the requirements set forth by the New York State Department of Health (NYSDOH) *Generic Community Air Monitoring Plan*, dated June 2000 (Appendix A), and the NYSDEC's *Technical and Administrative Guidance Memorandum* (TAGM) 4031, "Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites" (Appendix B). The intent of this CAMP is to provide for a measure of protection of the downwind communities from potential airborne releases of constituents of concern during SRI activities. As such, this CAMP specifies the potential air emissions, air monitoring procedures, monitoring schedule and data collection and reporting for the SRI activities to be conducted as described below.

1.1 Site Description

The site is in the City of Elmira, in Chemung County, New York. The city occupies a the floor of a glacially carved valley, flanked on the east and west by steep bedrock hills rising greater than 500 feet above the valley floor. The city itself is largely flat, sitting in the flood plain of the Chemung River, which flows west to east through the city, before turning toward the southeast and its junction with the Susquehanna River.

The former MGP occupied most of a city block, bounded by East Clinton Street, Madison Avenue and East Fifth Street. The site is approximately 1,500 feet west of Newtown Creek, a tributary to the Chemung River which is just over 3,000 feet to the south. The site is largely flat-lying, with a small topographic rise in the eastern corner, near the intersection of East Fifth and East Clinton Streets.

The MGP was constructed between 1865 and 1869 beside the Junction Canal, a waterway connecting the Chemung and North Branch Canals. The canal was backfilled and replaced by a railroad in the late 1800s. Given the site's substantial distance from major surface water bodies (i.e., Chemung River and Newtown Creek), it is assumed that water used in the operations of the MGP was likely obtained from an onsite well.

The site is believed to have initially produced coal gas, then water (or blue) gas, and finally carbureted water gas. Three gas holders were constructed; the latest and largest had a 1-million cubic foot capacity. At different stages of operation, the site also contained the following major structures: a gas house, coal house, purifier boxes, retorts, waste lagoons, and tar vessels.

With plant closure in 1947, most of the above-ground MGP structures were dismantled. The present site includes several of the original plant buildings (including the gas house), but none of the material handling components (e.g., holders or purifiers). The locations of the historical MGP structures are shown on Figure 1 of the SRI Work Plan.

NYSEG used the site as a service station until 1977, when it sold a portion of the property. The western portion of the site, including all the remaining buildings, was sold to I.D. Booth, Inc., an industrial supply wholesaler. I.D. Booth uses several of the old buildings as warehouses, augmenting their larger operations across the Madison Avenue to the west. The former gas house is leased to a bakery wholesale supplier. NYSEG retains ownership of the eastern potion of the site, where it maintains an electrical substation and a storage yard.

Land use in the area is mixed, with industrial and commercial operations immediately south and west, a public park to the northeast, and residential properties not immediately adjacent, but within 1000 feet of the site in all directions. The parcel immediately south of the site is owned by Trayer Products, Inc. (Trayer), a metal-parts manufacturer.

1.2 Summary of Selected Site Remedial Investigation Activities

The proposed SRI activities for the site include groundwater monitoring well installation and development, groundwater sampling and specific capacity testing, temporary monitoring well installation, surface soil sampling, test pit excavation, and subsurface soil sampling using a conventional drill rig. A more detailed description of the investigation activities can be found in the Table 1 of the SRI Work Plan.

1.3 Potential Air Emissions Related to Remedial Action Activities

Certain intrusive SRI activities to be conducted at the site have the potential to generate localized impacts to air quality including drilling, test pit excavation, and surface soil sampling. Some non-intrusive SRI activities to be conducted may also have the potential to generate impacts to air quality, and include the collection of groundwater and surface soil samples.

1.4 Air/Odor Emissions and Control Measures

Air emissions control and fugitive dust suppression techniques will be used during the SRI activities identified above, as necessary, to limit the air/odor emissions from the site. Air monitoring for the specific purpose of protecting the community from site activity impacts (and verification thereof) will take place during both intrusive and non-intrusive site activities.

Odor and dust control measures will be available at the site and used when necessary. The following dust and odor suppression measures may be used during these activities, depending upon specific circumstances and air monitoring results:

- Water spray; and
- Polyethylene sheeting (for covering drill cuttings, soil stockpiles, etc.).

Polyethylene sheeting will be used to control nuisance odors and volatile organic compound (VOC) emissions, as needed. Also, dust emissions at the site will be controlled by spraying water on exposed dry surface soil areas (e.g., temporary access roads, stockpiled drill cuttings, etc.), through the use of silt fences, and by covering soil stockpiles. Odor and dust control measures will be implemented based on visual or olfactory observations, and the results of airborne particulate and VOC monitoring.

2. Air Monitoring Procedures

Real-time air monitoring will be implemented at the site for polycyclic aromatic hydrocarbons (PAHs), VOCs, and particulate matter less than 10 microns in diameter (PM_{10}). Particulate monitoring will not be performed, however, during non-intrusive activities and precipitation events. Because the SRI activities occur both on and off-site, a site boundary will not be established for the purpose of air monitoring. Instead, upwind and downwind monitoring locations will be determined through visual observation (wind vane, windsock, or similar technique). Monitoring will occur at each sample location and will include the use of hand-held direct-reading survey instruments.

2.1 Sampling Location Selection

Sampling activities will be determined daily based on visual observation of a wind direction. A single upwind location will be selected daily where both VOC and PM_{10} will be recorded. This upwind location will be established at the start of the workday, each day before the start of SRI activities. Sampling activities will continue in a downwind direction throughout the day. If wind direction shifts radically during the workday, (greater than approximately +/- 60 degrees from original upwind) new upwind and downwind sampling locations will be established. Any location changes will be documented in the field logbook.

2.2 VOCs and PAHs Monitoring

As required by the NYSDOH guidance for community air monitoring during intrusive activities, VOCs will be monitored continuously during ground intrusive site activities (test pitting and installation of soil borings or monitoring wells) with instrumentation that is equipped with electronic data-logging capabilities. Because real-time monitors for PAHs do not exist, the real-time VOC monitors will also serve as surrogate indicators of PAH emissions at the site. A real-time VOC monitor equipped with either a photoionization detector (PID) or a flame ionization detector (FID) will be used to conduct the monitoring for VOCs and PAHs. A MiniRAE 2000 (or equivalent) will be used to conduct the real-time VOC monitoring. Appendix C provides detailed information on the MiniRAE 2000. All 15-minute readings will be recorded in the field logbook, as well as any instantaneous readings taken to facilitate activity decisions.

During non-intrusive site activities (monitoring well development, collection of groundwater samples from monitoring wells, and specific capacity testing), VOCs will be monitored periodically. Periodic monitoring may include monitoring upon arrival at the sample location, monitoring while opening a well cap or overturning surface soil, monitoring during well bailing and/or purging, and/or monitoring prior to leaving a sample location. However, if a sampling location is proximal to potentially exposed individuals, VOCs will be monitored continuously during sampling activities at that location.

2.3 Particulate Matter Monitoring

As required by the NYSDOH guidance, real-time particulate matter will be monitored continuously during intrusive site activities using instrumentation equipped with electronic data-logging capabilities. A MIE DataRAM (or equivalent) will be used to conduct the real-time PM_{10} monitoring. Appendix C provides detailed information on the MIE DataRAM. All 15-minute readings will be recorded in the field logbook, as well as any instantaneous readings taken to facilitate activity decisions.

Fugitive dust migration will be visually assessed during all work activities, and reasonable dust suppression techniques will be used during any site activities that may generate fugitive dust. These activities and their design controls were discussed previously in Section 1.3 of this report.

2.4 Action Levels

The action levels provided below are to be used to initiate response actions, if necessary, based on real-time monitoring.

2.4.1 Action Levels for VOCs and PAHs

As outlined in the NYSDOH guidance document for CAMPs, if the ambient air concentration of total VOCs exceeds 5 parts per million (ppm) above the background (upwind location) for the 15-minute average, intrusive site activities will be temporarily halted while monitoring continues. If the total VOC concentration readily decreases (through observation of instantaneous readings) below 5 ppm above background, then intrusive site activities can resume with continuous monitoring.

If the ambient air concentrations of total VOCs persist at levels in excess of 5 ppm above background but less than 25 ppm above background, intrusive site work activities will be halted, the source of the elevated VOC concentrations identified, corrective actions to reduce or abate the emissions undertaken, and air monitoring will be continued. Once these actions have been implemented, intrusive site work activities can resume provided the following two conditions are met.

- The 15-minute average VOC concentrations remain below 5 ppm above background; and
- The VOC level 200 feet downwind of the sample location or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less but in no case less than 20 feet) is below 5 ppm over background for the 15-minute average.

If the ambient air concentrations of total VOCs are above 25 ppm above background, the intrusive site activities must cease, and emissions control measures must be implemented.

Periodic monitoring for VOCs is required during non-intrusive activities. If these activities are undertaken at the site, ambient direct-reading (instantaneous) VOC data will be periodically collected at the location of the non-intrusive activity and recorded in the field activity logbooks.

2.4.2 Action Level for PM_{10}

As required by the NYSDOH guidance, if the ambient air concentration of PM_{10} at any one (or more) of the sampling locations is noted at levels in excess of 100 micrograms per cubic meter ($\mu g/m^3$) above the background (upwind location), or if airborne dust is observed leaving the work area, intrusive site activities will be temporarily halted. The source of the elevated PM_{10} concentration is to be identified, corrective actions to reduce or abate the emissions will be undertaken, and air monitoring will continue. Work may continue following the implementation of dust suppression techniques provided the PM_{10} levels do not exceed 150 $\mu g/m^3$ above background.

If, after implementation of dust suppression techniques, PM_{10} levels are greater than 150 µg/m^3 above background, work must be stopped and site activities must be re-evaluated. Work may only resume provided that the dust suppression measures and other controls are successful in reducing PM_{10} levels less than 150 µg/m^3 above background and in preventing visible dust from leaving the site.

If the ambient air concentration of PM_{10} is above 150 µg/m^3 above background, the intrusive site activities must cease and emissions control measures must be implemented.

2.5 Meteorological Monitoring

Wind direction is the only meteorological information considered relevant for the SRI activities and CAMP. Meteorological monitoring will be conducted periodically at the site using a windsock, wind vane, or other appropriate equipment. Wind direction will be established at the start of each work day and may be re-established at any time during the work day if a significant shift in wind direction is noted.

2.6 Instrument Calibration

Calibration of the VOC, and PM_{10} instrumentation will occur in accordance with each of the equipment manufacturer's calibration and quality assurance requirements. The VOC and PM_{10} monitors will be calibrated at least daily, and calibrations will be recorded in the field activity logbook.

3. Monitoring Schedule and Data Collection and Reporting

The following identifies the monitoring schedule and data collection and reporting requirements.

3.1 Monitoring Schedule

Real-time VOC and PM_{10} monitoring will be performed continuously throughout the intrusive activities. VOC monitoring will also be performed during non-intrusive sampling-type activities. Wind direction will be determined at the start of each day and at any other appropriate time during SRI activities.

3.2 Data Collection and Reporting

Air monitoring data will be collected continuously from VOC and PM_{10} monitors during intrusive site activities by an electronic data-logging system. The data management software will be set up so that instantaneous observed readings would be recorded by the electronic data acquisition system and averaged over 15-minute time periods. All readings will be recorded and archived for review by NYSDOH and NYSDEC personnel.

Appendices

Appendix A

Generic Community Air Monitoring Plan

New York State Department of Health
Generic Community Air Monitoring Plan

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical-specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

§ 253-29. Effluent limitations and concentrations.

The concentration in wastewater discharged into the city sanitary sewer system of any of the following pollutants, when averaged over a thirty-day period, shall not exceed the values specified below. The thirty-day average concentrations shall be computed using at least four (4) individual twenty-four-hour composite samples taken during a thirty-day period. In addition, the concentration of any single twenty-four-hour composite sample shall not exceed three (3) times the thirty-day average. These limitations shall apply to each and every individual industrial sewer lateral at a point immediately prior to discharge to the city sanitary sewer system.

Pollutant	30-Day Allowable Effluent Concentration (milligrams/liter)	24-Hour Allowable Effluent Concentration (milligrams/liter)
Cadmium, total	1	3
Chromium, total	8	24
Copper, total	1	3
Cyanide, total	0.3	0.9
Iron, total	40	120
Lead, total	10	30
Manganese, total	5	15
Mercury, total	4	12
Nickel, total	7	21
Zinc, total	10	30
Phenol	10	30
Irichlosoethylene	3	9
Tetrachloroethylene	3	9
1,1,1, trichloroethylene	0.5	1.5

§ 253-30. Restricted discharges.

No person shall discharge or permit the discharge or infiltration into the city sewer system of the following wastes unless prior written approval is granted by the City Engineer, subject to the limitations and requirements of § 253-31 of this Part 3:

A. Wastes containing more than three hundred (300) milligrams per liter of BOD. **[Amended 4-18-1994]**

B. Wastes containing more than three hundred fifty (350) milligrams per liter of total suspended solids.[8]

C. Wastes containing more than forty (40) milligrams per liter of total Kjeldahl nitrogen.

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[8] **Editor's Note: Former Subsection C, which immediately followed this subsection and restricted wastes containing phosphorus, was deleted 4-18-1994. Said ordinance also relettered former Subsection D as Subsection C.**

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored **continuously** at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring partculate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

June 20, 2000

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Appendix B

Fugitive Dust Suppression and Particulate Monitoring Programs at Inactive Hazardous Waste Sites

TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM #4031

FUGITIVE DUST SUPPRESSION AND PARTICULATE MONITORING PROGRAM AT INACTIVE HAZARDOUS WASTE SITES

TO:	Regional Hazardous Waste Remediation Engrs., Bur. Directors & Section Chiefs
FROM:	Michael J. O'Toole, Jr., Director, Division of Hazardous Waste Remediation
SUBJECT:	DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM -- FUGITIVE DUST SUPRESSION AND PARTICULATE MONITORING PROGRAM AT INACTIVE HAZARDOUS WASTE SITES
DATE:	Oct 27, 1989

Michael J. O'Toole, Jr. (signed)

1. Introduction

Fugitive dust suppression, particulate monitoring, and subsequent action levels for such must be used and applied consistently during remedial activities at hazardous waste sites. This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

2. Background

Fugitive dust is particulate matter--a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles, liquid droplets or solids, over a wide range of sizes--which becomes airborne and contributes to air quality as a nuisance and threat to human health and the environment.

On July 1, 1987, the United States Environmental Protection Agency (USEPA) revised the ambient air quality standard for particulates so as to reflect direct impact on human health by setting the standard for particulate matter less than ten microns in diameter (PM_{10}); this involves fugitive dust whether contaminated or not. Based upon an examination of air quality composition, respiratory tract deposition, and health effects, PM_{10} is considered conservative for the primary standard--that requisite to protect public health with an adequate margin of safety. The primary standards are 150 ug/m^3 over a 24-hour averaging time and 50 ug/m^3 over an annual averaging time. Both of these standards are to be averaged arithmetically.

There exists real-time monitoring equipment available to measure PM_{10} and capable of integrating over a period of six seconds to ten hours. Combined with an adequate fugitive dust suppression program, such equipment will aid in preventing the off-site migration of contaminated soil. It will also protect both on-site personnel from exposure to high levels of dust and the public around the site from any exposure to any dust. While specifically intended for the protection of on-site personnel as well as the public, this program is not meant to replace long-term monitoring which may be required given the contaminants inherent to the site and its air quality.

3. Guidance

A program for suppressing fugitive dust and monitoring particulate matter at hazardous waste sites can be developed without placing an undue burden on remedial activities while still being protective of health and environment. Since the responsibility for implementing this program ultimately will fall on the party performing the work, these procedures must be incorporated into appropriate work plans. The following fugitive dust suppression and particulate monitoring program will be employed at hazardous waste sites during construction and other activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Such activities shall also include the excavation, grading, or placement of clean fill, and control measures therefore should be considered.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM_{10}) with the following minimum performance standards:

   Object to be measured: Dust, Mists, Aerosols
   Size range: <0.1 to 10 microns
   Sensitivity: 0.001 mg/m^3
   Range: 0.001 to 10 mg/m^3
   Overall Accuracy: ±10% as compared to gravimetric analysis of stearic acid or reference dust

   Operating Conditions:
      Temperature: 0 to 40°C
      Humidity: 10 to 99% Relative Humidity

   Power: Battery operated with a minimum capacity of eight hours continuous operation

   Automatic alarms are suggested.

   Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes. Consequently, instrumentation shall require necessary averaging hardware to accomplish this task; the P-5 Digital Dust Indicator as manufactured by MDA Scientific, Inc. or similar is appropriate.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the entity operating the equipment to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m^3 over the integrated period not to exceed 15 minutes. While conservative, this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m^3, the upwind background level must be measured immediately using the same portable monitor. If the working site particulate measurement is greater than 100 ug/m^3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see Paragraph 7). Should the action level of 150 ug/m^3 be exceeded, the Division of Air Resources must be notified in writing within five working days; the notification shall include a description of the control measures implemented to prevent further exceedences.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM_{10} at or above the action level. Since this situation has the potential to migrate contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

    1. Applying water on haul roads.
    2. Wetting equipment and excavation faces.
    3. Spraying water on buckets during excavation and dumping.
    4. Hauling materials in properly tarped or watertight containers.
    5. Restricting vehicle speeds to 10 mph.
    6. Covering excavated areas and material after excavation activity ceases.
    7. Reducing the excavation size and/or number of excavations.

    Experience has shown that utilizing the above-mentioned dust suppression techniques, within reason as not to create excess water which would result in unacceptable wet conditions, the chance of exceeding the 150 ug/m^3 action level at hazardous waste site remediations is remote. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. If the dust suppression techniques being utilized at the site do not lower particulates to an acceptable level (that is, below 150 ug/m^3 and no visible dust), work must be suspended until appropriate corrective measures are approved to remedy the situation. Also, the evaluation of weather conditions will be necessary for proper fugitive dust control--when extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended.

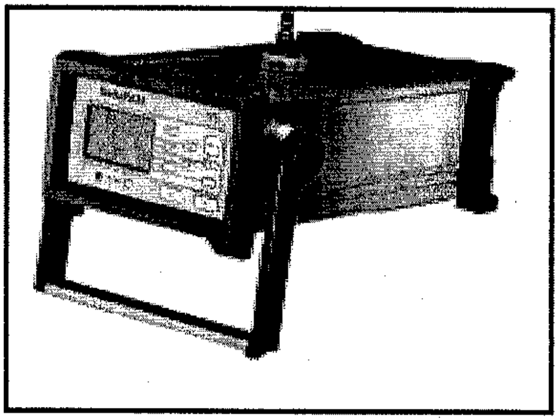
There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require appropriate toxics monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

Appendix C

Monitoring Equipment Specifications

MIE DataRAM Aerosol Monitor

Portable Real-Time Particulate Monitor



- **Real-time measurement of particle concentrations**
- **Datalogging**

The DataRAM aerosol monitor measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, continuous unattended monitoring of indoor, duct or process air, as well as environmental and perimeter monitoring. The DataRAM has the widest measurement range of any real-time aerosol monitor — from 0.0001 mg/m^3 to 400 mg/m^3, or a total span of almost seven decades.

OPTIONAL ACCESSORIES

Respirable Cyclone Precollector, for respirable particle monitoring.
Isokinetic Sampling Probe, for isokinetic sampling within ducts.
Temperature Conditioning Heater, for monitoring above 70 percent RH.
Omnidirectional Sampling Inlet, for ambient monitoring under a variety of wind speeds and directions.
PM-10 Inlet Head, for PM-10 or PM-2.5 ambient particulate monitoring.

SPECIFICATIONS

Concentration Measurement Ranges (autoranging)	0.1 to 999.99 µg/m^3, with resolution of 0.1 µg/m^3 1.00 to 39.99 mg/m^3, with resolution of 0.01 mg/m^3 40.0 to 399.9 mg/m^3, with resolution of 0.1 mg/m^3
Accuracy	± 5% of reading ± precision
Particle Size Range of Maximum Response	0.1 to 10 µm
Sample Flow Rate	1.7 to 2.3 lpm
Datalogging	10,000 data points, with average, minimum and maximum concentrations for each point
Output	RS-232 port
Power	Sealed lead-acid battery, 24 hours operation, or AC operation with adapter
Dimensions (HWD)	5.28" x 7.25" x 13.63"
Weight	11.7 lbs

The MIE DataRAM aerosol monitor rents with an AC adapter/charger, serial download cable, software, filter cassette, soft carrying case and operating manual.

ASHTEAD Technology RENTALS
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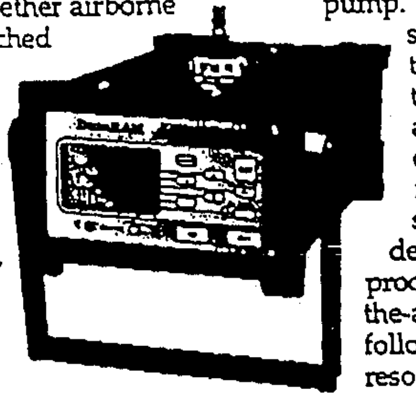
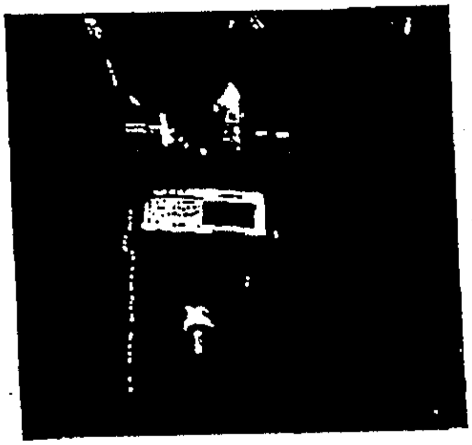
The World's Most Precise and Ve

Real-Time Measurement of Airborne Particulate Concentrations

With the DataRAM™, you'll never again have to wait for laboratory results to assess whether airborne pollutants have reached dangerous levels. The DataRAM Real-Time Aerosol Monitor measures mass concentrations of airborne dust, smoke, mists, haze, and fumes and provides continuous real-time readouts. Large-capacity onboard data logging capability lets you save concentration data for future analysis. With optional accessories, the DataRAM can also provide respirable, PM-2.5, or PM-10 correlated measurements.





For exposure sampling or continuous unattended indoor air, ambient, duct, or process monitoring, no other aerosol monitor is as fast, accurate, and easy to use as the DataRAM.

Designed for High Sensitivity

A high-sensitivity nephelometric monitor, the DataRAM samples the air at a constant, regulated flow rate by means of a built-in diaphragm pump. The DataRAM's light scattering configuration is optimized for the measurement of airborne particle concentrations, maximizing the unit's sensitivity. The detected signal is processed by state-of-the-art lock-in circuitry followed by high-resolution digitization, achieving ultimate detectability of atmospheric Rayleigh scattering fluctuations.

The Widest Measurement Range of Any Real-Time Particulate Monitor

In addition to its high sensitivity, the DataRAM has the widest measurement range of any real-time aerosol monitor—from 0.0001 mg/m^3 (0.1μg/m^3) to 400 mg/m^3. With a total span of almost 7 decades, the DataRAM is capable of effectively measuring mass concentrations of airborne particles in industrial and ambient environments ranging from exceptionally pristine to extremely polluted. The instrument can also be used for atmospheric visibility measurements over a wide range of scattering coefficients (0.00015 to 600 km^{-1}). The DataRAM's auto-ranging digital display provides both real-time and time-averaged concentrations.

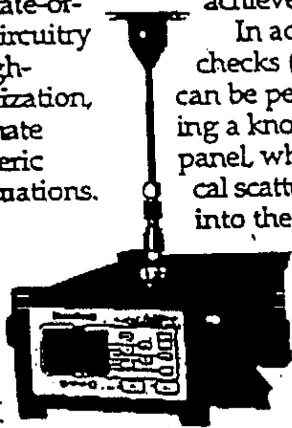
Exceptional Long-Term Stability

The DataRAM incorporates several technological advances which guarantee exceptional long-term stability. Near infrared source output feedback control provides drift-free operation and excellent temperature stability.

For either manual or preprogrammed/automatic zeroing of the monitor, an electronically controlled latching solenoid valve diverts the entire filtered air stream through the optical sensing stage in order to achieve a "zero" air reference.

In addition, instrument span checks (secondary calibration) can be performed simply by turning a knob on the DataRAM's back panel, which inserts a built-in optical scattering/diffusing element into the filtered air stream.

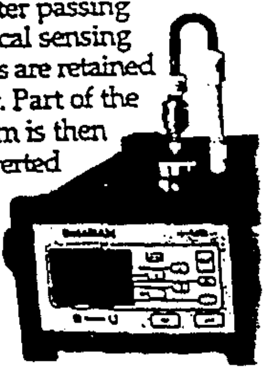
On-screen diagnostic indicators and automatic shut-off for low battery conditions also help ensure the monitor's correct operation and data storage.



DataRAM with Omnidirectional Sampling Inlet for ambient monitoring

Maintenance-Free Operation

After passing through the optical sensing stage, all particles are retained on a HEPA filter. Part of the filtered air stream is then continuously diverted through and

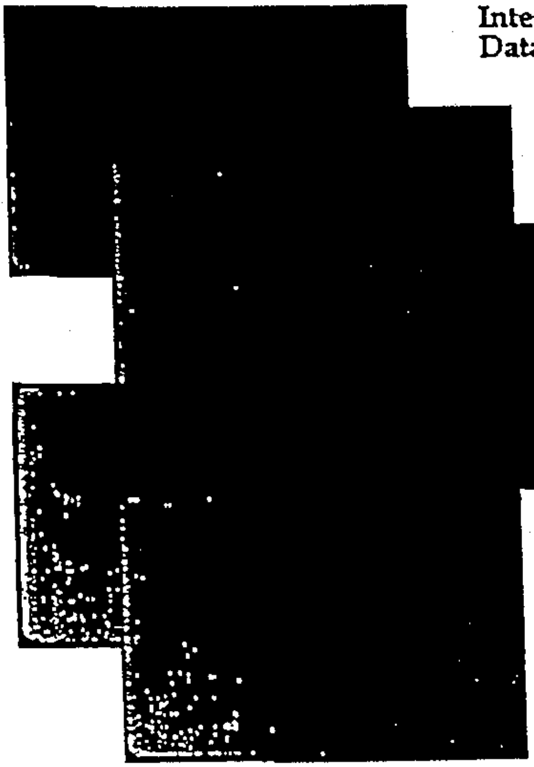


DataRAM with Cyclone Precollector for respirable particle measurements

satile Real-Time Aerosol Monitor

over all optically-sensitive areas (lenses, light traps, etc.) to form a continuous air curtain which protects against particle deposition. This design, in conjunction with a highly reliable diaphragm pump, ensures long-term maintenance-free operation.

A membrane filter (with special holder included) can be substituted for the HEPA cartridge for gravimetric and/or chemical analysis of the particles collected downstream of the sensing stage.



Menu-Driven Information Displays

In addition to the auto-ranging real-time concentration readout, the DataRAM provides users with a variety of informational displays on its 8-line LCD screen. Real-time and date, time-weighted average concentrations, elapsed run times, and other information are easily viewed by selecting the appropriate screen using a scroll-through menu. Operating parameters and diagnostic information displays can also be easily accessed through the menu using only 6 keys on the front of the instrument.

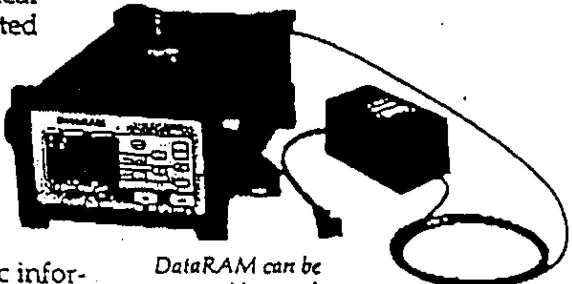
Integral Large-Capacity Data Logger

The DataRAM has built-in large-capacity data logging capabilities. Stored information includes time and date, average concentrations, maximum and minimum values over selected periods, STEL concentration, and tagging codes.

Logged information can be retrieved either by scrolling through the DataRAM's display or by down-loading to an external device such as a personal computer or printer.

Digital, Analog, and Alarm Outputs

The DataRAM provides continuous digital output (by means of an RS232C data port) as well as analog output and a switched output for selectable high-level alarm with a built-in audible signal.

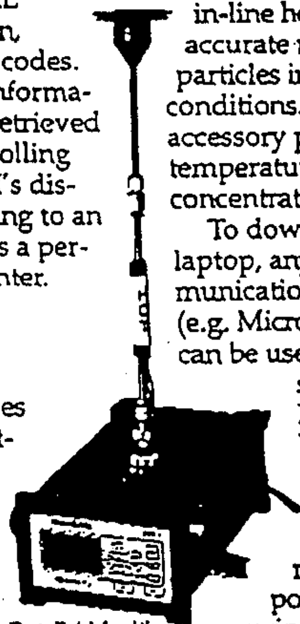


DataRAM can be powered by a rechargeable internal battery or an external power source

Accessories Expand Versatility and Enhance Accuracy

Several optional accessories are available for use with the DataRAM for a wide range of sampling applications. A cyclone precollector allows respirable particle measurements. An omnidirectional air sampling inlet (with or without a PM-10/2.5 head) is available for ambient monitoring. Isokinetic inlet nozzles are available for duct sampling. An in-line heater module allows accurate monitoring of solid particles in high humidity/fog conditions. A sample dilution accessory permits elevated temperature and/or very high concentration monitoring.

To down-load data to a PC or laptop, any standard serial communications software package (e.g. Microsoft Windows™ 3.1) can be used. Standard spreadsheet packages (such as Microsoft Excel™, Lotus™, and others) can easily access and analyze data log files transmitted to a PC fc review and archiving. A portable battery-powered printer and cabling accessories are also available.



DataRAM with In-Line Heater for monitoring in high humidity or fog

Specifications

Concentration measurement ranges (auto-ranging)[1]:
0.1 to 999.9 μg/m^3 (resolution: 0.1 μg/m^3)
1.00 to 39.99 mg/m^3 (resolution: 0.01 mg/m^3)
40.0 to 399.9 mg/m^3 (resolution: 0.1 mg/m^3)

Scattering coefficient range: 1.5×10^{-7} to 6×10^{-1} m^{-1} (approximate) at $\lambda = 880$ nm

Concentration display averaging/updating interval[2]: 1 or 10 seconds

Precision/repeatability over 1 hour (2-sigma)[3]:
± 0.3 μg/m^3 for 10 second averaging
± 1.0 μg/m^3 for 1 second averaging

Accuracy[1]: ± 5% of reading ± precision

Particle size range of maximum response: 0.1 to 10 μm

Sampling flow rate[2]: 1.7 to 2.3 liters/minute

Sampling flow rate stability (long term)[4]: ± 5% (up to maximum pump loading)

Purge/clean air filter replacement time (typical): >5 years (@ constant 1 mg/m^3)

Alarm level adjustment range[2]: 0.1 μg/m^3 to 399.9 mg/m^3

Alarm averaging time[2]: real-time (1 or 10 seconds), or STEL (15 minutes)

Data logging averaging periods[2]: 1 second to 4 hours

Total number of data points in memory: 10,000 (each point: average, minimum, and maximum concentrations)

Logged data:

- For each data point: average, minimum, and maximum concentrations; time/date; and data point number
- Run summary: tag number of logged points; start time/date; total elapsed run time; averaging time; data logging averaging period; calibration factor; STEL concentration; STEL occurrence time after start; overall average concentration; overall maximum and minimum concentrations with data point number

Number of data tags: 10

Real time and date data: seconds; minutes; hours; day of month; month and year (with leap year compensation)

Clock accuracy: ± 1 minute/month, or better

Elapsed time range: 1 second to 99 days

Time keeping and data storage duration: >10 years

Readout display: LCD 120 x 64 dots, 15 characters x 8 lines, 57.6 x 38.4 mm active area

Internal battery: rechargeable sealed lead-acid: 6.5 Ahr; 6 V nominal

Operating time with new battery and initial full battery charge[4]: >24 hours

Operating time with DataRAM charger: continuous and unlimited

Charging input power: 115/230 VAC, 50/60 Hz, 50 VA

External DC power (optional): 6 V @ 3 A

Analog output (auto-ranging)[5]:
0 to 5 V, for 0 to 4 mg/m^3
0.5 to 5 V, for 4 to 40 mg/m^3
0.5 to 5 V, for 40 to 400 mg/m^3

Digital output: RS232C, 9600 baud; 8 data bits, 1 stop bit; parity: none

Alarm output: switched, 1 A @ 10 V maximum, resistance <0.1 Ω

Alarm sound intensity: 90 dB @ 1 m

Fuse: 1 A, fast

Operating environment: 0° to 40°C (32° to 104°F), 0 to 95% RH, noncondensing

Storage environment: -20° to 60°C (-4° to 140°F)

Dimensions: 134 mm (5.28 in) H x 184 mm (7.25 in) W x 346 mm (13.63 in) D

Weight: 5.3 kg (11.7 lbs)

Standard accessories included: universal voltage battery charger, standard HEPA filter cartridge, analytical filter holder, PC communications software disk, digital output cable, carrying case, and instruction manual

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[1] Referred to gravimetric calibration with AC Fine test dust (mmd = 2 to 3 μm, $\sigma g = 2.5$)
[2] User selectable
[3] At constant temperature
[4] At 25°C
[5] Range identified on LCD screen

MIE

RR

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MIE

DataRAM Accessories

A complete line of accessories designed to extend and complement the capabilities and applications of the MIE DataRAM™, the most advanced and powerful real-time particulate monitor available. These modular accessories permit ambient air monitoring over a wide range of wind, temperature and humidity conditions, dilution sampling of high temperature/high concentration streams, respirable particle monitoring, data printout in the field, PC interfacing, etc.

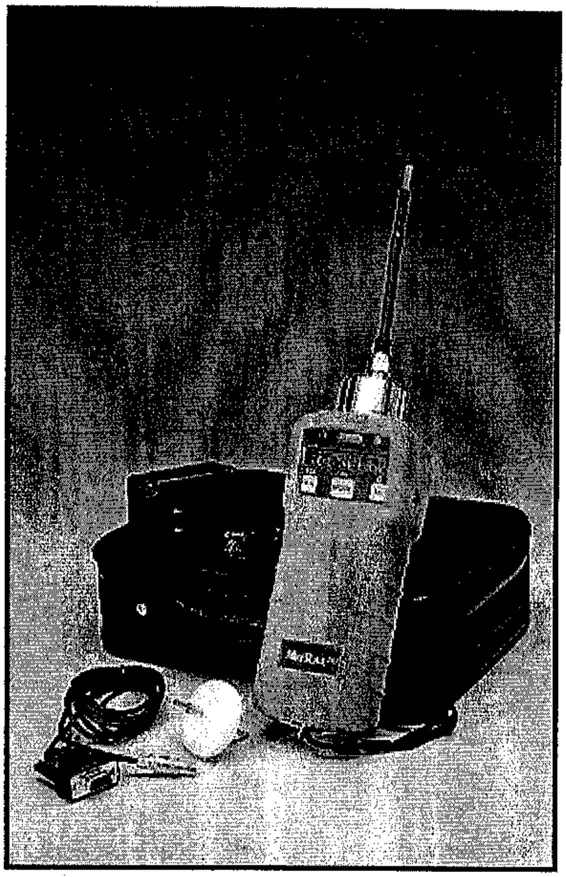
NAME (MODEL NUMBER)	DESCRIPTION	APPLICATIONS
Omnidirectional Sampling Inlet (DR-OSI)*	Annular type sampling inlet designed, for a flowrate of 2 lpm, to provide a smooth transition between horizontal wind borne particle motion and vertical flow into DataRAM monitor.	Ambient monitoring under a variety of wind speeds and directions to ensure representative sampling especially for particles smaller than 10µm.
Temperature Conditioning Heater (DR-TCH)*	An in-line tubular heater without flow obstructions, designed to raise the temperature and reduce the relative humidity of the sampled air stream.	Ambient monitoring at high humidity conditions (typically above 70% RH) in order to evaporate liquid water from airborne particles and/or eliminate fog droplets. Normally used in combination with DR-OSI and DR-PM10/2.5.
PM-10/PM-2.5 Inlet Head (DR-PM10/2.5)*	A modular impactor for 10µm or 2.5µm cutpoint (at 2 lpm) with easily interchangeable nozzles. The DR-PM10/2.5 is designed to be used in combination with the DR-OSI and/or the DR-TCH.	Specifically intended for PM-10 or PM-2.5 ambient particulate monitoring. Typically used in line with the Omnidirectional Sampling Inlet (DR-OSI) which plugs into the DR-PM10/2.5.
Isokinetic Sampling Nozzle Set (RAM-ISN)	Made of stainless steel, it consists of a two-section sampling probe, four (4) interchangeable nozzles covering the range of 750 and 5000 ft/min., tubing, fittings, and carrying case.	To be used to sample isokinetically within ducts and stacks with the DataRAM monitor. Can be used in combination with the DR-TCH to remove water aerosols.
Respirable Cyclone Precollector (DR-RCP10)	Consists of a Dorr-Oliver 10-mm nylon cyclone and fittings for quick connect to DataRAM inlet.	For respirable particle monitoring. Flowrate on DataRAM can be adjusted to provide either "old" 3.5µm or "new" 4.0µm particle cut points.

---

*Included in Ambient Sampling Inlet Set (model DR-AVS).

MiniRAE 2000
Handheld VOC Monitor

- **Intrinsically safe**
- **Smallest handheld VOC monitor**
- **Datalogging workhorse**



This VOC monitor with PID (photoionization detector) sensor weighs just over one pound, yet it's a heavyweight for leak detection, fugitive emissions monitoring to EPA Method 21 and inspecting leaking underground storage tanks. The MiniRAE 2000 is also a highly useful tool in industrial hygiene applications, including confined space entry, personnel and work place monitoring and for emergency response to hazardous spills. This rugged instrument comes with a belt clip.

With built-in correction factors for more than 100 chemicals, the MiniRAE 2000 provides excellent all-around sensitivity to most VOCs, down to 0.1 ppm. Selectable survey and hygiene modes permit the user to set appropriate alarm thresholds for STEL, TWA and low/high level peak values. Datalogging and custom software.

SPECIFICATIONS

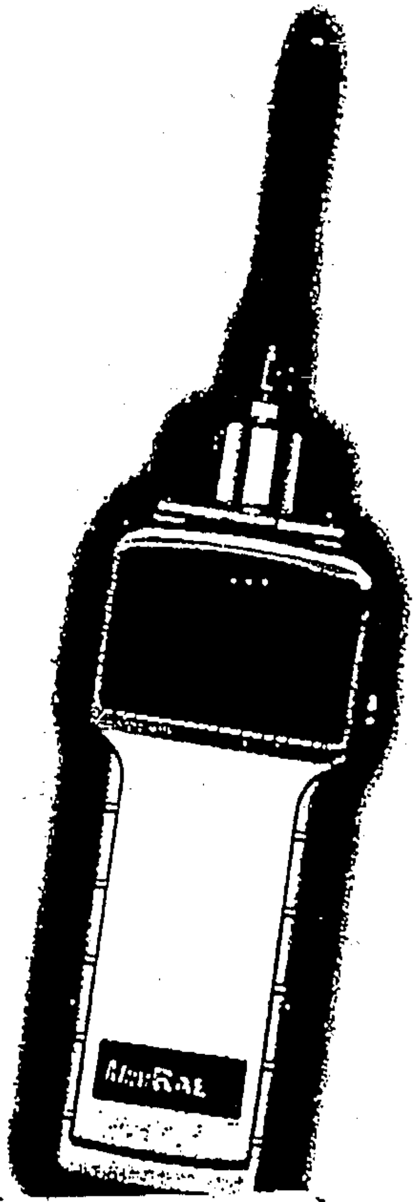
Range	Resolution	Response Time	Accuracy
0 to 999 ppm	0.1 ppm	< 3 seconds	± 2 ppm or 10% of reading <2000 ppm
100 to 10,000 ppm	1 ppm	< 3 seconds	± 20% of reading > 2000 ppm
			Calibrated to 100 ppm isobutylene

Sampling Pump	Internal integrated flow rate 400 cc/minute Sample from 100' horizontally or vertically
Datalogging	15,000 points with time/date, header information
Approvals	UL and cUL Class I, Division 1, Groups A, B, C and D, EEx ia IIC T4
Battery	Rechargeable, field changeable NiMH battery pack, 10 hours operation
Dimensions (HWD)	2" x 3" x 8.2"
Weight	19.5 oz

RAE SYSTEMS MiniRAE 2000 PID rents with download cable, zero filter, probe tip, hydrophobic filter, charger, alkaline battery adapter, case and operating manual.

MiniRAE 2000

Portable VOC Monitor



- Still the smallest handheld VOC monitor on the market
- New RAE Photo-Ionization Detector (PID) 3-D sensor
  - Easily accessible lamp and sensor
  - Reduced humidity interference
  - Improved linearity
  - Increased sensitivity
  - Extended range 0-10,000 ppm
- Strong, built-in sample draw pump with pump stall feature
  - Sample up to 100' (30m) horizontally or vertically
  - Prevents liquid flow into the monitor
  - Warns if sample tubing is blocked or crimped
- External, field replaceable NMH rechargeable battery
  - 10 hours of continuous monitoring
  - Smart battery charging
  - Alkaline battery holder supplied
  - Automotive charger available
- Robust inlet probe
- Large keys operable with 3 layers of gloves
- Large easy to read back light display
  - Alarm activated
  - Darkness or manually activated
- Preset alarm thresholds for STEL, TWA, low and high level peak values. Audio buzzer and flashing LED display will be activated when the limits are exceeded
- 15,000 point data logging storage capacity for data download to PC
- Rubber protective boot
- 102 built-in correction factors from a RAE list of 250+ chemicals
- User selectable hygiene and survey modes
- Protected from portable radios
- Ppm or mg/m^3 readout

Environmental Applications

- Air pollution — trace, toxic gases
- Leaking underground storage tanks
- Monitoring drums, perimeter fence line
- Leak detection — fugitive emissions (EPA Method 21)
- Soil, well and water head space analysis
- Vapor recovery breakthrough

Industrial Hygiene, Health, Safety and Plant Applications

- Confined space entry — broad band, real time monitoring of low level toxic gases
- Emergency response to hazardous spills
- Indoor air quality in new, sick and mixed usage buildings
- Personnel monitoring — determine levels for personal protective equipment (PPE)
- Survey instrument — prioritization of sample collection
- Work place monitoring — peak, STEL and TWA

800-242-3910 / 716-424-2140 / 714-955-3930 / 713-956-283
(Toll-Free) (Rochester, NY) (Irvine, CA) (Houston, TX)

MiniRAE 2000

Specifications

Size	8.2" (21.8 cm) L x 3." (7.62 cm) W x 2." (5.08 cm) H
Weight	19.5 oz (553 gm) with battery pack
Detector	Photo-ionization sensor with standard 10.6 eV or optional 9.8 or 11.7 eV UV lamp
Battery	Rechargeable, external, field replaceable Nickel Metal Hydride battery pack. Alkaline battery holder (for 4 AA) supplied
Operation Time	10 hours continuous
Battery Charging	Up to 10 hours charge through built-in smart charger
Display	Large LCD, manual, darkness and alarm activated
Range, Resolution and Response Time (t90)	Isobutylene (calibration gas) 0-999 ppm 0.1 ppm < 3 sec 100-10,000 ppm 1 ppm < 3 sec
Measurement Accuracy	± 2 ppm or 10% of reading <2000 ppm ± 20% of reading > 2000 ppm Calibrated to 100 ppm isobutylene
PID Detector	Easy access to lamp and sensor for cleaning and replacement
Correction Factors	102 built-in VOC gases
Calibration	Two points field calibration of zero and standard reference gas. Calibration memory of 8 calibration gases, alarm limits, span values and calibration date
Robust Inlet Probe	Flexible 5" (13 cm) tubing
Large Keypads	1 operation and 2 program keys
Direct Readout	Instantaneous, average, STEL and peak value, battery voltage and elapsed time
Intrinsic Safety	UL & cUL Class 1, Division I, Group A,B,C,D (US & Canada), EEx ia IIC T4 (Europe)
Alarm Setting	Separate preset alarm limit for high, low, STEL and TWA alarm
Operating Mode	Survey or Hygiene, user selectable
Audible Alarm	90 db buzzer
Visual Alarm	Flashing red LED
External Alarm	Optional plug in pen size vibration alarm
Alarm Mode	Latching or automatic reset
Data Logging	15,000 points with time/date. Header information includes monitor serial number, user ID, site ID, date and time
Communication	Download data and up load instrument setup from PC through RS-232 link to serial port. Software compatible with Windows™ 95, 98 and NT
Remote Control	Power On/Off and data logging through RS-232 port
Analog Output	Calibrated output, user selectable full-scale range
Sampling Pump	Internal integrated flow rate 400 cc/minute Sample from 100' (30m) horizontally or vertically
Low Flow Alarm	Auto shut off pump at low flow condition
Temperature	14°F to 104°F (-10°C to 40°C)
Humidity	0 % to 95 % relative humidity (non-condensing)
Attachment	Wrist strap

Ordering Information

Model PGM-7600 Monitor

- MiniRAE 2000 unit with 10.6 eV PID detector
- Nickel metal hydride batteries
- Alkaline battery holder
- Rubber boot
- Inlet probe and water trap filter
- Operation and maintenance manual
- Soft carry case
- Pro-RAE Suite software (data logging version)

Model PGM-7600 Kit

Items included with Monitor Plus

- Calibration Gas
- Calibration Regulator with flow controller
- Porous metal filter and O-ring kit
- Gas outlet port and tubing
- Tool kit
- Hard transport case

Accessories

- 9.8 & 11.7 eV lamps
- Lamp cleaning kit
- Automatic charger
- Remote access probe
- External vibration alarm
- Automotive charger adapter

UL cUL Ex CE ISO 9001 CERTIFIED

ASHTEAD TECHNOLOGY
Environmental Instrument Rentals

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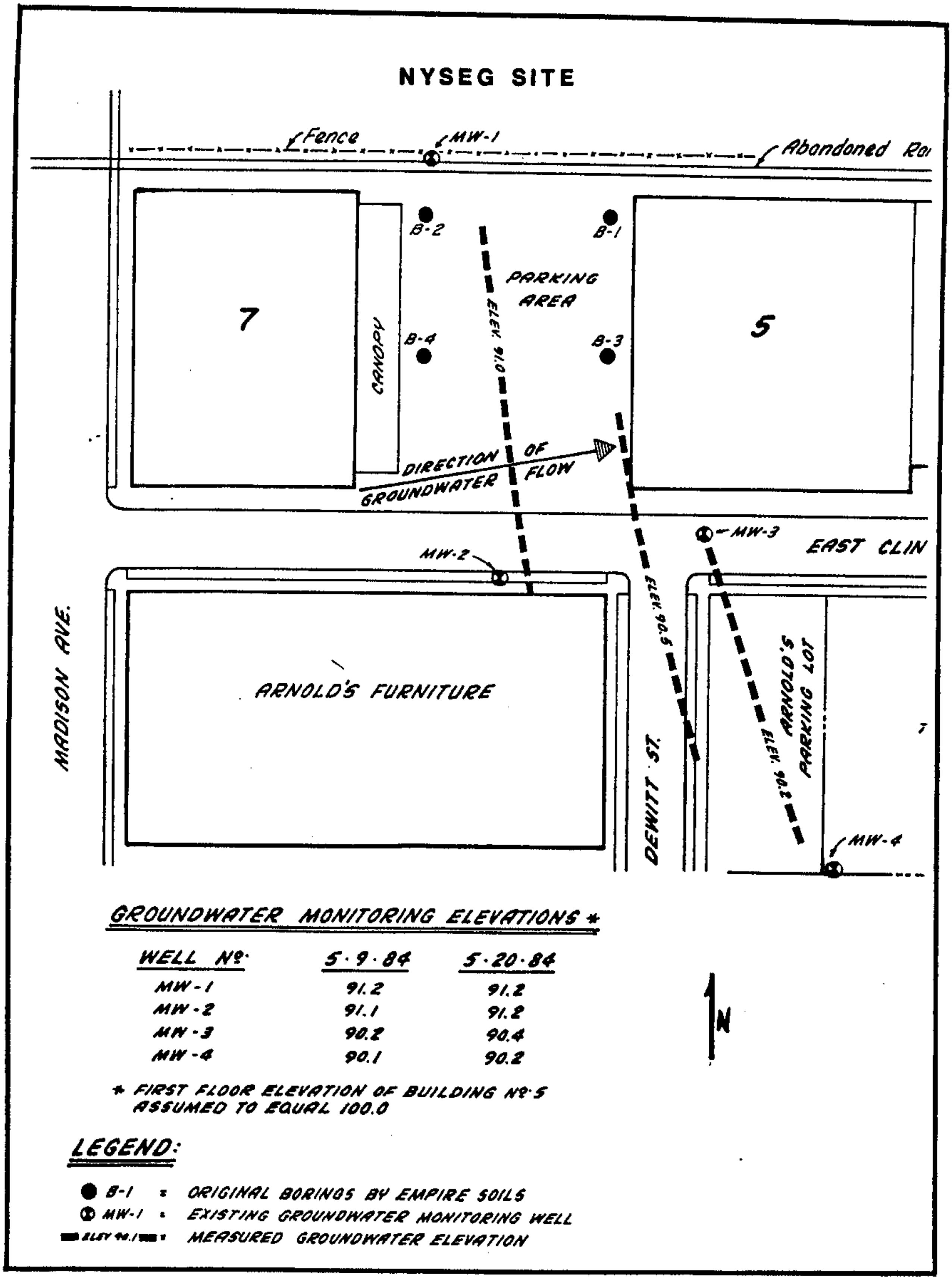
Appendix E

Previous Investigation Locations

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Appendix E-1

Groundwater Investigation Program for Trayer Products, Inc. (June 15, 1984)



GROUNDWATER MONITORING ELEVATIONS *

WELL Nº	5·9·84	5·20·84
MW-1	91.2	91.2
MW-2	91.1	91.2
MW-3	90.2	90.4
MW-4	90.1	90.2

* FIRST FLOOR ELEVATION OF BUILDING Nº 5 ASSUMED TO EQUAL 100.0

LEGEND:

● B-1 = ORIGINAL BORINGS BY EMPIRE SOILS
⊗ MW-1 = EXISTING GROUNDWATER MONITORING WELL
▬ ELEV 90.1 ▬ = MEASURED GROUNDWATER ELEVATION

Figure 3-6. Groundwater contours, monitoring well locations and previous borings on the Trayer Products, Inc. property.

(CLARK ENGINEERS, 1984)

Appendix E-2

Task II Report – Investigation of the Former Coal Gasification Plant Site, Elmira, NY (June 18, 1987)

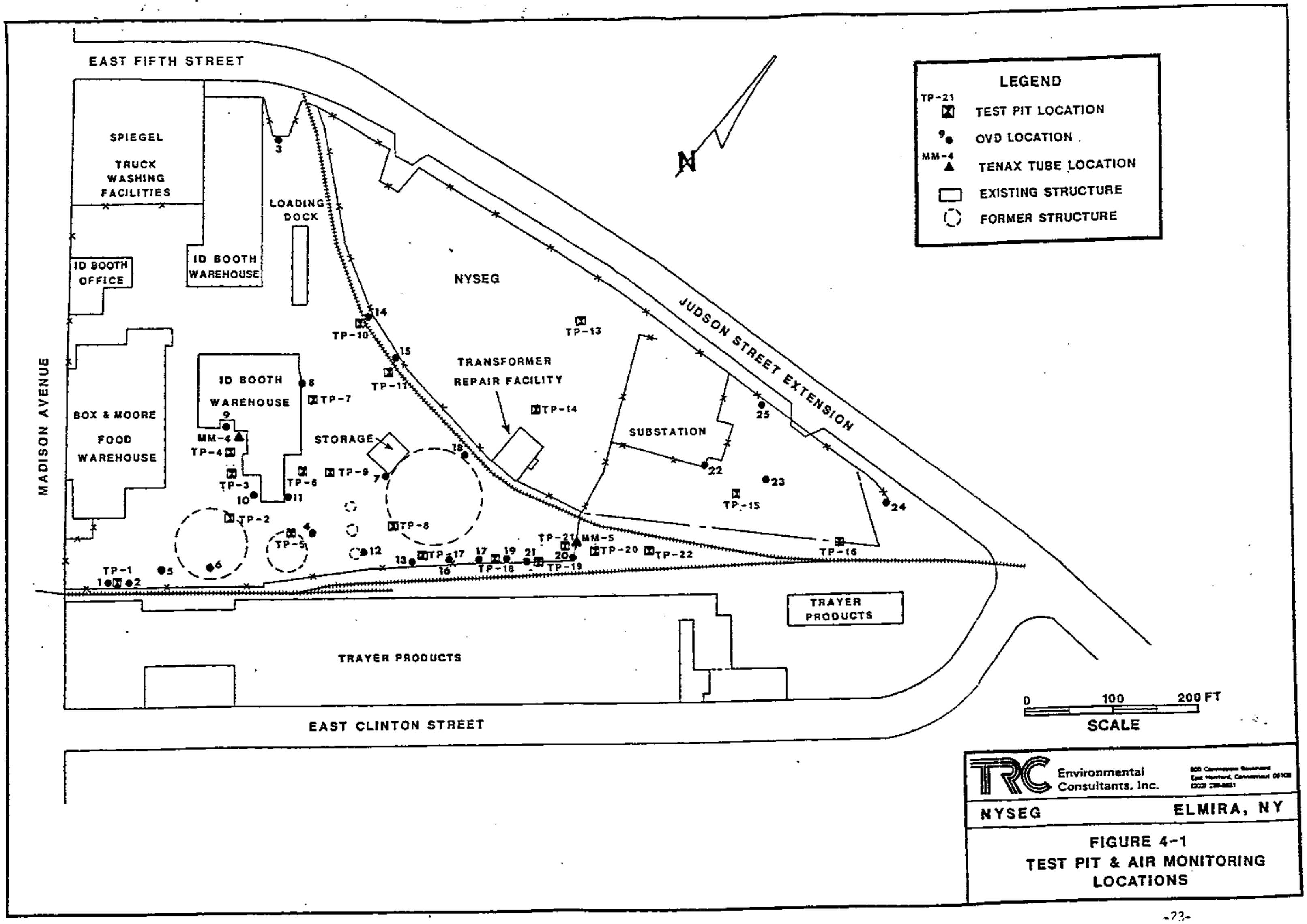


FIGURE 4-1
TEST PIT & AIR MONITORING LOCATIONS

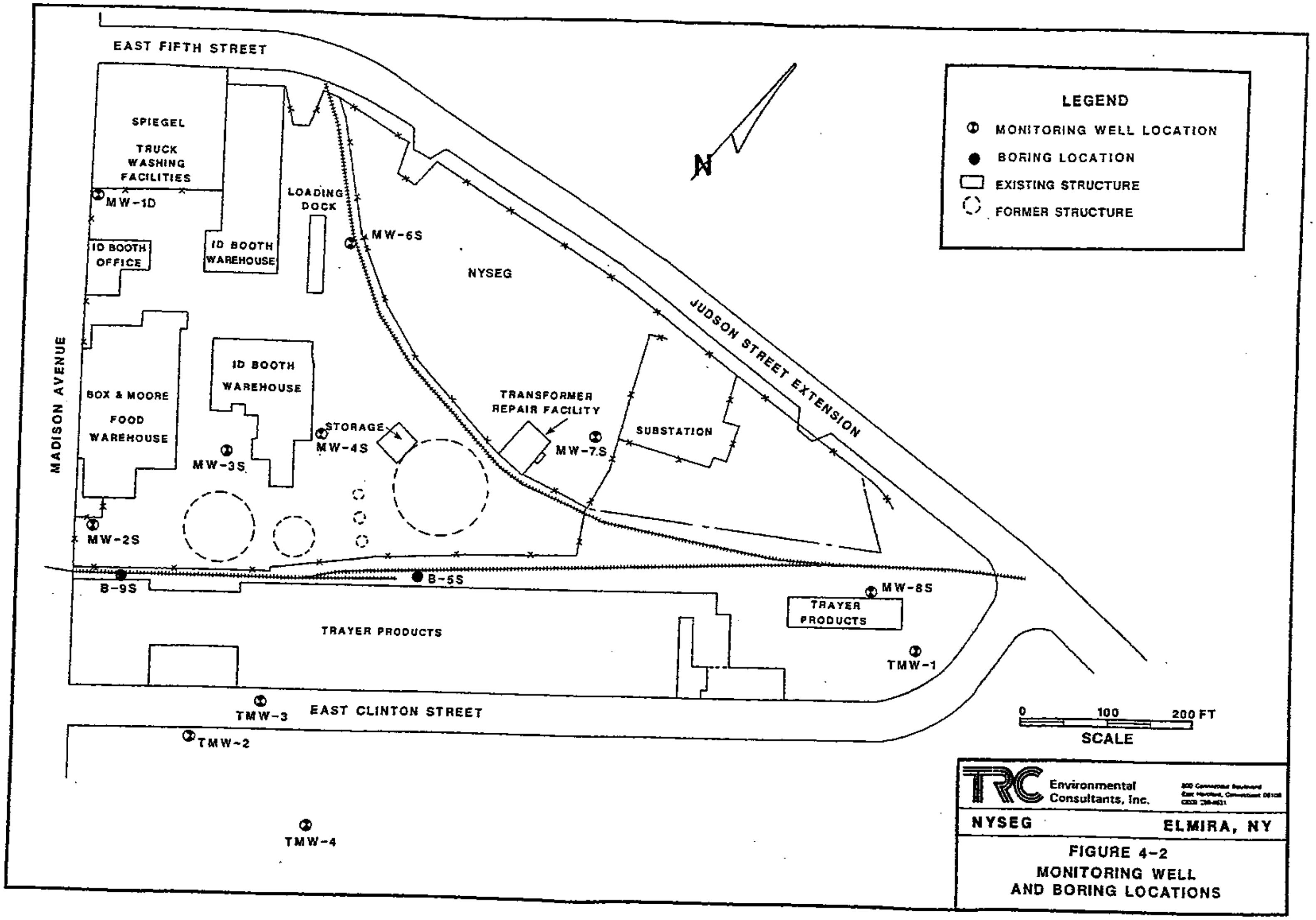
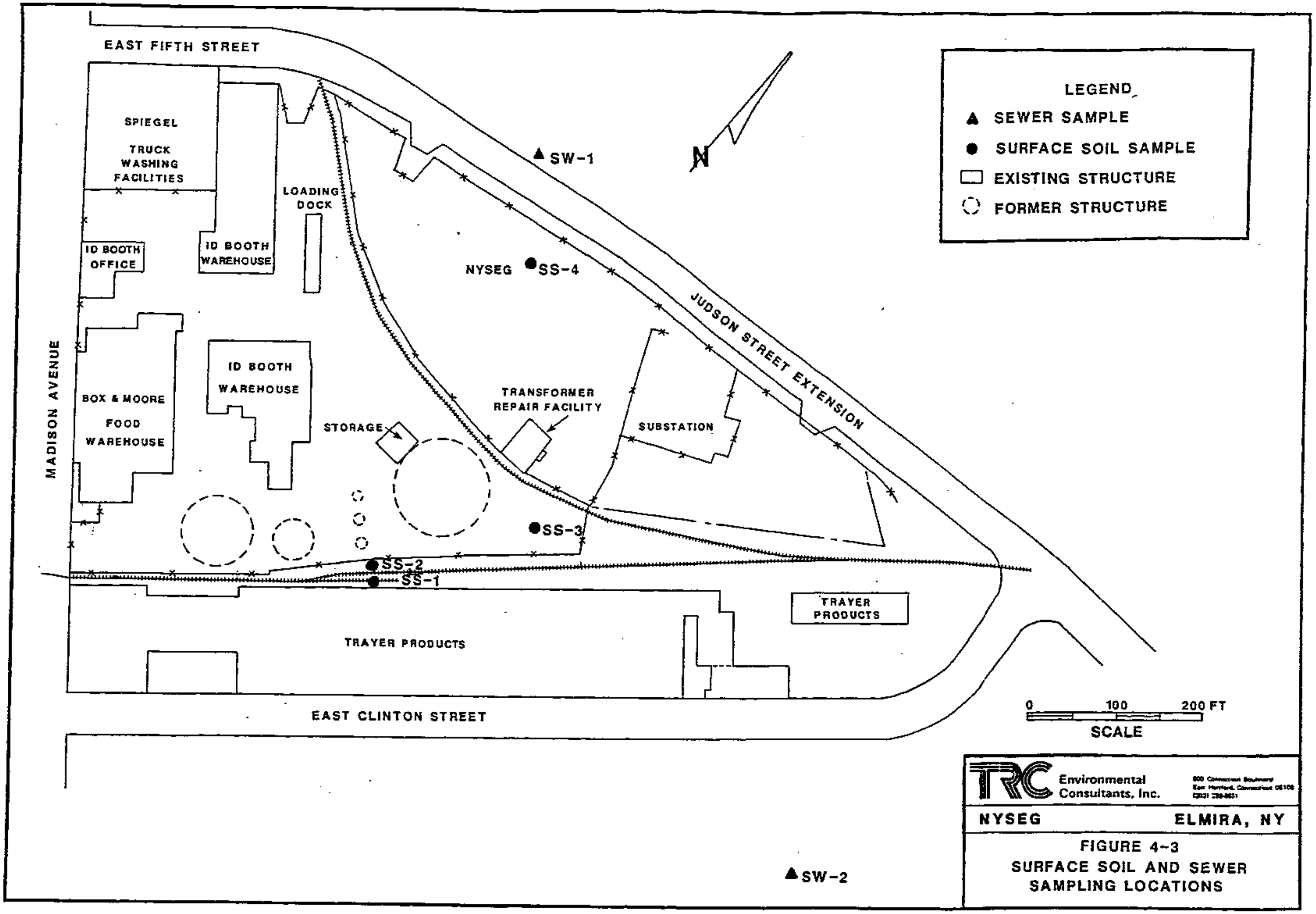


FIGURE 4-2
MONITORING WELL
AND BORING LOCATIONS



NYSEG ELMIRA, NY

FIGURE 4-3
SURFACE SOIL AND SEWER SAMPLING LOCATIONS

Appendix E-3

Task III Report – Investigation of the Former Coal Gasification Plant at Elmira, NY (July 1990)

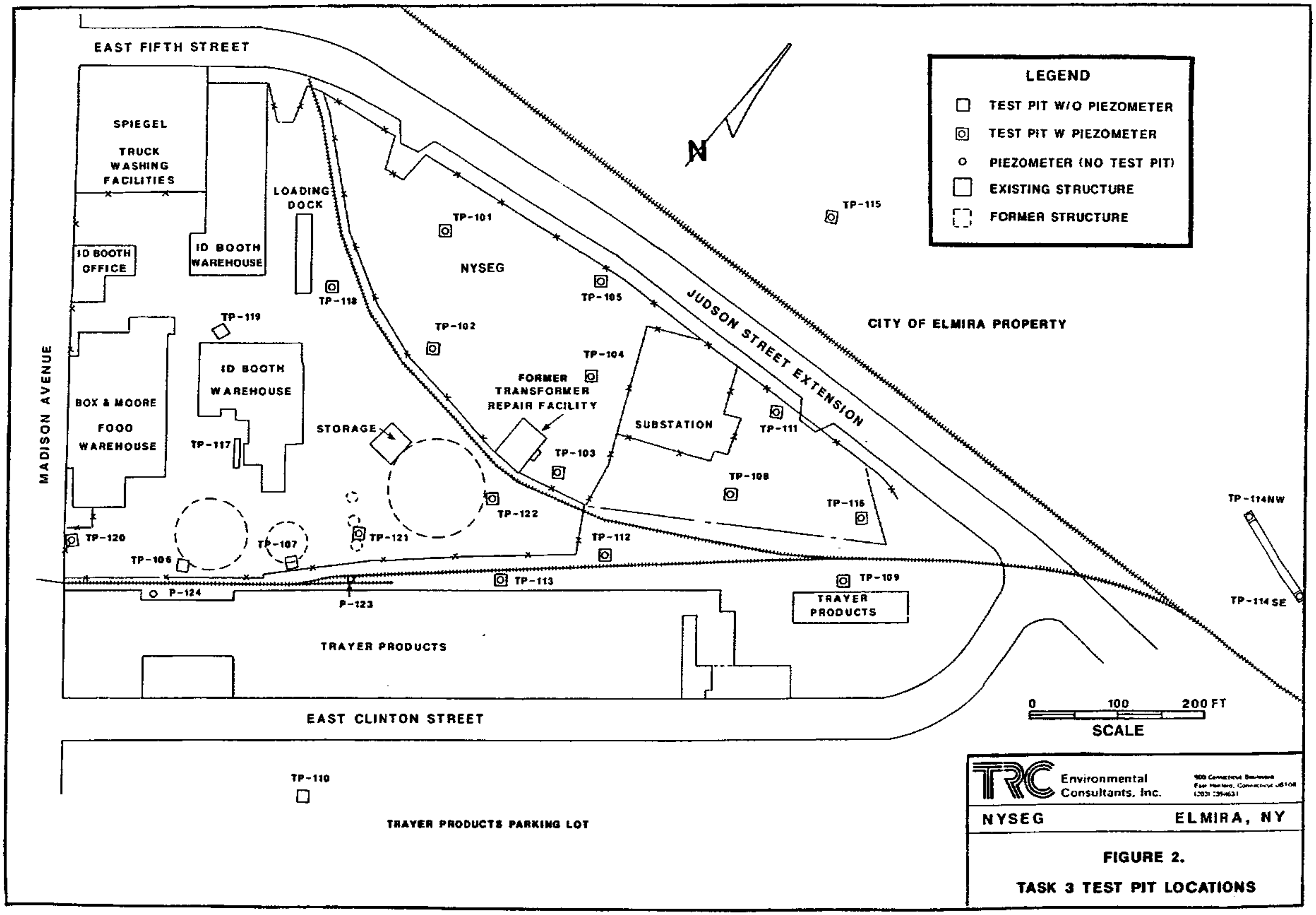


FIGURE 2.

TASK 3 TEST PIT LOCATIONS

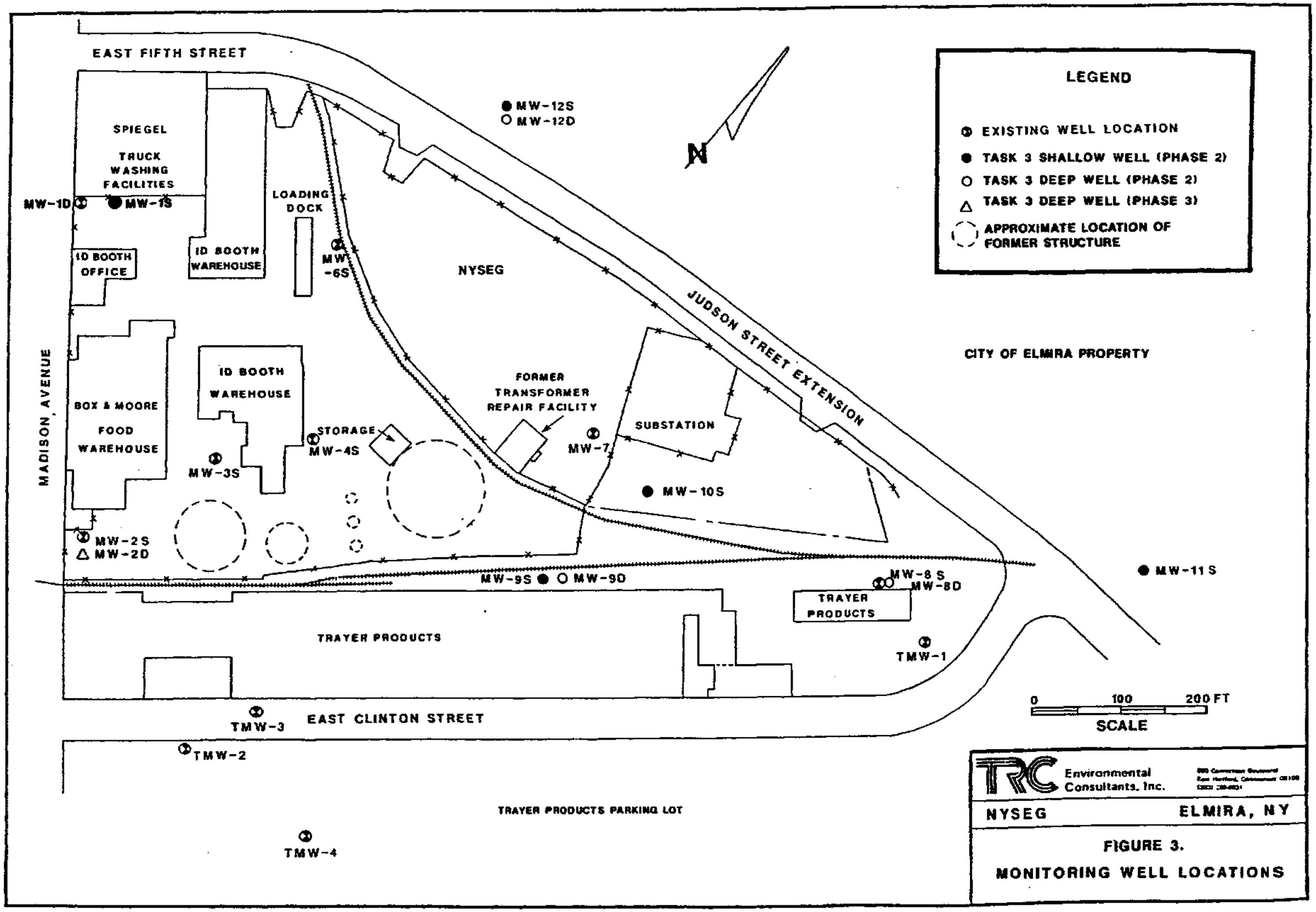


FIGURE 3.

MONITORING WELL LOCATIONS

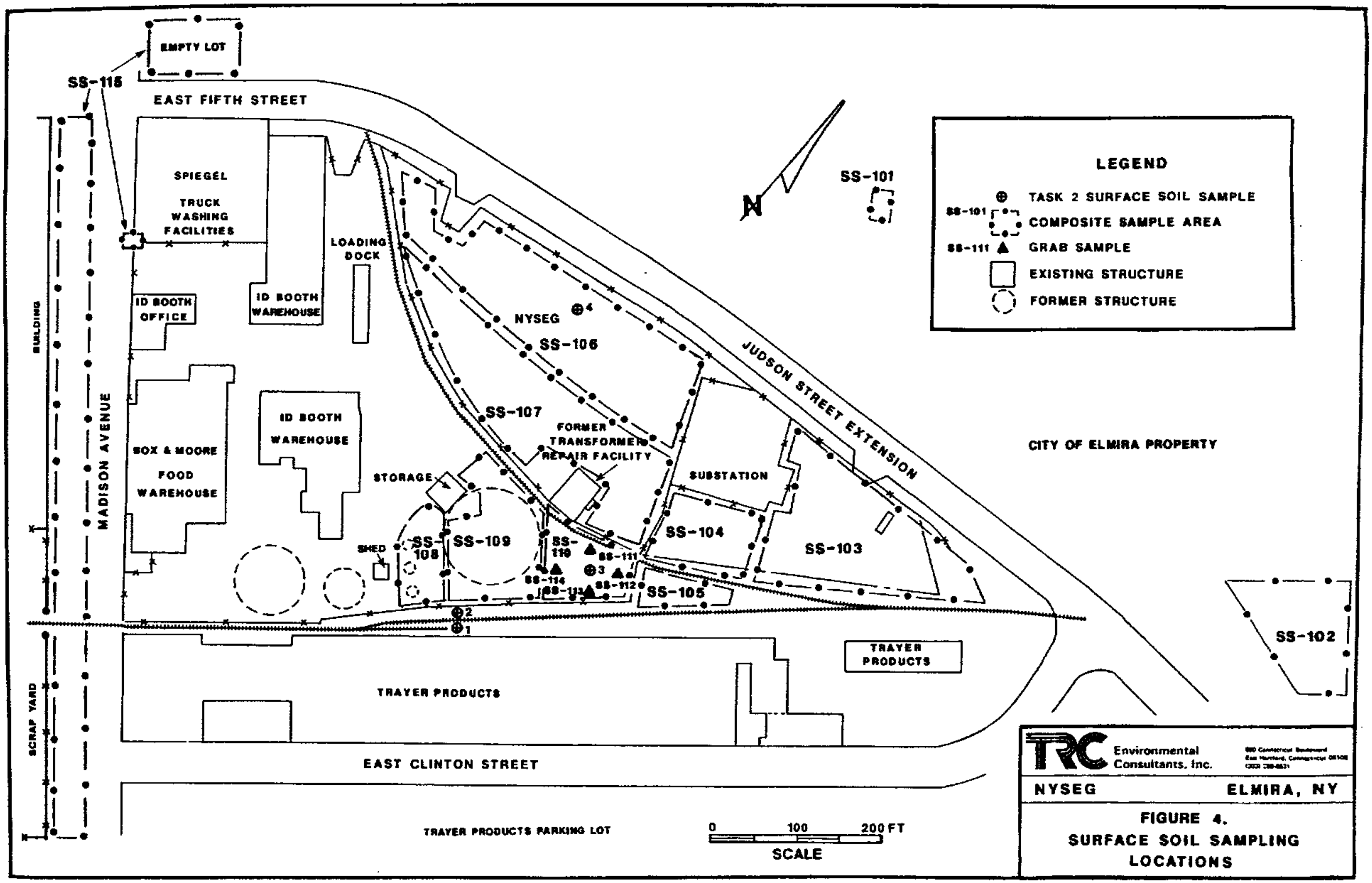


FIGURE 4.
SURFACE SOIL SAMPLING LOCATIONS

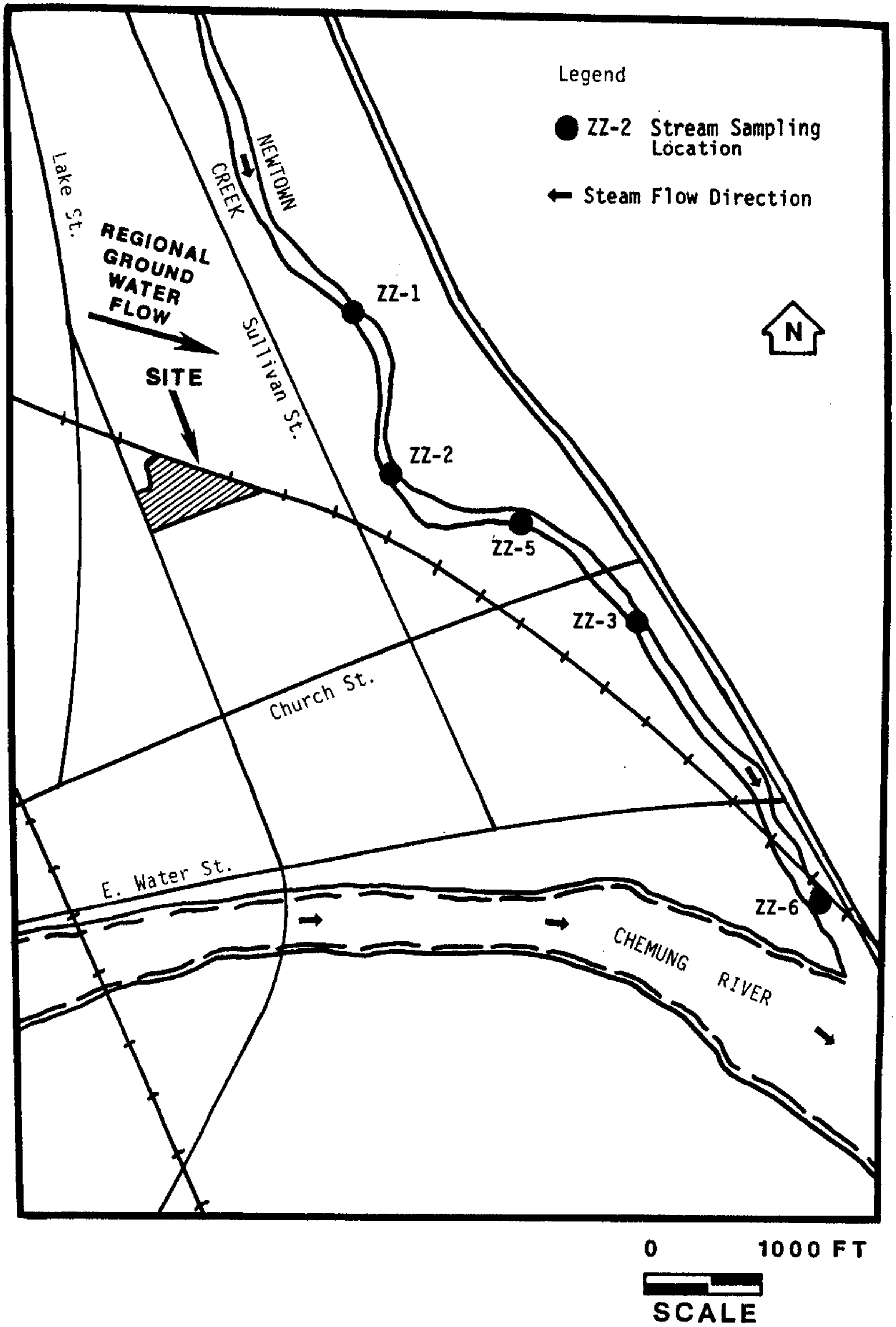
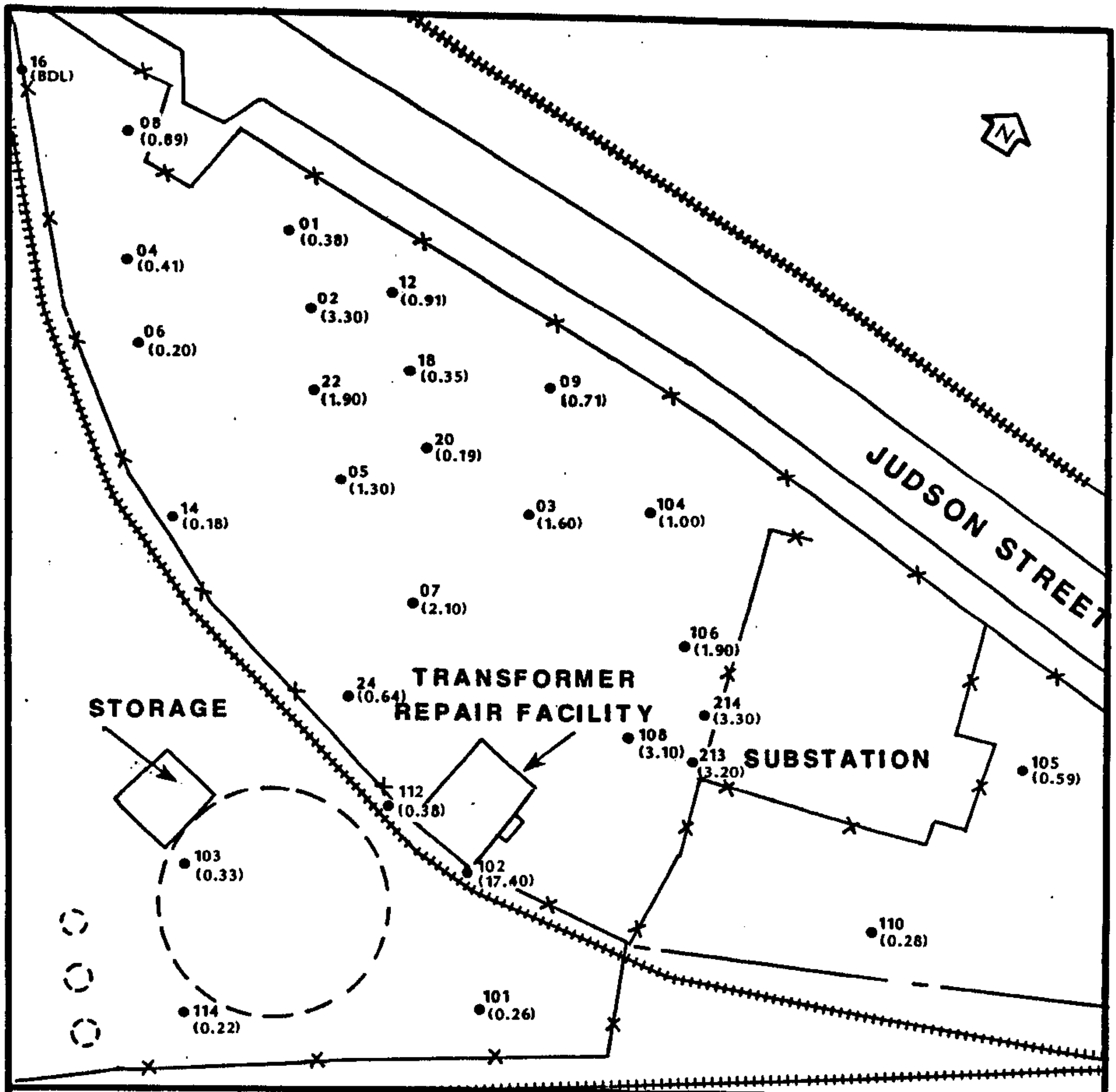


FIGURE 5. SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

Appendix E-4

PCB Soil Sampling Program, NYSEG Substation, Elmira, NY (June 22, 1989)



LEGEND

110● SAMPLE LOCATION

(210) PCB CONCENTRATION (ppm)

(NS) NO SAMPLE COLLECTED

(BDL) BELOW DETECTION LIMIT

0 100 FT

SCALE

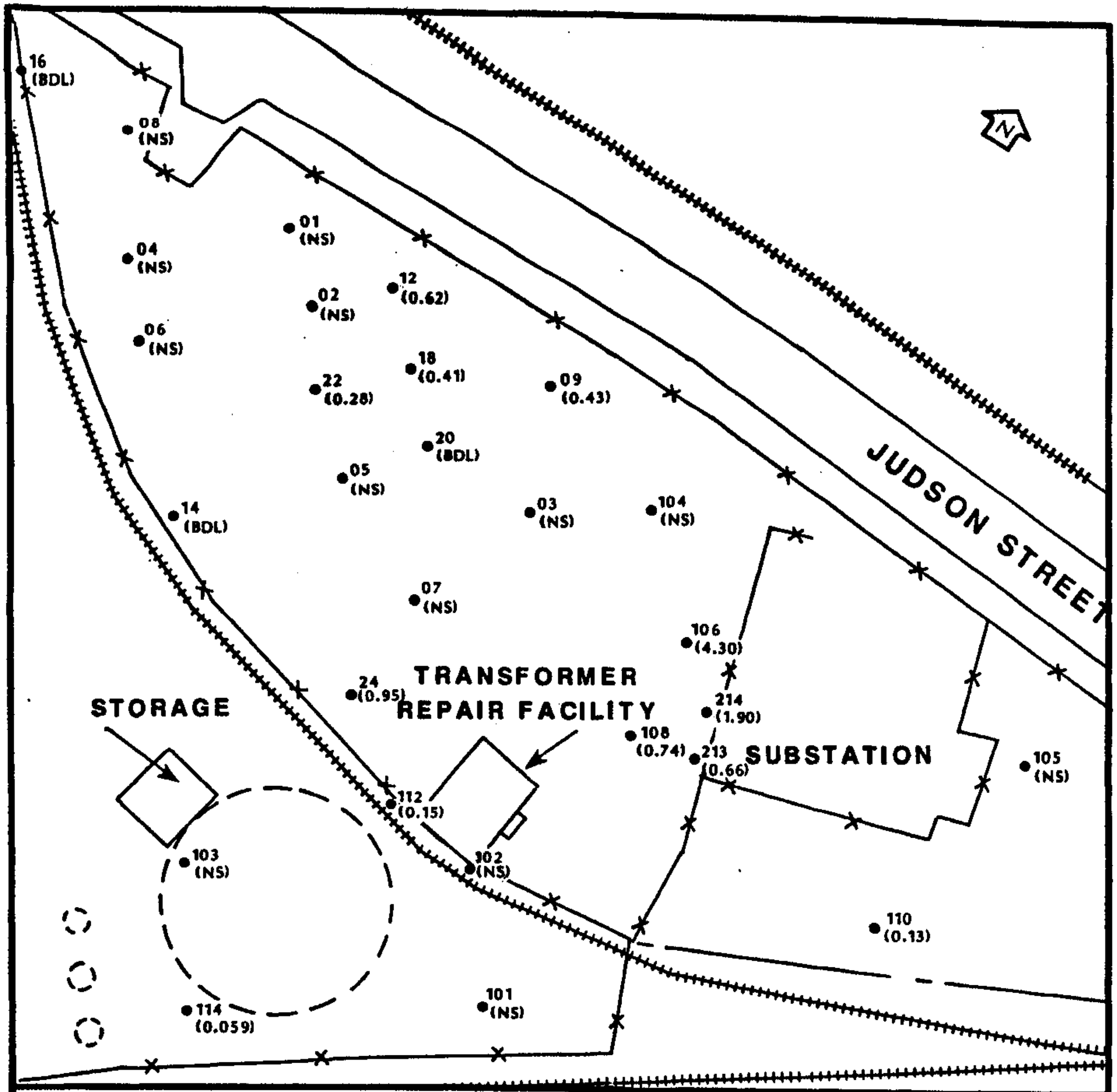
TRC
Environmental Consultants, Inc.

800 Connecticut Boulevard
East Hartford, CT 06108
(203)289-8631

NYSEG ELMIRA, NY

FIGURE 1.

CONCENTRATION OF PCB AT SURFACE



LEGEND

110 ●	SAMPLE LOCATION
(0.62)	PCB CONCENTRATION (ppm)
(NS)	NO SAMPLE COLLECTED
(BDL)	BELOW DETECTION LIMIT

0 100 FT

SCALE

TRC
Environmental Consultants, Inc.

800 Connecticut Boulevard
East Hartford, CT 06108
(203)289-8631

NYSEG ELMIRA, NY

FIGURE 2.

CONCENTRATION OF PCB AT
1 FOOT DEPTH

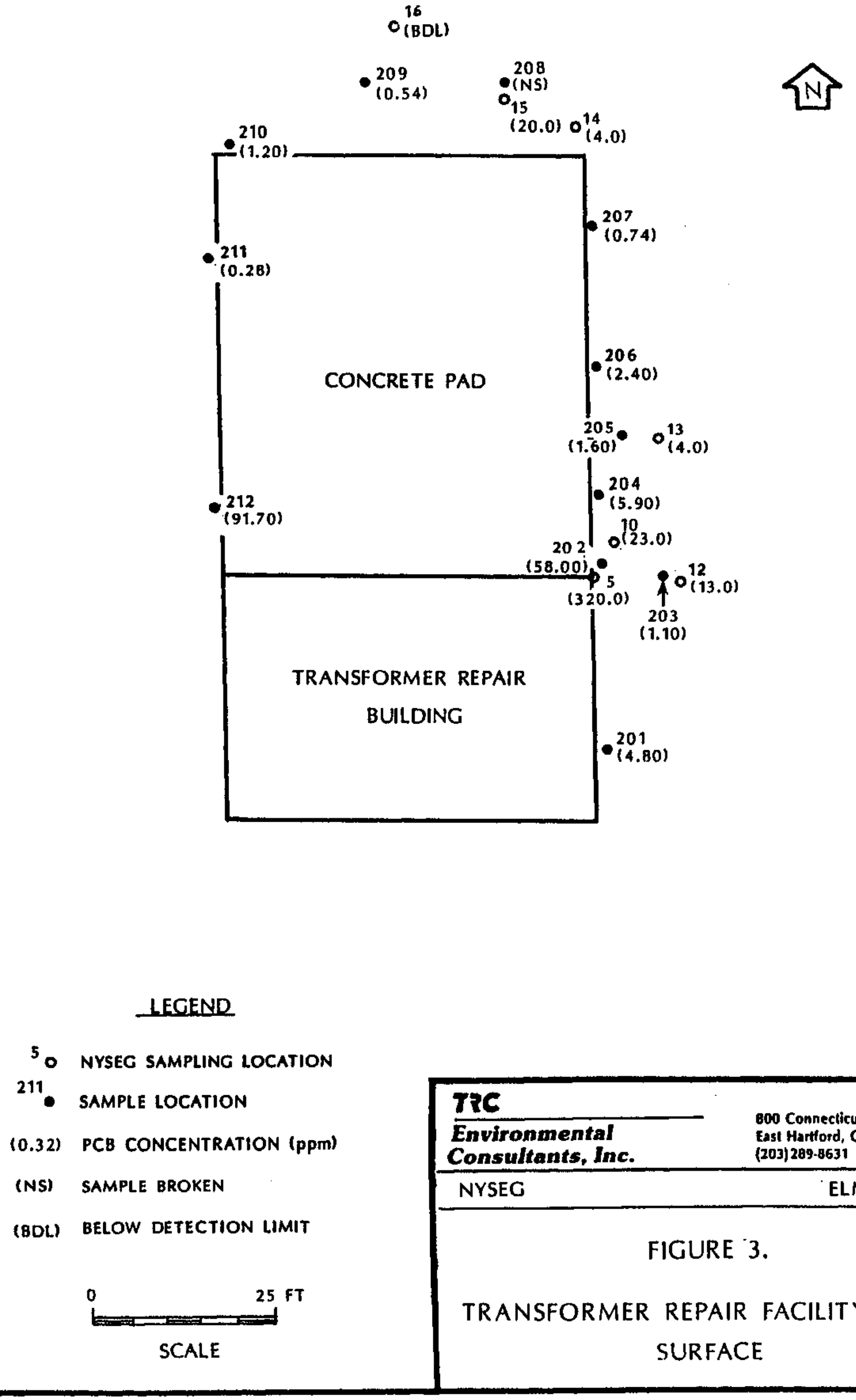


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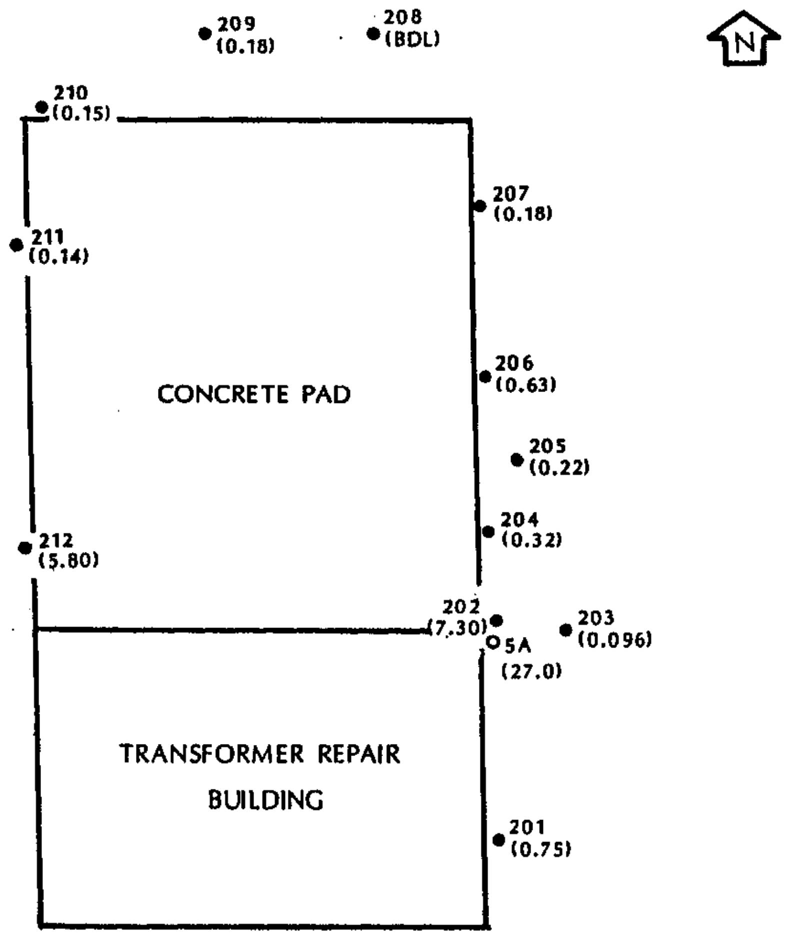
FIGURE 3.

TRANSFORMER REPAIR FACILITY AREA SURFACE



LEGEND

5A ○	NYSEG SAMPLING LOCATION (6 INCHES)
211 ●	SAMPLE LOCATION
(0.320)	PCB CONCENTRATION (ppm)
(NS)	NO SAMPLE COLLECTED
(BDL)	BELOW DETECTION LIMIT

0 25 FT
SCALE

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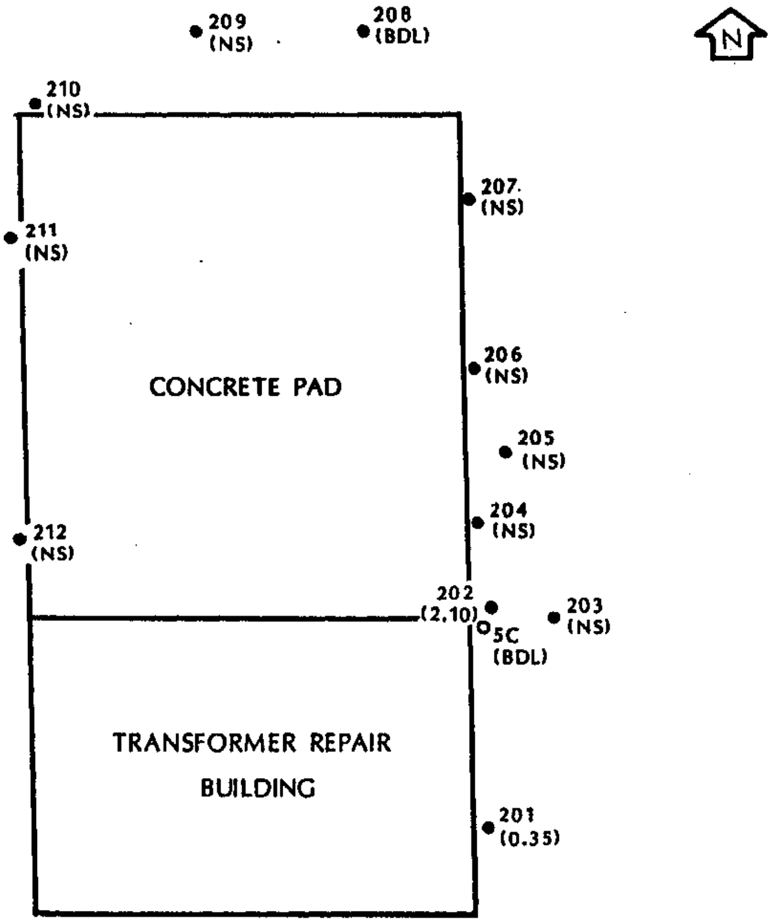
FIGURE 4.

TRANSFORMER REPAIR FACILITY AREA
1 FOOT DEPTH



LEGEND

5C ○	NYSEG SAMPLING LOCATION (16 INCHES)
211 ●	SAMPLE LOCATION
(0.320)	PCB CONCENTRATION (ppm)
(NS)	NO SAMPLE COLLECTED
(BDL)	BELOW DETECTION LIMIT

0 25 FT

SCALE

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FIGURE 5.

TRANSFORMER REPAIR FACILITY AREA
2 FOOT DEPTH

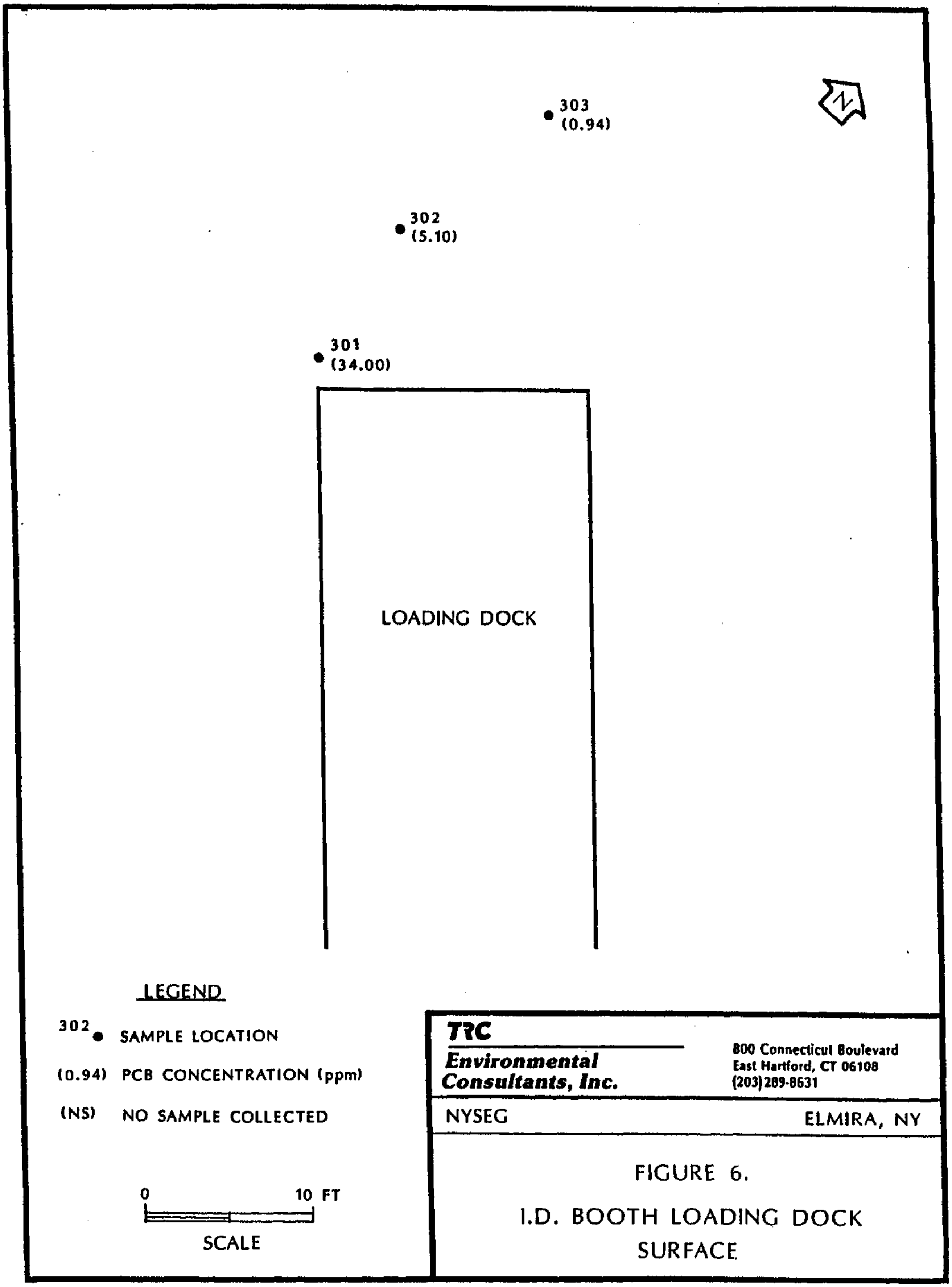

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FIGURE 6.

I.D. BOOTH LOADING DOCK SURFACE

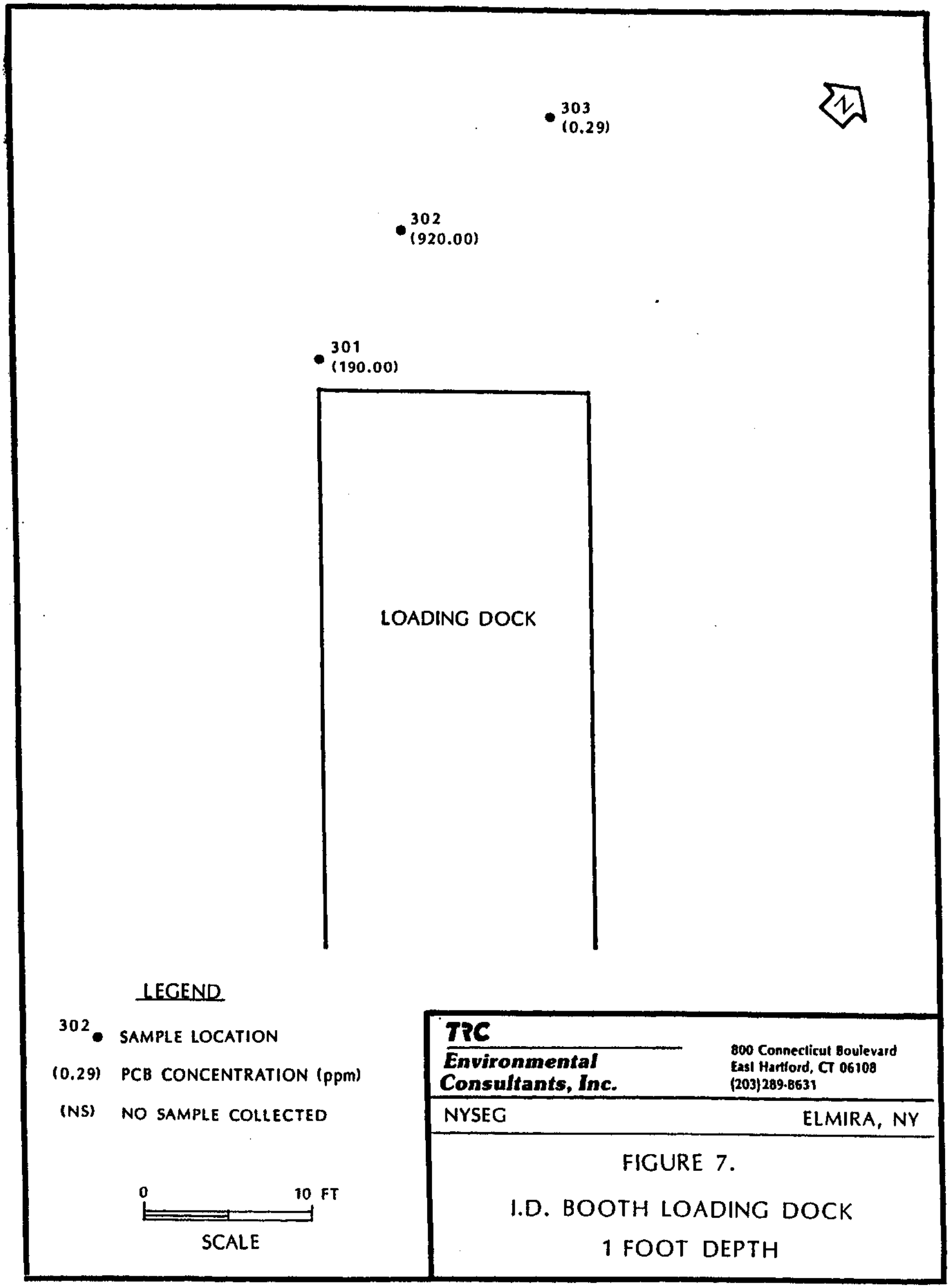

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FIGURE 7.

I.D. BOOTH LOADING DOCK
1 FOOT DEPTH

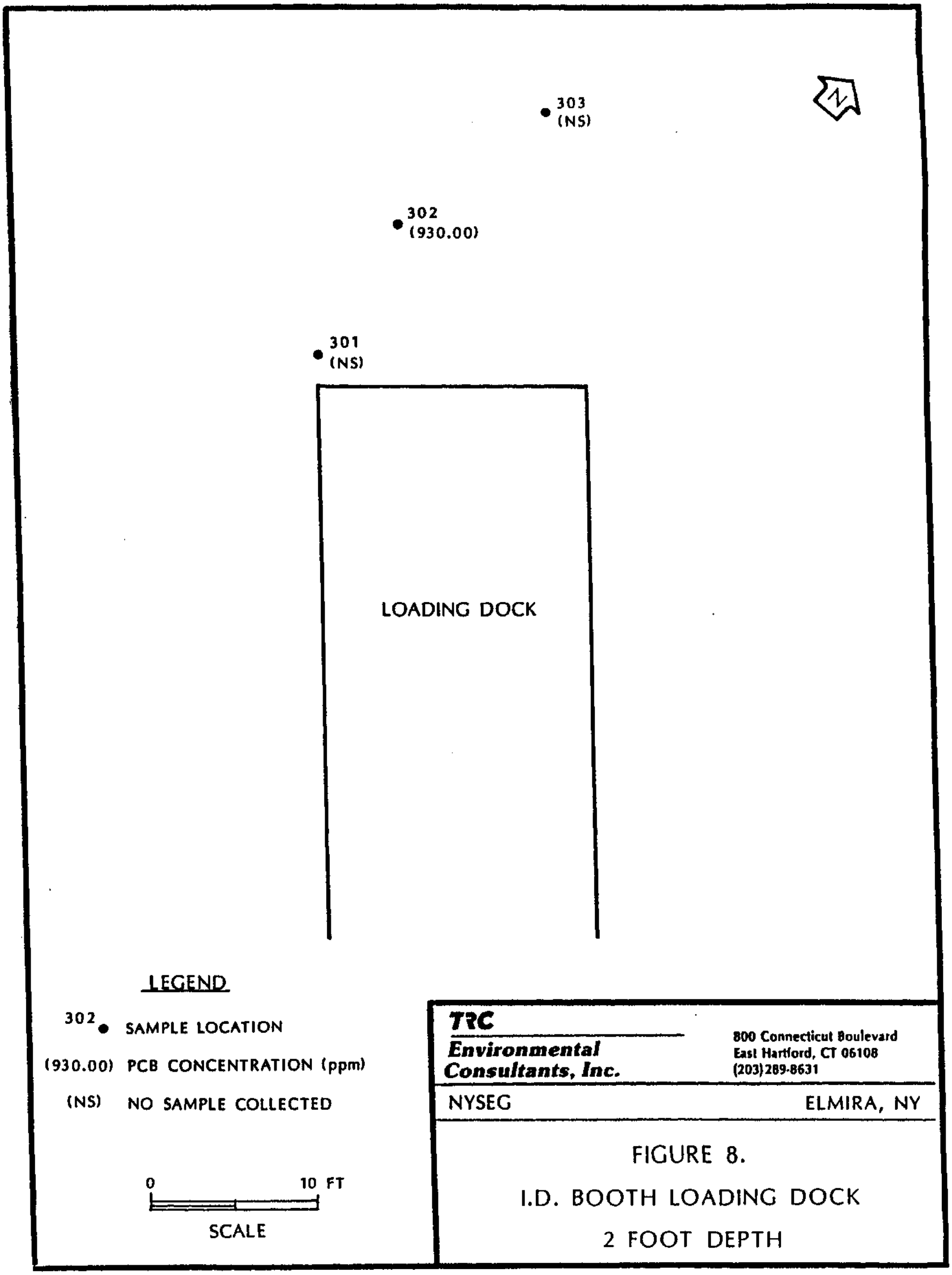

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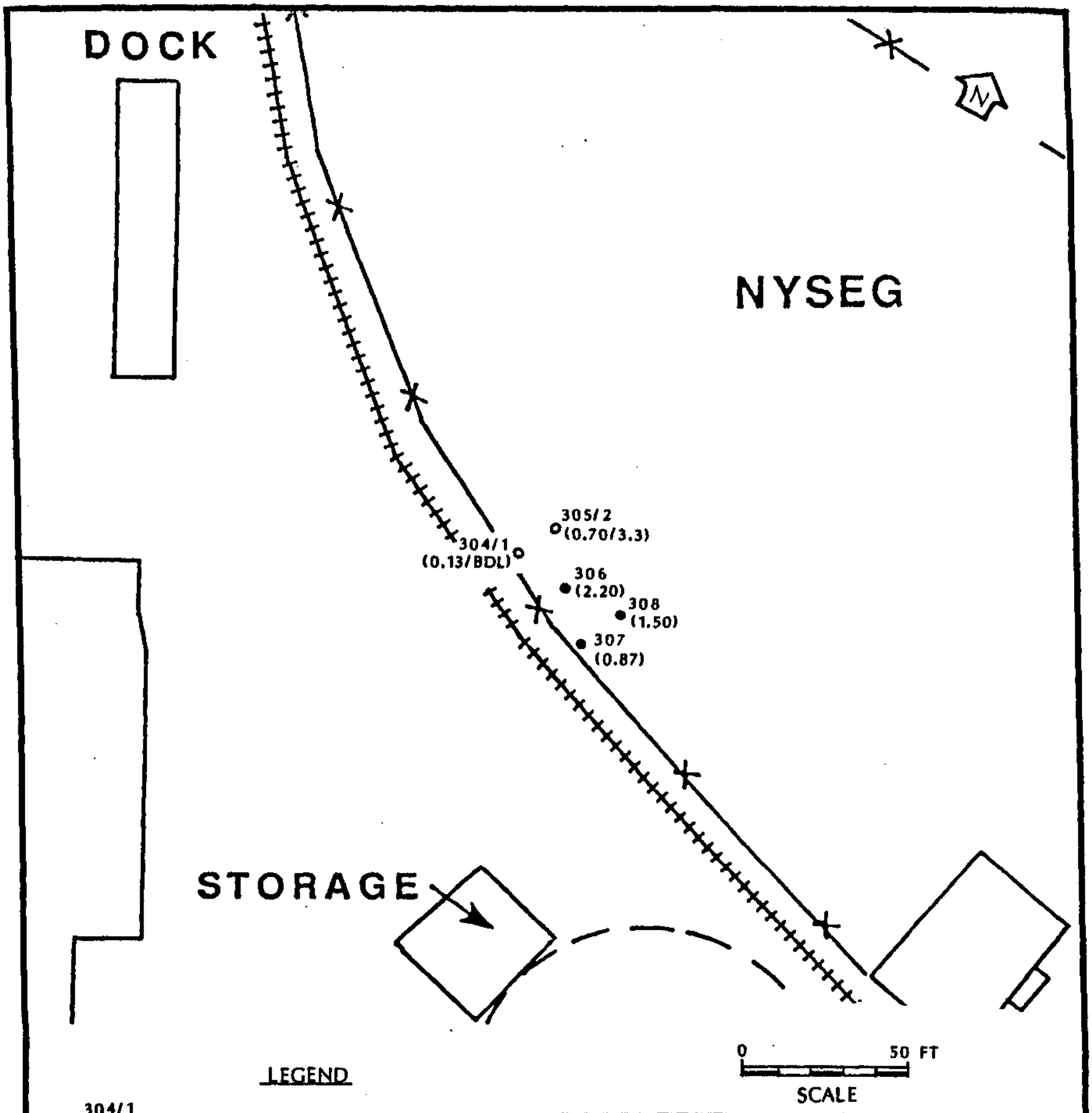
FIGURE 8.
I.D. BOOTH LOADING DOCK
2 FOOT DEPTH



LEGEND

304/1 ○	NYSEG AND TRC SAMPLING LOCATION
308 ●	SAMPLE LOCATION
(0.70/3.3)	NYSEG AND TRC PCB CONCENTRATION
(2.20)	PCB CONCENTRATION (ppm)
NS	NO SAMPLE COLLECTED
(BDL)	BELOW DETECTION LIMIT

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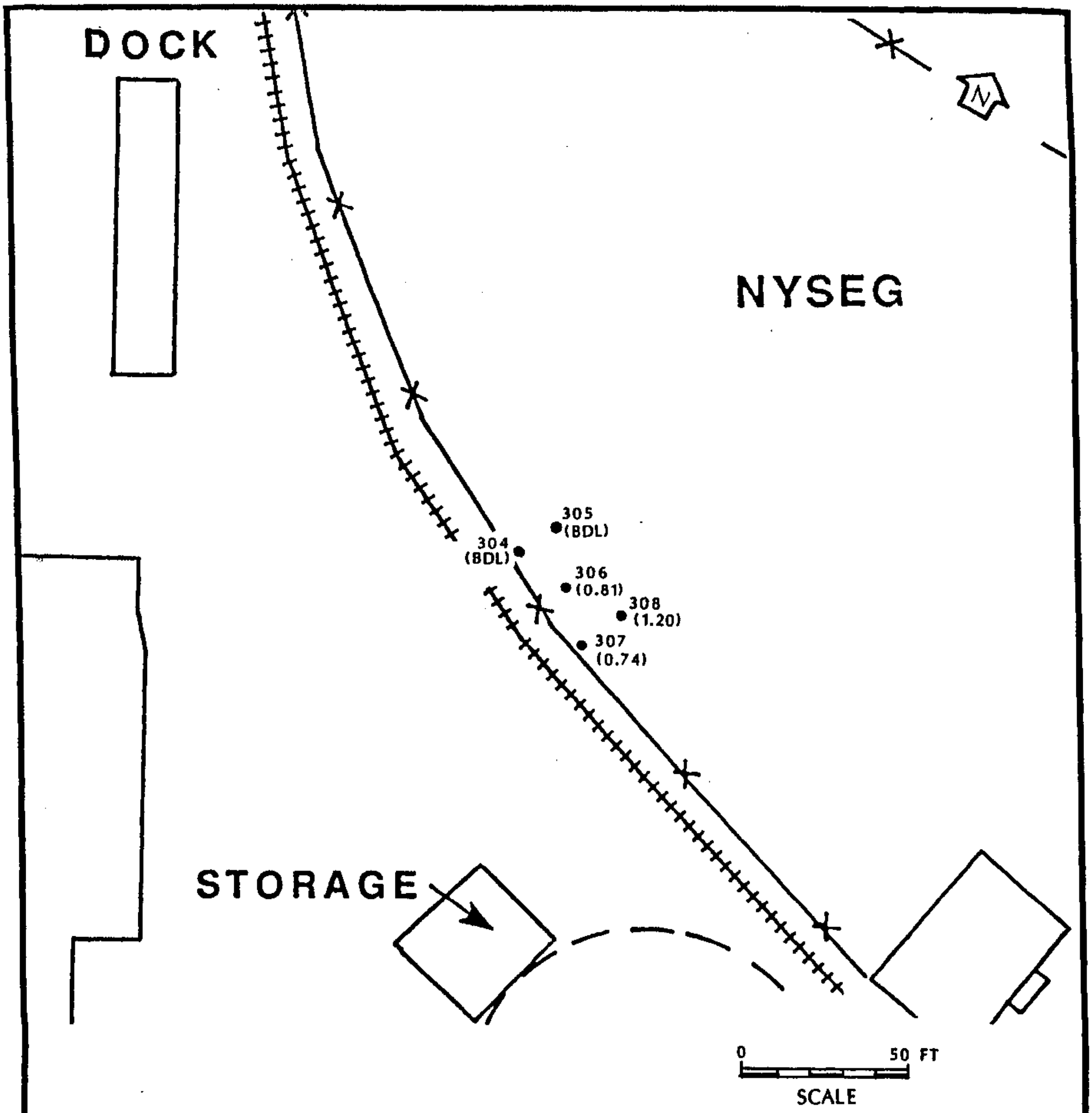
FIGURE 9.
FORMER LOADING DOCK AREA
SURFACE



LEGEND

304 ●	SAMPLE LOCATION
(0.81)	PCB CONCENTRATION (ppm)
NS	NO SAMPLE COLLECTED
(BDL)	BELOW DETECTION LIMIT

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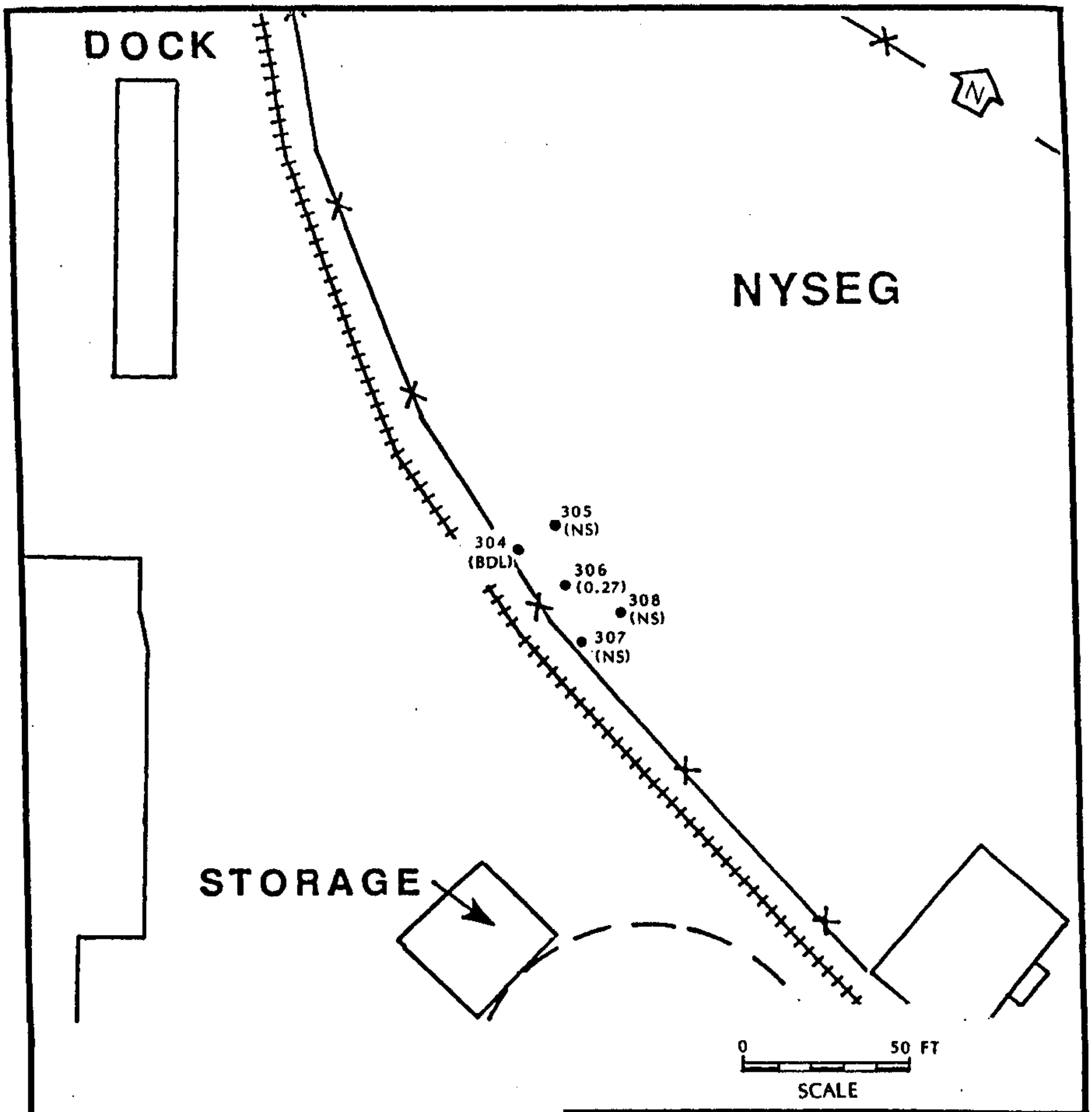
FIGURE 10.
FORMER LOADING DOCK AREA
1 FOOT DEPTH



LEGEND

304●	SAMPLE LOCATION
(0.27)	PCB CONCENTRATION (ppm)
NS	NO SAMPLE COLLECTED
(BDL)	BELOW DETECTION LIMIT

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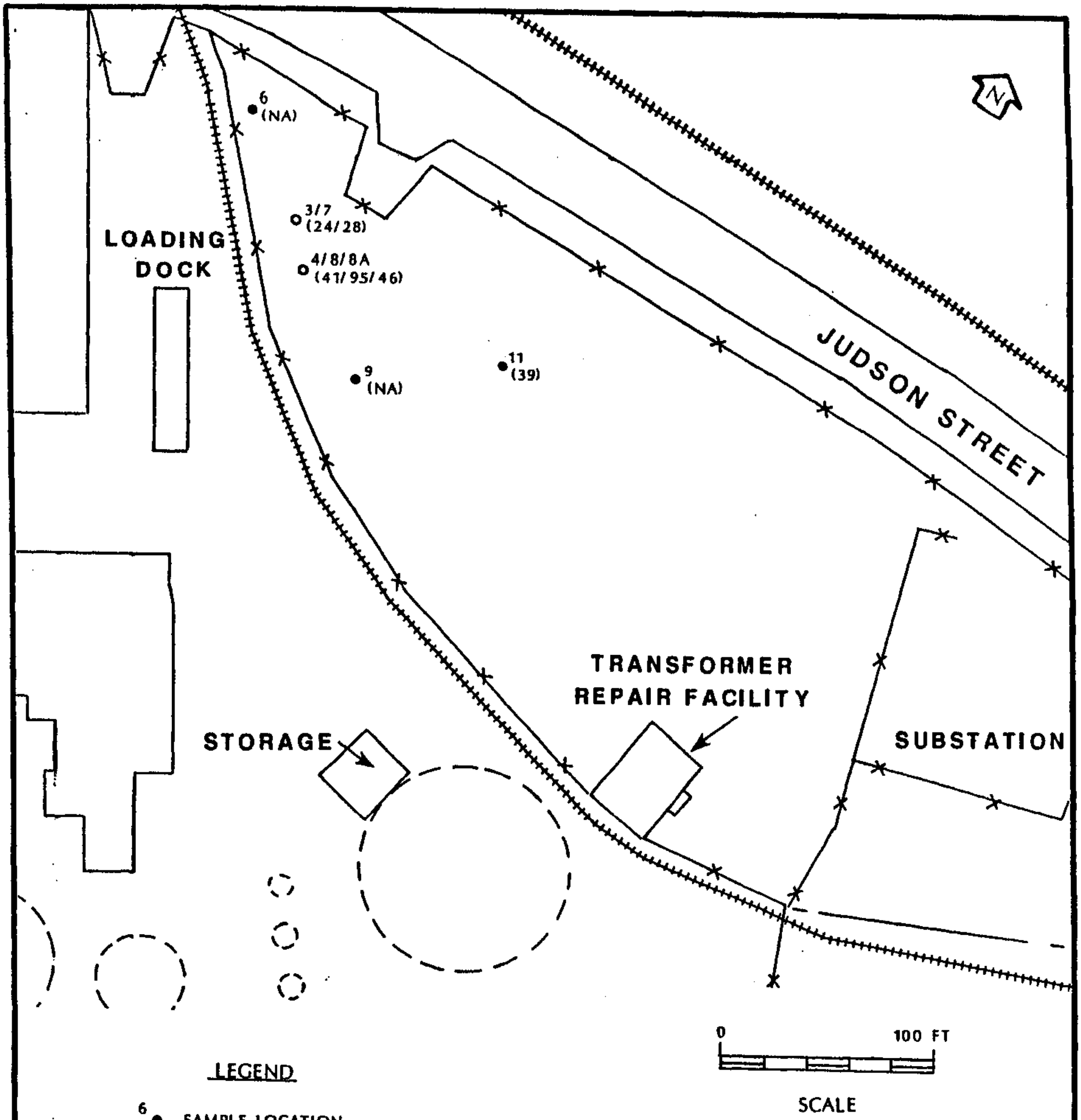
FIGURE 11.
FORMER LOADING DOCK AREA
2 FOOT DEPTH



LEGEND

6 ●	SAMPLE LOCATION
3/7 ○	SAMPLED TWICE
(39)	PCB CONCENTRATION (ppm)
NA	NOT ANALYZED
ND	NONE DETECTED

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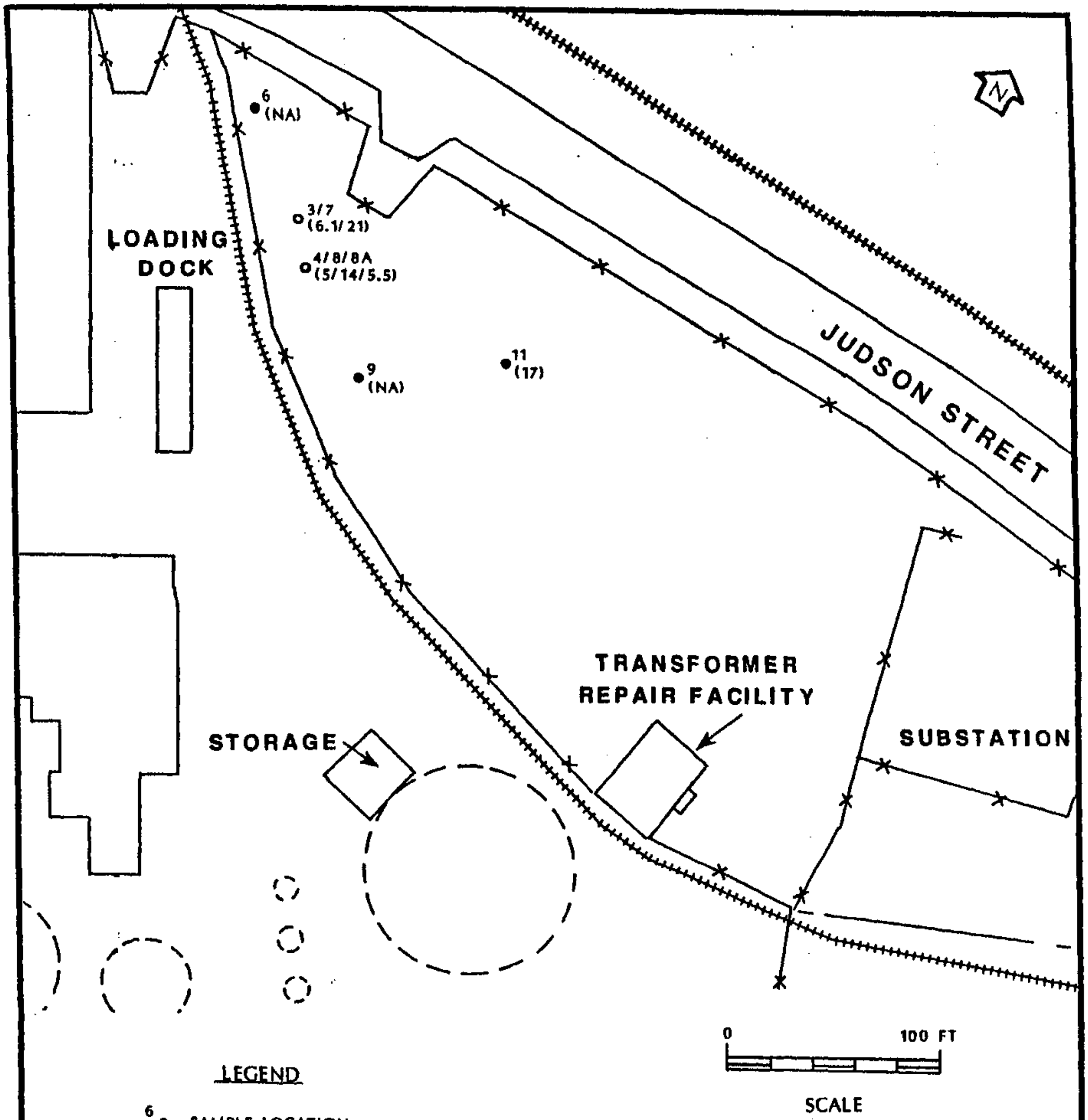
NYSEG
ELMIRA, NY

FIGURE 12.

NYSEG HEAVY METAL
SURFACE SOIL SAMPLES
TOTAL ARSENIC



LEGEND

6 ●	SAMPLE LOCATION
3/7 ○	SAMPLED TWICE
(6.1/21)	METAL CONCENTRATION (ppm)
NA	NOT ANALYZED
ND	NONE DETECTED

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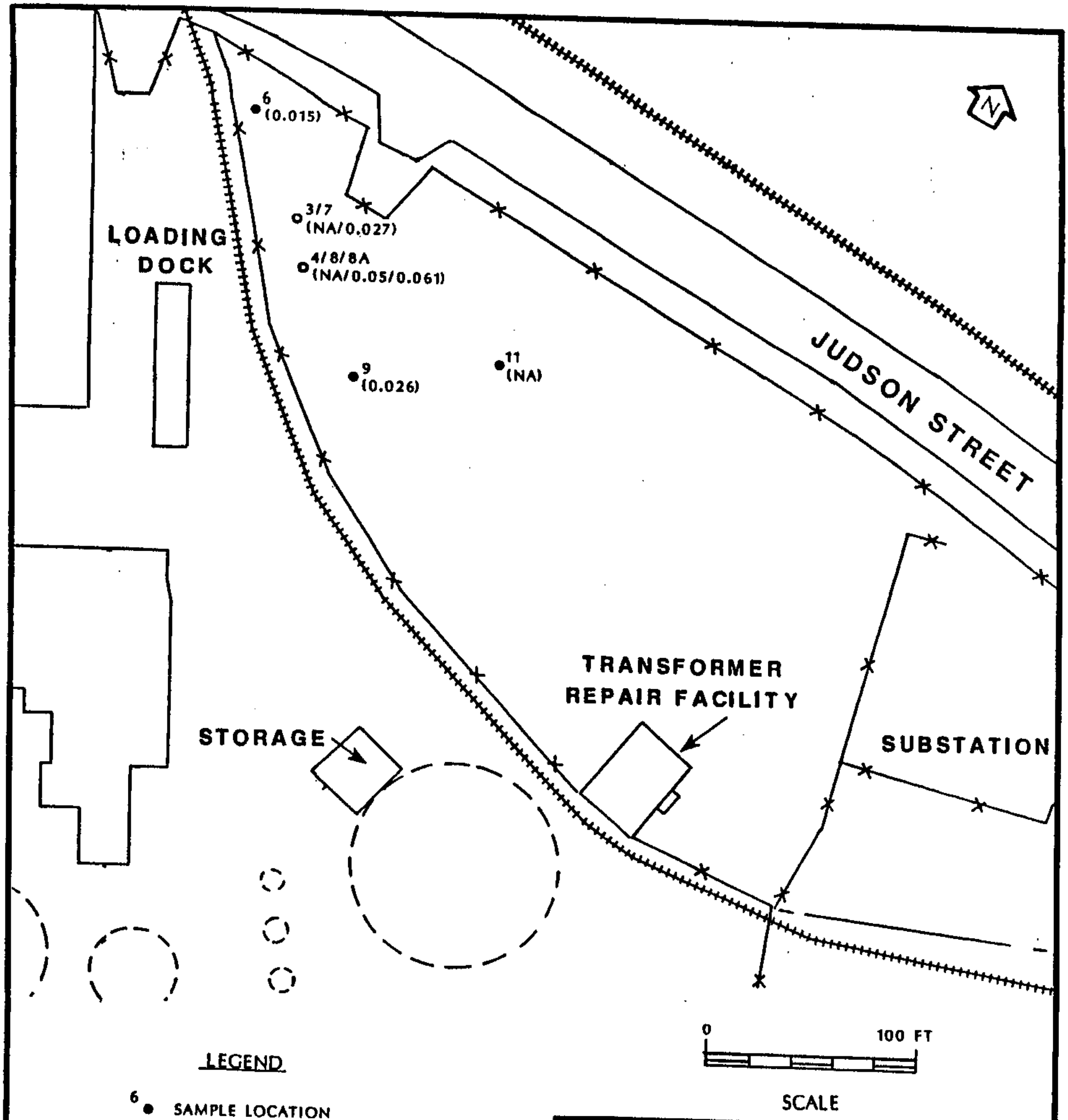
FIGURE 13.

NYSEG HEAVY METAL
SURFACE SOIL SAMPLES
TOTAL CHROMIUM



LEGEND

6 ●	SAMPLE LOCATION
3/7 ○	SAMPLED TWICE
(0.015)	METAL CONCENTRATION (ppm)
NA	NOT ANALYZED
ND	NONE DETECTED

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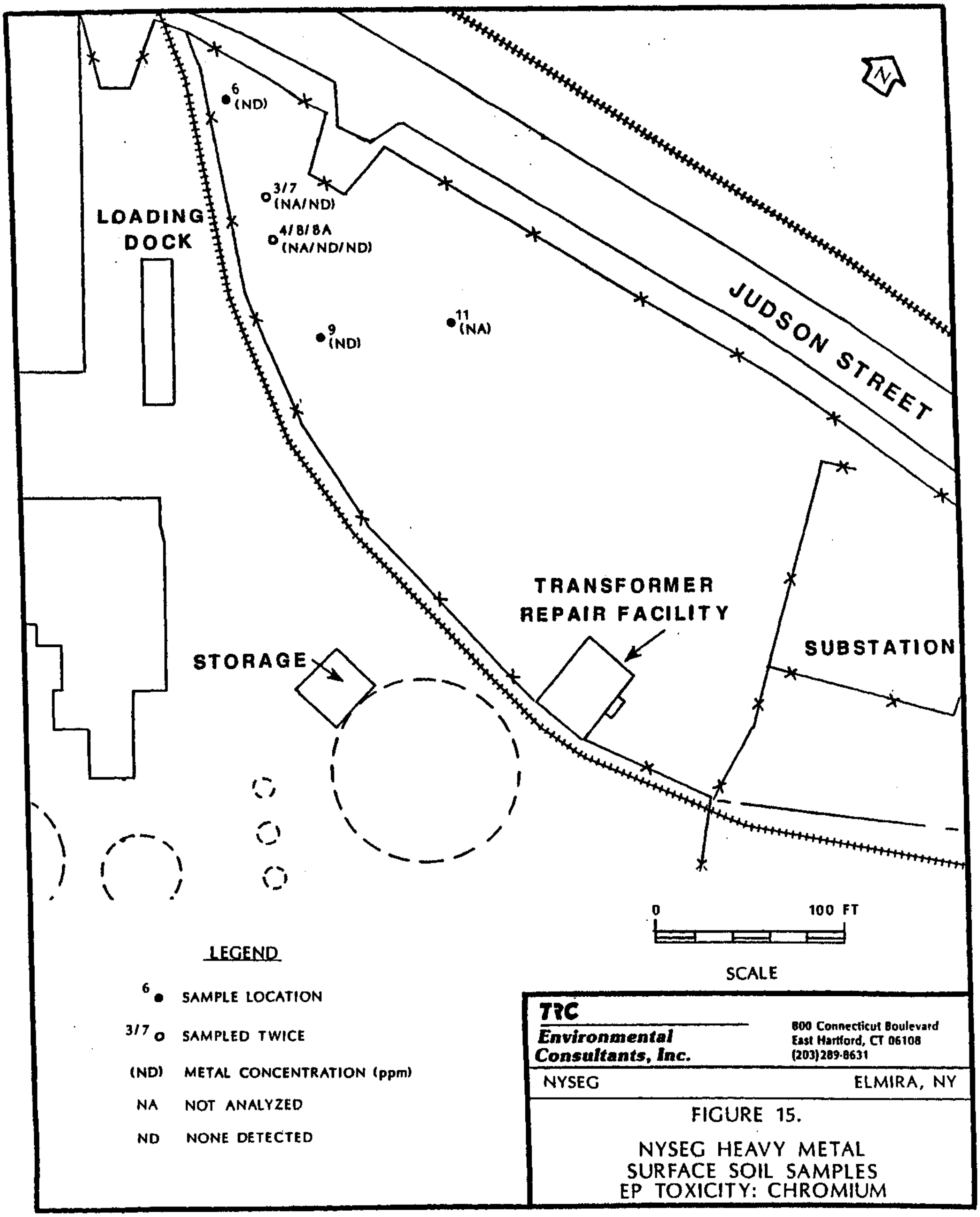
FIGURE 14.

NYSEG HEAVY METAL
SURFACE SOIL SAMPLES
EP TOXICITY: ARSENIC



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NYSEG ELMIRA, NY

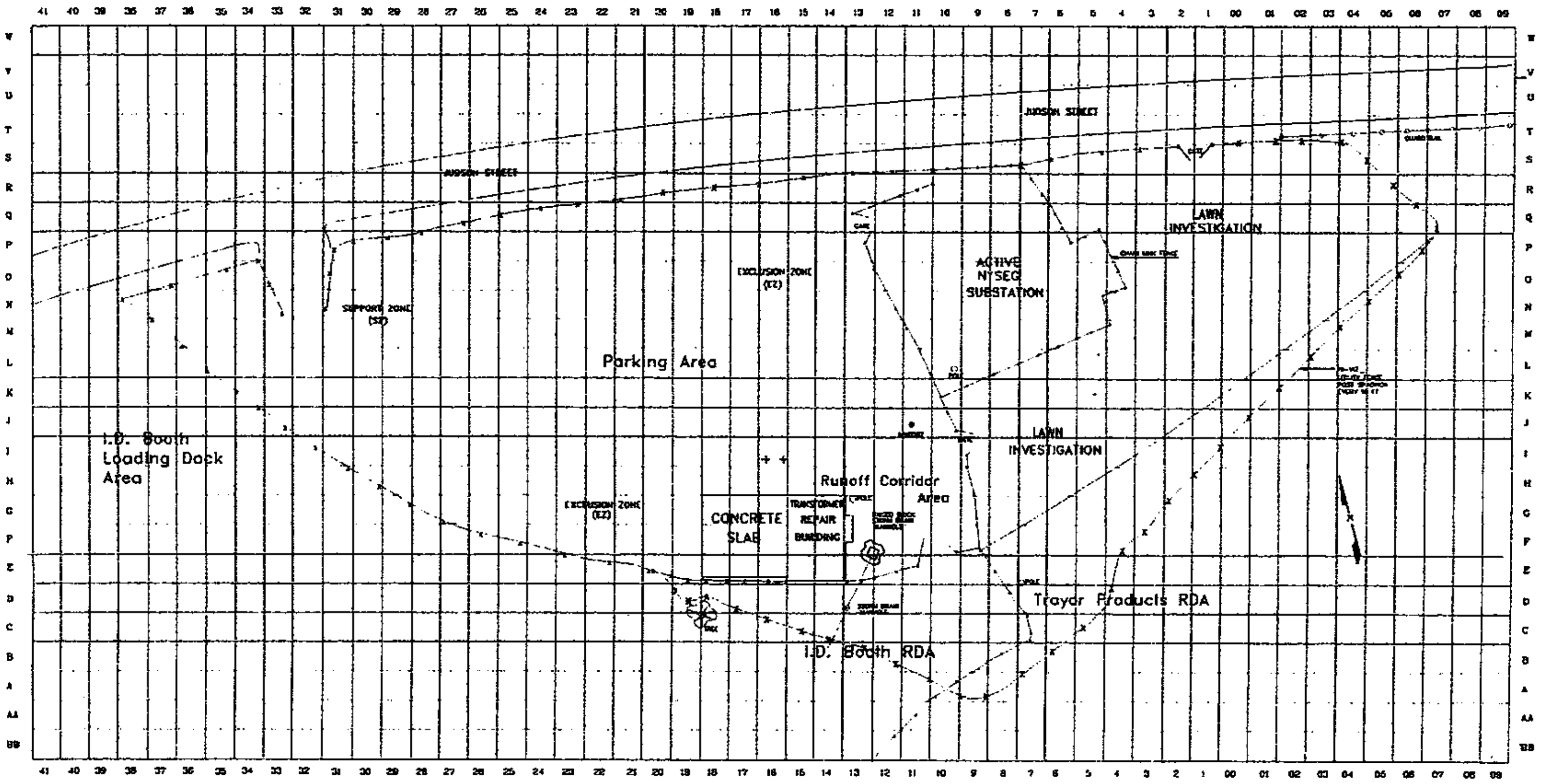
FIGURE 15.

NYSEG HEAVY METAL SURFACE SOIL SAMPLES EP TOXICITY: CHROMIUM

Appendix E-5

PCB Interim Remedial Measure – Final Engineering Report – NYSEG Former Service Center (April 1997)

NYSEG/Elmira- Site Overview



Permanent Fencing

Temporary Fencing & Erosion Controls

Approximate Property Line

GRID SPACING = 20 FEET SQUARE

Figure 1-2

SCALE APPROXIMATE

WESTINGHOUSE REMEDIATION SERVICES, INC.
MONTGOMERYVILLE, PENNSYLVANIA 18936

DRAWING TITLE
SITE OVERVIEW MAP
WESTINGHOUSE PROJECT #3440-96-3072
MADISON AVENUE SUBSTATION
ELMIRA, N.Y.

REVISED	DLD	3/14/97
DRAWN BY	B.C.	8/3/96

SIZE F | DRAWING NO. SITEOVRW-1 | SCALE 20ft grids | SHEET 1 OF 1

Appendix F

Work Plan for Cyanide Analyses

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Work Plan for Soil and Groundwater Characterization for Cyanide Species and Complexes at the Elmira (Madison Avenue) Former MGP Site

Prepared for

New York State Electric & Gas Corporation

Mr. John Ruspantini

Kirkwood Industrial Park

Binghamton, NY 13902

Prepared by
Ish Inc.
690 W. Fremont Avenue, Suite 3
Sunnyvale, California

May 2003

Section 1

1.1 Background:

The Elmira (Madison Avenue) former MGP site (the "site") is located in the City of Elmira, Chemung County, New York. NYSEG acquired the property in 1936 and operated or maintained it until 1977, when all of the buildings and much of the property was sold to I.D. Booth Inc. Since late 1980s NYSEG has carried out a number of site investigations. TRC, as a NYSEG contractor, collected information in the late 1980s and early 1990s to define nature of environmental impacts at the site presumably due to former MGP sources. NYSEG recently (2003) selected Blasland, Bouck & Lee, Inc. (BBL) to carry out a supplemental remedial investigation (SRI) at the site. NYSEG also selected Ish Inc. to carry out the investigation and assessment of cyanide in soil and groundwater at the site as part of the SRI. Therefore, Ish Inc. has developed this work plan to describe the sampling and analysis plans for the characterization of cyanide species and complexes in soils and groundwater at the site. However, BBL staff will actually collect, handle, and ship all soil and groundwater samples described in this work plan for cyanide in accordance with the procedures described in BBL's SRI Work Plan and supporting appendices.

Total cyanide analysis for the 45 soil and 28 groundwater samples will be carried out by Chemtech Laboratories using the SW-846 method 9010B for soil/solid matrix samples and by EPA method 335.1 (same as Standard Method 4500-CN-G) for aqueous matrix samples. The Chemtech Laboratory is a NYSDOH certified environmental laboratory.

A subset of 10 subsurface soil samples, from the 34subsurface soil samples collected in the soil borings and test pit excavation work by BBL, will be analyzed by Clarkson University for total cyanide (by EPA SW-846 extraction method 9013 followed by SM 4500-CN-C method), free cyanide (by microdiffusion method, ASTM 4285-95) and metal cyanide complexes (by IC method, Dionex application note AN-55). Similarly, a subset of 7 groundwater samples will also be analyzed by Clarkson University for total cyanide, free cyanide, and metal cyanide complexes.

Both Chemtech Laboratory and Clarkson University will analyze soil and groundwater samples for total cyanide. For soil samples, it is necessary to carry out alkaline extraction (by EPA method 9013) and subjecting the aliquots to the different analyses such that a complete mass balance between cyanide complexes, species and total cyanide can be achieved.

The personnel at Clarkson University are amongst the few premier experts on analyses of cyanide species and complexes in soil and water samples. Although Clarkson University is not a NYSDOH certified laboratory, they have performed numerous evaluations of cyanide in soil and groundwater samples from many hazardous waste sites within and outside the State of New York, especially MGP sites. As such, personnel at Clarkson University are very experienced in determining cyanide species and metal complexes in soil and groundwater samples from MGP sites.

1.2 Objective

The objective of this work plan is to specify and describe the sampling and analysis plans for characterization of total cyanide, cyanide species and complexes in soils and groundwater at the site.

1.3 Work Plan Organization:

This work plan has two remaining sections. Section 2 contains project approach and provides description of sample collection methods and analytical procedures. Section 3 contains approach to project management including proposed schedule for implementation of the sampling and analysis work plan. This section also describes the data analysis and reporting requirements for the results being developed.

Section 2

2.1 Project Approach

Recent discussions between NYSEG, BBL, NYSDEC, and the NYSDOH have established the sampling locations for soils as shown in Figure 1 of the SRI Work Plan prepared by BBL. This figure also contains the locations of existing groundwater monitoring wells and the proposed new monitoring wells for the site. This work plan for cyanide characterization is designed to obtain soil and groundwater samples from the locations specified in Figure 1 of BBL's SRI Work Plan. All samples will be collected by BBL staff in accordance with the procedures described in BBL's SRI Work Plan and supporting appendices. Altogether 45 soil samples and 28 groundwater samples will be collected and analyzed for total cyanide by Chemtech Laboratory. Clarkson University will analyze 10 soil samples and 7 groundwater samples for total cyanide, metal cyanide complexes and free cyanide species as described in the following subsections. Table 1 shows the summary of the number of samples to be analyzed by each laboratory and the analyses to be performed.

2.2 Soil Sample Collection and Handling

Subsurface and surface soil samples will be collected in a manner consistent with the procedures described in BBL's SRI Work Plan and supporting appendices.

2.3 Groundwater Sample Collection and Handling

Groundwater samples will be collected in accordance with the procedures described in BBL's SRI Work Plan and supporting appendices. All groundwater samples for cyanide analyses will be collected in one liter amber HDPE bottles and preserved with sodium hydroxide pellets such that the pH of the preserved samples is greater than 12. Groundwater samples will be collected without filtering in the field. Sample bottles should be completely filled with water with no headspace left. Care will be taken to minimize exposure of the groundwater sample to direct sunlight during collection and handling in the field. Once the groundwater sample has been collected and preserved, the sample bottle will be immediately placed in the cooler with ice. All sample bottles will be properly labeled and prepared for shipment via overnight express delivery service to the analytical laboratories.

2.4 Characterization of Surface Soils for Total Cyanide

There will be six surface soil samples collected from the site (as shown in Figure 1) to measure total cyanide concentrations. Five soil samples to represent background conditions will also be collected for total cyanide concentrations. Once the 11 surface soil samples have been collected, they will be sent to the Chemtech Laboratory via overnight delivery service containing appropriate chain-of-custody forms.

2.5 Characterization of Surface Soils for Total Cyanide and Cyanide Species

Figure 1 shows 17 soil boring locations and two test pit excavation areas where one or more subsurface soil samples may be collected by BBL for various analyses (see the SRI Work Plan for detail). Altogether, 34 subsurface soil samples will be collected by BBL from these locations and sent to Chemtech laboratory by overnight delivery service for total cyanide analysis. Ten of these 34 subsurface soil samples will also be analyzed at Clarkson University for total cyanide by Standard Method No. 4500-CN-C (Total cyanide by distillation), free cyanide by ASTM Method 4285-95, and metal cyanide complexes by Dionex Application Note AN-55. All 10 soil samples will be first extracted by EPA SW-846 Method 9013 at Clarkson University and aliquots of the extracts will be subjected to distillation for total cyanide determination, microdiffusion analysis for free cyanide, and IC analysis with pre-concentration step to measure concentrations of metal cyanide complexes in the 10 soil samples.

2.6 Characterization of Groundwater Samples for Total Cyanide, Metal Cyanide Complexes and Free Cyanide Species

Available data on total cyanide in samples from the site shows a wide range of concentrations in groundwater monitoring wells. Monitoring well MW-10S has shown the highest total cyanide concentration in groundwater at the site, with MW-3S and MW-6S showing total cyanide concentrations above 1 mg/L. Because the fraction of free cyanide species in groundwater at MGP sites is usually less than 1% of the total cyanide and because health risks are almost entirely due to free cyanide species (NYGAS, 2001), it is helpful to know the amounts of free cyanide species and metal cyanide complexes in samples where total cyanide value is above 200 μg/L (the MCL value for drinking water). Therefore, seven groundwater samples will be collected for analysis at Clarkson University for total cyanide, metal cyanide complexes, and free cyanide species. The groundwater samples from existing monitoring wells MW-3S, MW-6S, MW-7, MW-9S, MW-10S, MW-2D, and one of the new shallow wells, are targeted for these analyses. However, 28 groundwater samples will be collected from all existing and the new wells for analysis of total cyanide by Chemtech Laboratory using the NY State approved method for total cyanide. The groundwater samples will be shipped to the two laboratories with appropriate chain-of-custody forms for next day delivery, making sure that the amber bottles remain cooled by ice for the entire duration of the shipment.

BBL will also collect 2 field duplicates for groundwater QA/QC purpose. One field duplicate will be sent to Chemtech Laboratory with the 28 groundwater monitoring well samples for total cyanide analysis. The second field duplicate will be sent to Clarkson University with the 7 groundwater monitoring well samples for total cyanide, metal cyanide complexes and free cyanide analyses.

Reference: NYGAS, 2001 Assessment of Cyanide Contamination and Human Exposure Risks at Manufactured Gas Plant Sites in the State of New York, prepared by ThermoRetec Consulting Corporation, Monroeville, Pa.

Table 1:
Summary of Number of Samples and Analyses to be Performed

Sample Description	**No. of Samples**	**Analysis to be Performed**	**Laboratory Performing the Analysis**
Site Surface Soil	6	Total Cyanide	Chemtech Lab
Background Surface Soil	5	Total Cyanide	Chemtech Lab
Subsurface Soil from Borings and Test Pits	34	Total Cyanide	Chemtech Lab
Subset of Subsurface Soil from Borings and Test Pits	10	9013 Extraction, Total CN, Metal Complexes, Free Cyanide	Clarkson University
Groundwater Samples from Monitoring Wells	28	Total Cyanide	Chemtech Lab
One Field Duplicate for Groundwater	1	Total Cyanide	Chemtech Lab
Subset of Groundwater Samples from Monitoring Wells	7	Metal Complexes, Total CN^-, Free Cyanide	Clarkson University
One Field Duplicate for Groundwater	1	Metal Complexes, Total CN^-, Free Cyanide	Clarkson University

Section 3

3.1 Project Management Approach

To accomplish the characterization program for cyanide in soil and groundwater at the site, a team approach is used. The team consists of NYSEG, Ish Inc., BBL, Chemtech Laboratory, and Clarkson University. Dr. Ishwar Murarka from Ish Inc. will serve as the principal investigator and will be responsible for specifying all sampling and analysis requirements for the cyanide characterization part of the work as well as for the evaluation of the data and preparation of the report for cyanide in soils and groundwater at the site. BBL will be responsible for implementing field sampling, sample handling and shipping for the samples to the laboratories for analysis of cyanide. Clarkson University will perform all metal cyanide complexes and free cyanide analyses as well as total cyanide analysis on a subset of samples from the site. Chemtech Laboratory, a NYSDOH certified laboratory, will perform all total cyanide analyses.

3.2 Data Analysis and Reporting

Ish Inc. staff will analyze and interpret the new cyanide data with the historical data from the site to establish the nature and extent of cyanide distribution in soils and groundwater at the site. Appropriate summary tables, figures and graphs will be prepared by Ish, Inc to present the cyanide data. A draft report of the cyanide assessment will be prepared as an appendix to BBL's draft SRI Report and submitted for review and comments. A final report will be then prepared to incorporate any comments from the NYSDEC. Final version of CAD drawings/plots depicting the distribution of cyanide species and complexes will be completed by BBL using the draft version prepared by Ish Inc. NYSEG will submit the SRI report containing both the BBL work and the Ish Inc work to NYSDEC as required by the Order on Consent. Ish Inc. will prepare responses to NYSDEC comments on the cyanide assessment portion of the SRI report.

3.3 Schedule

The soil and groundwater sampling work will be performed by BBL as indicated in the schedule in BBL's SRI Work Plan. Analytical work for cyanide will be performed by the two laboratories within the sample holding period, and the analytical results are to be received by Ish Inc. within one month after samples were shipped to the laboratories.