MANUFACTURED GAS PLANT
SITE SCREENING REPORT
CLARK STREET SITE
AUBURN, NEW YORK

PREPARED FOR:

NEW YORK STATE ELECTRIC AND GAS

NYSEG

PREPARED BY:

ATLANTIC ENVIRONMENTAL SERVICES, INC.
188 Norwich Avenue
Colchester, Connecticut 06415

ATLANTIC PROJECT NO.: 1284-02-12

MAY 1991

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PREPARED FOR:

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EXECUTIVE SUMMARY

The purpose of this program is to prioritize a number of former manufactured gas plant (MGP) sites for New York State Electric and Gas Corporation (NYSEG). The site evaluated in this report is the Clark Street Site in Auburn, New York. The intent of the program is to determine if there is any imminent threat to human health or the environment at this site and to establish a relative ranking of sites. The Site Screening and Priority-Setting System (SSPS) developed by the Electric Power Research Institute (EPRI) specifically for use with MGP sites was used to prioritize the NYSEG sites.

MGPs were the primary source of producing combustible gas for heating, cooking, and illumination at 1,500 to 2,500 sites in the United States between 1816 and the 1950s. Gas was manufactured at plants similar to Clark Street from coke, coal, and oil and had certain by-products and residues associated with the processes. The Clark Street MGP was constructed prior to 1904 and produced carburetted water gas until circa 1946.

The general approach used to investigate MGP residues at the Clark Street Site was to identify routes of exposure which may result in direct contact with MGP residues and to chemically characterize the media associated with the exposure routes to evaluate potential health risks. The SSPS calculates indicators of actual and perceived risks for each site evaluated. The actual risk is determined from surface water, ground water, air, and direct contact exposure routes. It predicts the actual imminent threat at the site based on available data. The perceived risk reflects economic risks, public image impacts, and similar effects on the previously identified exposure routes. The perceived risk score focuses on the single exposure pathway of greatest risk.

The SSPS scores evaluate several site characteristics which include site size and current use, waste containment efforts, nearby ground water and surface water use, soil and hydrological conditions, precipitation, chemical characteristics, and potential receptors. Site surveys, historical data, state and federal publications as well as a field sampling and analysis program provided the information needed to complete the SSPS analysis. The media sampled at the Clark Street Site in Auburn, New York included surface water, streambed sediments and surficial soils.

Analyses performed on the samples did not detect any residues associated with MGP processes in the Owasco Lake Outlet bordering the Clark Street Site. Upstream surface water sample SW-1 contained elevated levels of zinc when compared to the New York State (NYS) Water Quality Standards and Guidance Values. The detection of zinc in sediments upstream of the site has no apparent relation to MGP residues due to its upstream location.

Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and elevated levels of some inorganics were detected in streambed sediments collected at the site. The streambed sediment sample collected adjacent to the site (SE-2) contained 1.0 parts per million (ppm) benzene, 1.4 ppm ethylbenzene, and 1.1 ppm total xylenes. All of the streambed sediment samples contained polycyclic aromatic hydrocarbons (PAHs) at total concentrations of 14.5 ppm (SE-1), 60.8 ppm (SE-2), and 10.1 ppm (SE-3). Sediments samples also contained carcinogenic polycyclic aromatic hydrocarbons (C-PAHs) at total concentrations of 11.5 ppm in SE-1, 21.2 ppm in SE-2, and 6.8 ppm in SE-3. Upstream sediment sample SE-1 had 0.16 ppm dibenzofuran. All of the streambed sediments contained bis(2-ethylhexyl)phthalate. Concentrations of arsenic, beryllium, calcium, mercury, lead, and nickel were noted to be higher than background levels reported by Shacklette and Boerngen (1984). Cyanide was detected in Sample SE-2 (adjacent to the site) at 6.8 pm. The PAHs, VOCs, and cyanide detected in the streambed sediment samples may be indicative of MGP residues, as the concentrations are greatest in the along-site sample SE-2 and these compounds have been associated with MGP residues at similar sites. However, the presence of dibenzofuran and the other PAHs indicate other upstream sources, not the least of which could be storm runoff from city streets. Bis(2-ethylhexyl)phthalate, a SVOC, is both a laboratory contaminant and ubiquitous in the environment.

Surface soil samples SS-4 and SS-5 contained 0.57 ppm and 0.70 ppm toluene, respectively. All the surface soil samples contained PAHs at concentrations of 1.7 ppm (SS-1), 128.5 ppm (SS-2), 204.3 ppm (SS-3), 11.1 ppm (SS-4), and 7.2 ppm (SS-5). C-PAHs were detected at levels of 1.4 ppm in SS-1, 123.9 ppm in SS-2, 110.2 ppm in SS-3, 7.6 ppm in SS-4, and 6.4 ppm in SS-5. Small quantities of dibenzofuran and 2-methylnaphthalene (SVOCs) were detected in soil samples SS-2 and SS-3. Surface soil sample SS-1 contained 0.38 ppm pentachlorophenol (SVOC). Soil sample SS-2 contained 9.7 ppm cyanide and SS-3 contained 3.2 ppm cyanide. Elevated levels of arsenic, calcium, mercury, and nickel were detected in all of the surface soil samples when compared to background metal concentrations as described by Shacklette and Boerngen (1984). The detection of PAHs, toluene, 2-methylnaphthalene, dibenzofuran, and cyanide in the surficial soils at the Clark Street Site may be indicative of MGP residues. Pentachlorophenol is not associated with MGP residues. The elevated levels of metals in the surficial soils could have originated from several sources and do not necessarily indicate association with MGP residues.

The Clark Street Site received an actual risk score of 22.1 and a perceived risk score of 25.3. The SSPS scores reflect the assumption that subsurface MGP residues exist at the Clark Street Site, although no subsurface investigations were conducted. The answers to and assumptions used to answer specific SSPS questions in order to ensure consistency between sites are detailed in Appendix A. The breakdown of exposure route and individual question scores are also listed in Appendix A.

The major route of exposure to MGP residues at the Clark Street Site, based on available data, was identified as direct contact with surficial soils. Surficial soils at the site contained PAHs which can be associated with MGP operations, as well as combustion, and/or fuel oils. 2-methylnaphthalene and dibenzofuran also were detected in surficial soils and may be associated with MGP residues. Cyanide was detected in three samples collected from the Clark Street Site. Cyanides at MGP sites are associated with purifier residue and are complex cyanides which are stable under normal environmental conditions. A subsurface structure containing contents exuding a characteristic MGP odor was identified at the site. Some rubble, ash, and coal were observed over various parts of the site.

The Clark Street Site received relatively high SSPS scores. These scores resulted from the detection of VOCs and relatively high concentrations of PAHs in surficial soils and streambed sediments. Based on the SSPS score of this site relative to other sites and the fact that a subsurface structure most likely containing MGP residues was present at the site, a focused remedial investigation is recommended for the Clark Street Site. The investigation should include ground water and subsurface soil studies focusing in areas where former MGP structures existed, areas of vegetative stress, and where visual or olfactory residuals are evident in order to better assess the potential risks associated with the site.

1.0 INTRODUCTION

Combustible gas for heating, cooking, and illumination was manufactured from coke, coal, and oil at 1,500 to 2,500 sites in the United States between 1816 and the 1950s. Manufactured gas was the major gas fuel available during this period for the majority of the country. During the 1940s and 1950s, the manufactured gas industry encountered severe competition from natural gas. Natural gas became more readily available through interstate pipelines, was less expensive and had a higher Btu content than manufactured gas. Natural gas became the major base fuel. Eventually manufactured gas processes were phased out and the plants were decommissioned.

The three major processes used to manufacture gas were coal carbonization, carburetted water gas and oil gas. In the coal carbonization process, bituminous coal was heated in a sealed chamber causing the distillation of gas from coal and the formation of coke. Carburetted water gas, containing hydrogen and carbon monoxide, was produced by passing steam through a bed of incandescent coke (or coal). The resultant "blue gas" was then passed through two chambers containing hot firebrick in which oil was sprayed and the oil cracked into gaseous hydrocarbons and tar. Oil gas cracked oil alone into gaseous hydrocarbons, tar, and carbon. The carburetted water gas and the oil gas processes used a variety of oil-based feedstocks such as naphtha, gas oil, fuel oil, and residual oils.

The three processes produced similar by-products however, important differences exist which affect the current character and toxicity of the wastes. Tars produced during coal carbonization were high in phenols and base neutral organics. Tars produced by carburetted water gas and oil gas processes contain lower amounts of these compounds. Substantial amounts of cyanide and ammonia were produced by coal carbonization but only trace amounts of cyanide were produced during carburetted water gas and oil gas processes.

A number of former MGP sites, operated by NYSEG or its predecessor companies, have been investigated for potential risk to human health and/or the environment. If residues of the MGP remain at the sites, they may pose health risks to the surrounding populations and the environment. The sites were screened for size, current use, waste containment, nearby ground water and surface water use, soil and hydrological conditions, rainfall, chemical characteristics, and potential receptors. The information gathered through the screening effort was input into SSPS in order to assign risk-based priorities among the sites. The goal of the screening is to identify and prioritize former MGP sites that may then require further investigation.

During the priority setting, no attempt was made to determine the ultimate level of site remediation which might be required. Site prioritization was conducted in order to enable NYSEG to develop plans of action and resource allocation so that any potential risks posed by these sites can be adequately addressed.

3.0 SCOPE OF WORK

The following sections describe the information gathered concerning site history, current land use, physiography, hydrogeology, ground water and surface water use, sensitive habitats, and field activities relating to the Clark Street Site evaluation.

3.1 Site History

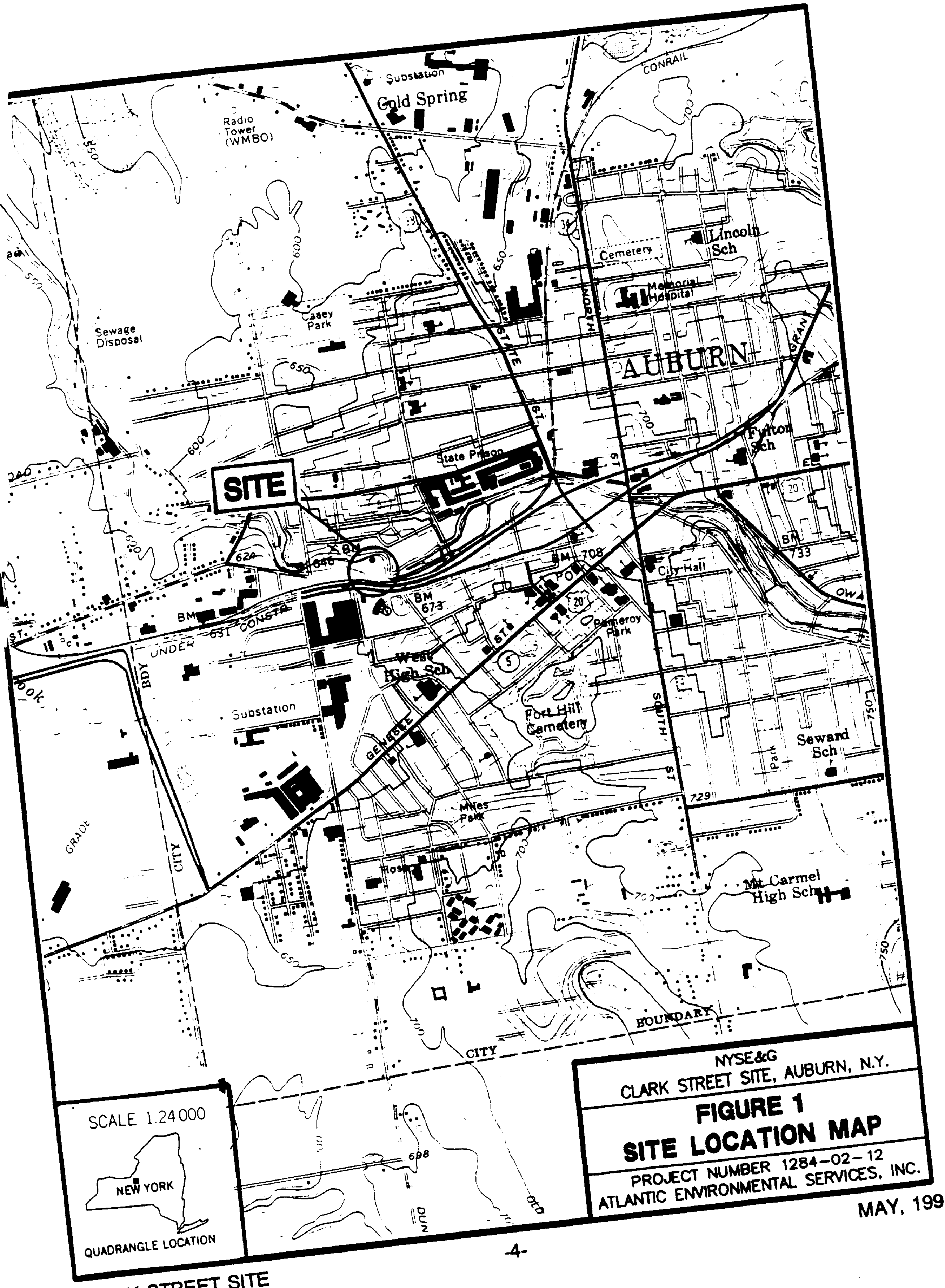
The Clark Street Site is the location of the former Clark Street MGP located in Auburn, New York. The site location is indicated on the Auburn, New York USGS Quadrangle map (Figure 1). The Clark Street Site acquisition, organization, history, and available Sanborn and site plan Maps (Figures B-1 through B-5), which were researched and compiled by NYSEG, are included in Appendix B. The following site history is summarized on a Fact Sheet following the Title Page of this report. The Clark Street MGP was constructed prior to 1904 and produced carburetted water gas until circa 1946, according to NYSEG records. The Citizens Light and Power Company first operated the Clark Street MGP according to the 1904 Sanborn Map and NYSEG records. Figure 2 illustrates the existence and configuration of structures at the Clark Street Site from 1904 through 1958. The earliest depiction of the plant configuration illustrated on the 1904 Sanborn Map (Figure B-1) consisted of a single gas plant building. A generator room, purifying room, meter room and two boilers for steam production were located within the building. Two gas holders, 75,000 cubic feet (cf) and 204,000 cf capacity, were located northeast of the gas works. A large above-ground oil tank was located northwest of the gas works. The Auburn Gas Company acquired the Citizens Light and Power Company in 1905 and the Auburn Gas Light Company in 1901, and operated the Clark Street MGP until 1911. In 1911, the Empire Gas and Electric Company acquired the Auburn Gas Company. A 1926 plant map (Figure B-2) documents the construction of a third large (491,000 cf) gas holder west of the gas plant and a small unlabeled feature northeast of the gas plant. It is unknown when the northwest spur of the railway was removed. NYSEG acquired the Clark Street Site in 1936. A 1943 plant map (Figure B-3) documents the demolition of the 75,000 cf and 204,000 cf gas holders, the removal of the oil tank and the addition of a tar pump house. According to NYSEG records, gas production had ceased at the Clark Street MGP and the facility had been converted to a utility operations center/gas storage facility by 1946 (Figure B-4). A 1958 site plan map (Figure B-5) documents the demolition of the remaining holder and construction of a new substation northeast of the gas plant building. The gas plant building was partially razed after 1961 according to NYSEG records. A small portion was retained as a gas regulator building.

3.2 Site Reconnaissance

3.2.1 Current Use

The Clark Street Site is located in a mixed commercial/ residential area in the southwest section of Auburn, New York (Figure 1). The closest residences are approximately 100 feet north of the site, across the Owasco Lake Outlet. The site is located at the end of Clark Street and is bounded by the Owasco Lake Outlet to the east and north, a vehicle maintenance shop to the west and southwest (Sackel Property), and by a railroad right-of-way to the south. An adjacent land use map is provided as Figure 3.

The site is presently occupied by a NYSEG substation and a gas regulator building surrounded by open vegetated and gravel-covered land. The foundation of the former gas plant is visible. A



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CLARK STREET SITE, AUBURN, N.Y.

FIGURE 1
SITE LOCATION MAP

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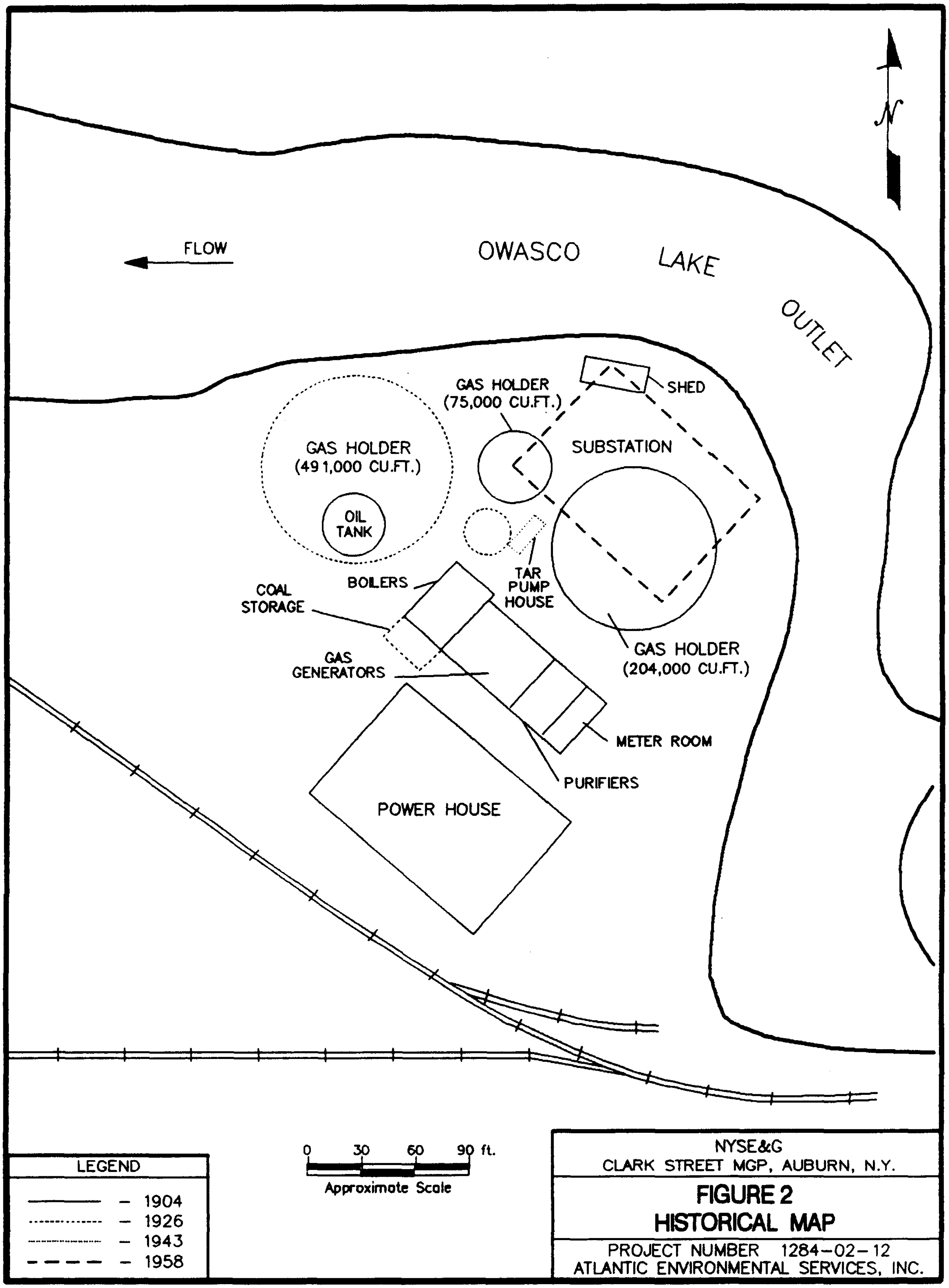
MAY, 1991

CLARK STREET SITE
AUBURN, NY



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CLARK STREET MGP, AUBURN, N.Y.

FIGURE 2
HISTORICAL MAP

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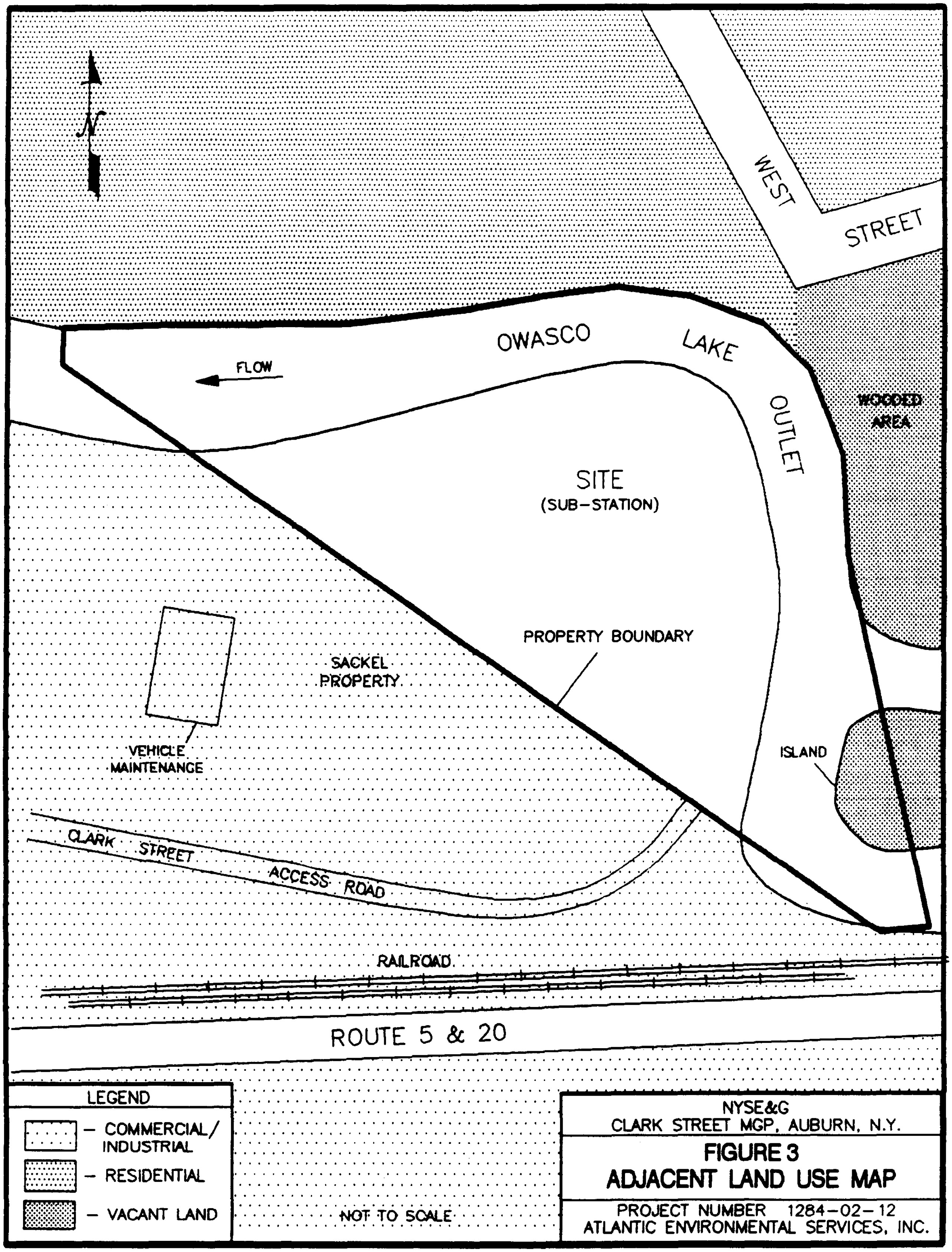

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CLARK STREET MGP, AUBURN, N.Y.

FIGURE 3
ADJACENT LAND USE MAP

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partially buried structure, possibly a drip vessel, which contained liquids having an MGP characteristic odor was located northwest of the gas house in an overgrown area of the site. Some rubble, ash, and coal were observed over various parts of the site. No other odors, purifier residues or tars associated with MGP operations were observed on the ground or in the surface water at the site. No tar seeps or sheens were observed along the Owasco Lake Outlet streambed, however, large boulders inhibited observations. Public access to the site is not restricted, however no evidence existed of any public usage. The site is separated from the closest residences by the Owasco Lake Outlet. Neighborhood children likely gather on the opposite bank of the Owasco Lake Outlet from the site. Xerox copies of aerial and ground photos of the Clark Street Site are included in the field data section of this report (Appendix C).

3.2.2 Physiography

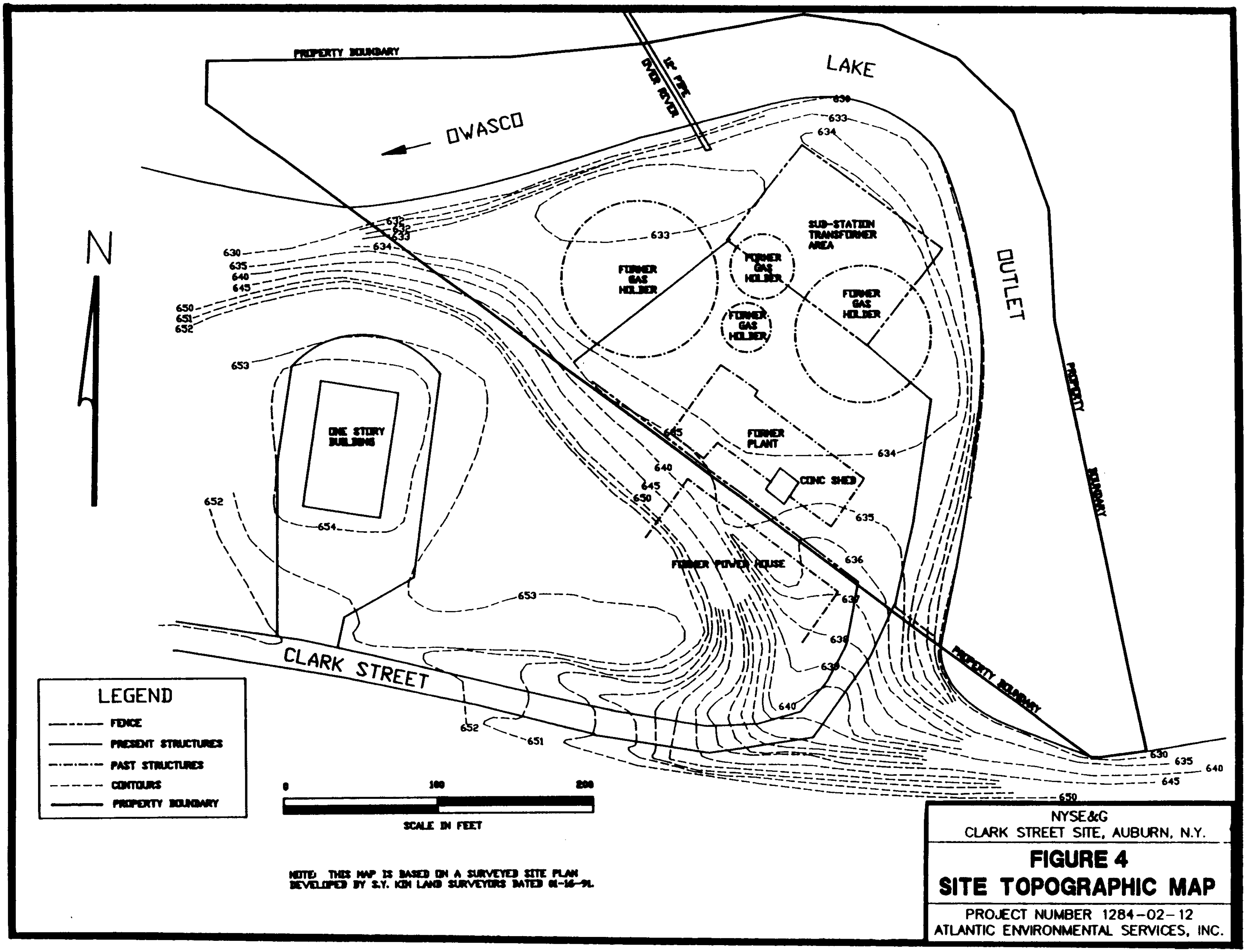
The Clark Street Site was surveyed by S.Y. Kim Land Surveyor, P.C., Latham, New York. Figure 4 is a reduced topographical map of the site. The Clark Street Site base map is located in the pocket at the end of this report. Surveyor field notes are located in Appendix D.

The Clark Street Site is generally level, sloping gently toward the Owasco Lake Outlet. The average elevation across the site is approximately 634 feet above Mean Sea Level (MSL). The southwestern edge of the site borders along the base of a ridge leading up to the Sackel property on which a vehicle maintenance shop is located. The ridge is steeper (approximately 50% slope) at the northern edge of the Clark Street Site boundary than at the southern edge (approximately 10% slope).

The maximum 24 hour rainfall recorded in Skaneateles in 1989 was 2.6 inches (Hadlen, 1989). Rainfall data for Auburn in 1989 is incomplete. Surface water runoff from the Sackel property and the Clark Street Site flows unrestricted to the Owasco Lake Outlet. During the initial site survey on October 23, 1990, ponding of rainwater was observed in the gravel area west of and adjacent to the substation fence, as well as in the vegetated area covering the westernmost former gas holder. Precipitation infiltration is restricted by relatively impermeable surficial soils and by the fill emplaced at the site, however ponding creates the potential for infiltration. The wind speed at the site can be greater than 4 meters per second, however the vegetative and gravel cover deter airborne dust particles.

3.2.3 Hydrogeology

Preliminary geologic and hydrogeologic information on the Clark Street Site has been obtained from Hutton (1971). The soils at the Clark Street Site are mapped as fill and disturbed soils within the industrial area occupying the valley along the Owasco Lake Outlet in central Auburn. The existence of fill was verified during the surface soil sampling. The closest undisturbed soils are mapped as the Cazenovia Silt Loam, a moderately well drained to well drained soil derived from reddish till with high lime content. These soils were probably present at the site during MGP operations and are characterized by a moderately fine texture and typically contain twenty-eight to thirty-five percent (28-35%) clay. The permeability of the soils are reported to range from 0.20 to 0.63 inches per hour (1.4^{-4} to 4.4^{-4} centimeters per second). Permeability of the fill material was not determined. The soils are typically thin, with bedrock present within ten feet of the surface. The bedrock underlying the site is the Onondaga Limestone.



NOTE: THIS MAP IS BASED ON A SURVEYED SITE PLAN DEVELOPED BY S.Y. KIM LAND SURVEYORS DATED 01-16-91.

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CLARK STREET SITE, AUBURN, N.Y.

FIGURE 4
SITE TOPOGRAPHIC MAP

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The depth to shallow ground water at the site is unknown. The Owasco Lake Outlet is approximately 4 feet (at an elevation of 630 feet MSL) below the average elevation of the site (634 feet MSL). Shallow unconfined ground water probably discharges to the Owasco Lake Outlet, indicating that the depth to shallow ground water at the site is within 4 feet of the surface. MGP structures, mainly gas holders, were commonly constructed below grade and are assumed to be at least within 3 feet (1 meter) of the shallow aquifer at the site. Information concerning other aquifers at the site are unknown.

3.2.4 Ground Water and Surface Water Use

The Clark Street Site in Auburn, New York is bordered by the Owasco Lake Outlet. NYSDEC has classified the Owasco Lake Outlet as a Class D surface water body. Class D surface waters are suitable for fishing and for primary and secondary contact recreation. The City of Auburn receives its potable water supply from Owasco Lake. The City intake is approximately 4 miles (6.4 km) upstream of the Clark Street Site. The system served approximately 32,550 people in the early 1980s (Axelrod, 1984).

There is a city ordinance in Auburn which forbids homeowners to drill wells on their properties. USGS well records indicate that one domestic well is located within 3.11 miles (5 kilometers (km) of the site. It is unknown if the well is currently in use. According to Ted Medrek (Cayuga County DOH employee of 20 years) there are no wells which are used in the Auburn City area.

3.2.5 Sensitive Habitats

There are no federally regulated wetlands located within 2.5 miles (4 km) of the site (NYSDEC Fish and Wildlife Branch Wetland Maps). No endangered species are known to exist within 2.5 miles (4 km) of the Clark Street Site (NYSDEC Natural Heritage Files and Maps).

3.3 Field Activities

Prior to the performance of any field activities, a work plan, quality assurance/quality control document and health and safety plan were submitted to and approved by NYSEG. The Health and Safety Plan and the Quality Assurance/Quality Control Document are included in Appendices E and F, respectively.

The general approach used to investigate MGP residues at the Clark Street Site was to identify routes of exposure which may result in direct contact with MGP residues and to chemically characterize the media associated with the exposure routes to evaluate potential health risks associated with the site.

Exposure routes with the potential for direct contact identified at the Clark Street Site include:

- dermal contact/incidental ingestion of surface soils potentially contaminated by tars, fuel oil, coal pile leachate or purifier residues; and
- dermal contact/incidental ingestion of surface water and sediments in the Owasco Lake Outlet potentially contaminated by runoff or direct discharge.

Surface water, streambed sediment, and surface soils were sampled at the site. No wells for ground water sampling are present at the site. No subsurface soil investigations were performed at the Clark Street Site. The potential effects of MGP residues on ground water and subsurface soils at the site were estimated using geometric mean concentrations of selected parameters commonly found in the subsurface at MGP sites and the annual gas production for the Clark Street MGP for purposes of completing the SSPS forms (see Appendix A, questions 18 and 23 for details). Sample locations and rational are presented in Table 1.

3.3.1 Surface Water and Streambed Sediment Samples

A total of three (3) surface water samples were collected from the Owasco Lake Outlet at the Clark Street Site on November 27, 1990. Sampling locations are indicated on Figure 5. Surface water samples were obtained from upstream (SW-1, on the south side of the river, adjacent to the railroad tracks), adjacent to the site (SW-2, by the drainage swale leading from the former gas plant area), and downstream (SW-3, 50 feet downstream of the Clark Street Site boundary) locations. These locations were selected to evaluate the changes in water quality potentially attributable to discharge of ground water, tar, or surface water runoff from the Clark Street Site into the Owasco Lake Outlet. Surface water samples were collected according to Atlantic Procedure 1022 (Appendix G).

Surface water samples were analyzed for volatile organic compounds using EPA Method 624, semi-volatile organic compounds using EPA Method 625, metals using EPA Method 200.7, lead using EPA Method 7191, chromium using EPA Method 7421, and cyanide using EPA Method 335.

A total of three (3) streambed sediment samples were collected from the Owasco Lake Outlet on November 27, 1990. These sample locations are coincident with the surface water sample locations. Sediment samples were collected in accordance with Atlantic Procedure No. 1022 (Appendix G).

Sediment samples were analyzed for volatile organic compounds using EPA Method 8240, semi-volatile organic compounds using EPA Method 8270, metals using EPA Method 6010, lead using EPA Method 7191, chromium using EPA Method 7421, and cyanide using EPA Method 9010.

3.3.2 Surface Soil Samples

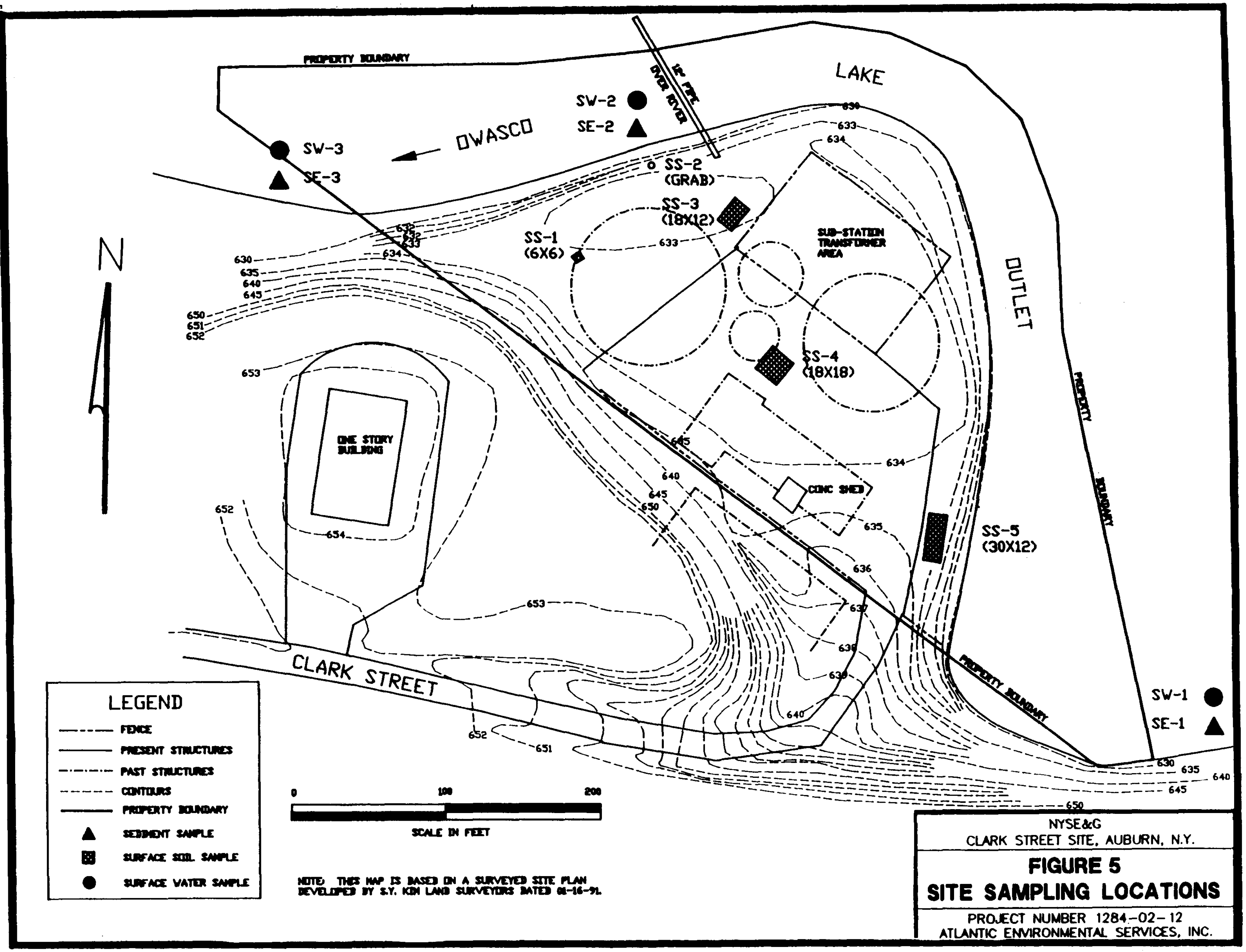
A total of five (5) surface soil samples were collected at the Clark Street Site on November 27 and 28, 1990. Sampling locations are illustrated on the Sampling Locations Map (Figure 5). Surface soils were collected from 0.0 to 0.5 foot depth using dedicated stainless steel sampling spoons. All of the surface soil sample areas except SS-2 were gridded and consisted of 49 nodal points each. Five (5) nodes, randomly selected, were sampled and combined to produce each composite sample. Surface soil sample SS-2 was not gridded due to dense overgrowth in the sample area. Five randomly selected locations within the sample area were sampled and combined to produce a composite sample. Sample areas and nodal selection are detailed in the field data section, Appendix C of this report. Sample collection procedures are outlined in Atlantic Procedure 1020 (Appendix G).

Surface soil sample SS-1 was collected between the westernmost former holder and the Owasco Lake Outlet. Surface soil sample SS-2 was located on the Owasco Lake Outlet bank on both sides of the drainage swale leading from the former gas works area to the Owasco Lake Outlet. Surface soil sample SS-3 was taken along the northwest side of the substation, downgradient of the former

TABLE 1

SAMPLING LOCATIONS AND RATIONALE FOR THE CLARK STREET SITE, AUBURN, NEW YORK

SAMPLE ID	LOCATION AND RATIONALE		ANALYSES
SURFACE WATER			
SW-1	Upstream	To evaluate potential changes in surface water quality which may be attributable to the discharge of ground water or tars, or runoff of surface water from the Clark Street Site into the Owasco Lake Outlet.	VOCs-EPA Method 624 SVOCs-EPA Method 625 Metals-EPA Method 200.7 Lead-EPA Method 7191 Chromium-EPA Method 7421 Cyanide-EPA Method 335
SW-2	Mid-site		
SW-3	Downstream		
STREAMBED SEDIMENT			
SE-1	Upstream	To evaluate potential changes in streambed sediment quality which may be attributable to the discharge of ground water or tars, or runoff of surface water from the Clark Street Site into the Owasco Lake Outlet.	VOCs-EPA Method 8240 SVOCs-EPA Method 8270 Metals-EPA Method 6010 Lead-EPA Method 7191 Chromium-EPA Method 7421 Cyanide-EPA Method 9010
SE-2	Mid-site		
SE-3	Downstream		
SURFACE SOILS			
SS-1	Former westernmost gas holder area to evaluate potential contamination from holder contents.		VOCs-EPA Method 8240 SVOCs-EPA Method 8270 Metals-EPA Method 6010 Lead-EPA Method 7191 Chromium-EPA Method 7421 Cyanide-EPA Method 9010
SS-2	Along the drainage swale leading from the former gas works operation to evaluate potential contamination from runoff from the plant area.		
SS-3	In the vicinity of the former holders, west of the substation to evaluate potential contamination from holder contents.		
SS-4	In the vicinity of the former tar handling area to evaluate potential contamination from the tar tanks.		
SS-5	Along the grassy bank of the Owasco Lake Outlet downgradient from the former plant building to evaluate potential contamination from runoff from the gas works area.		



NOTE: THIS MAP IS BASED ON A SURVEYED SITE PLAN DEVELOPED BY S.Y. KIM LAND SURVEYORS DATED 01-16-91.

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CLARK STREET SITE, AUBURN, N.Y.

FIGURE 5
SITE SAMPLING LOCATIONS

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gas works area. Surface soil sample SS-4 was located to the southwest of the substation over the former tar handling area. Surface soil sample SS-5 was taken in the grassy area southeast of and downgradient from the former MGP.

Surface soil samples were analyzed for the same parameters and using the same EPA methods as the streambed sediment samples.

4.0 ANALYTICAL RESULTS

This section summarizes the analytical results of the sampling program conducted at the Clark Street Site in Auburn, New York. Appendix H lists the results of the analyses performed by Wadsworth/Alert Laboratories, Inc. on the samples collected from the various media at the site.

4.1 Surface Water Analytical Results

No volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), or cyanides were detected in any of the surface water samples collected at the Clark Street Site. The only elevated metal concentration detected in the surface water was in upstream surface water sample SW-1 which contained 0.094 ppm zinc when compared to NYSDEC Ambient Water Quality Standards (Zambrano, 1990).

4.2 Streambed Sediment Analytical Results

Streambed sediment sample SS-2 contained 1.0 ppm benzene, 1.4 ppm ethylbenzene, and 1.1 ppm total xylenes. All of the streambed sediment samples contained C-PAHs and PAHs as summarized in Table 2. Complete analytical analyses from which Table 2 is derived are tabulated in Appendix H. Sediment sample SE-1 (upstream) had a total of 14.5 ppm PAHs and 11.5 ppm C-PAHs. Sediment sample SE-2 (adjacent to the site) contained 21.2 ppm C-PAHs and 60.8 ppm PAHs. Sediment sample SE-3 (downstream) C-PAH concentration was 6.9 ppm and PAH concentration was 10.1 ppm. The particular PAHs detected in the samples may be associated with MGP residues. Relatively small quantities of bis(2-ethylhexyl)phthalate were detected in the three streambed sediment samples. Bis(2-ethylhexyl)phthalate, a SVOC, is a common laboratory contaminant and is ubiquitous in the environment. Dibenzofuran is a carcinogenic SVOC associated with combustion; and, therefore, may be related to MGP residues was detected at 0.16 ppm in SE-1.

All of the streambed sediment samples contained elevated levels of a few metals which also are summarized in Table 2. The background concentration of each metal was derived from the background concentrations listed for the sampling location closest to Auburn, New York in Shacklette and Boerngen (1984). Streambed sediment sample SE-2 had 6.8 ppm cyanide.

The VOCs, PAHs, C-PAHs, dibenzofuran, and cyanide detected at the Clark Street Site may be indicative of former MGP residues. Along-site streambed sediment sample SE-2 consistently contained the highest concentrations of the majority of the compounds. The fact that sample SE-2 was collected at the point where the drainage swale discharges to the river suggests that the origin of these compounds may be from the Clark Street Site. The C-PAHs and PAHs in upstream sample SE-1 could originate from urban runoff, the upstream McMaster Street former MGP, or other sources.

4.3 Surface Soil Analytical Results

Surface soil samples SS-4 and SS-5 contained approximately 0.57 ppm and 0.70 ppm toluene, respectively. These values were detected but were below quantification limits and therefore are estimated concentrations. All of the surface soil samples contained C-PAHs and PAHs as summarized in Table 3. Complete analytical analyses from which Table 3 is derived are tabulated in Appendix H.

TABLE 2

VOLATILE ORGANIC, SEMI-VOLATILE ORGANIC, AND INORGANIC COMPOUNDS DETECTED IN STREAMBED SEDIMENTS AT THE CLARK STREET SITE, AUBURN, NEW YORK

	(CONCENTRATIONS IN PPM)			
ELEMENT	**SE-1**	**SE-2**	**SE-3**	**TYPICAL BACKGROUND CONCENTRATION AT SIMILAR SITES**
VOLATILE ORGANICS				
Benzene	–	1.00	–	
Ethylbenzene	–	1.40	–	
Total Xylenes	–	1.10	–	
TOTAL	–	3.50	–	
SEMI-VOLATILE ORGANICS				
Bis(2-ethylhexyl)phthalate	0.79J	2.10J	0.29J	
Dibenzofuran	0.16J	–	–	
NON-CARCINOGENIC PAHS				
Acenaphthene	0.19J	–	–	
Anthracene	0.55J	2.10J	0.51J	
Fluoranthene	5.50	17.00	3.70	
Fluorene	0.22J	0.79J	0.17J	
Naphthalene	0.17J	4.90	–	
Phenanthrene	3.60	15.00	2.40	
Pyrene	4.30	21.00	3.30	
TOTAL	14.53	60.79	10.08	10.00(1)
CARCINOGENIC PAHS				
Benzo(a)anthracene	2.20	7.10	1.60	
Benzo(b)fluoranthene	2.90	0.83J	1.70	
Benzo(k)fluoranthene	1.20	–	0.66J	
Benzo(a)pyrene	2.10	4.20J	0.84J	
Chrysene	2.40	6.90	1.60	
Indeno(1,2,3-cd)pyrene	0.67J	2.20J	0.45J	
TOTAL	11.47	21.23	6.85	10.00(1)
INORGANICS				**BACKGROUND CONCENTRATIONS**
Antimony	–	–	9.70	<1.00(2)
Arsenic	7.50	9.10	7.10	2.6(2)
Beryllium	*	1.00	1.10	<1.00(2)
Calcium	*	97,000	170,000	5,200(2)
Mercury	0.37	–	0.14	0.13(2)
Nickel	*	17.00	22.00	15.00(2)
Cyanide	–	6.80	–	500(1)

– None detected
* Detected, but below background concentration.
J Detected, but below quantification limit (estimated value).
(1) Level based on typical background concentrations at similar sites.
(2) Shacklette and Boerngen (1984)

T/P
= 1.28 0.81 1.12

TABLE 3

VOLATILE ORGANIC, SEMI-VOLATILE ORGANIC, AND INORGANIC COMPOUNDS DETECTED IN SURFACE SOILS AT THE CLARK STREET SITE, AUBURN, NEW YORK

	(CONCENTRATIONS IN PPM)					
ELEMENT	**SS-1**	**SS-2**	**SS-3**	**SS-4**	**SS-5**	**TYPICAL BACKGROUND CONCENTRATION AT SIMILAR SITES**
VOLATILE ORGANICS						
Toluene	–	–	–	0.57J	0.70J	
TOTAL	–	–	–	0.57	0.70	
SEMI-VOLATILE ORGANICS						
Bis(2-ethylhexyl)phthalate	–	–	–	–	0.23J	
Dibenzofuran	–	1.50J	2.10J	–	–	
2-Methylnaphthalene	–	0.41J	0.50J	–	–	
Pentachlorophenol	0.38J	–	–	–	–	
NON-CARCINOGENIC PAHS						
Acenaphthene	–	2.60J	3.90J	–	–	
Acenaphthylene	–	1.50J	0.63J	–	–	
Anthracene	–	6.90J	12.00	–	0.30J	
Fluoranthene	0.63J	40.00	68.00	3.80	2.40	
Fluorene	–	2.50J	4.30	0.16J	–	
Naphthalene	–	2.00J	1.50J	–	0.09J	
Phenanthrene	0.38J	25.00	51.00	2.50	1.20	
Pyrene	0.65J	48.00	63.00	4.60	3.20	
TOTAL	1.66	128.50	204.33	11.06	7.19	10.00(1)
CARCINOGENIC PAHS						
Benzo(a)anthracene	–	23.00	30.00	–	1.20	
Benzo(b)fluoranthene	0.45J	3.50J	29.00	2.50	1.70	
Benzo(k)fluoranthene	0.19J	45.00	13.00	–	0.60J	
Benzo(a)pyrene	0.25J	20.00	4.10	1.80	1.10J	
Chrysene	0.38J	24.00	28.00	2.40	1.30	
Indeno(1,2,3-cd)pyrene	0.15J	8.40	6.10	0.91J	0.50J	
TOTAL	1.42	123.90	110.20	7.61	6.40	10.00(1)
INORGANICS						**BACKGROUND CONCENTRATIONS**
Arsenic	6.60	13.00	9.00	19.00	33.00	2.60(2)
Beryllium	*	*	–	–	–	<1.00(2)
Calcium	52,000	89,000	48,000	150,000	79,000	5,200(2)
Mercury	0.19	0.16	0.28	0.40	0.45	0.13(2)
Nickel	15.00	22.00	17.00	22.00	15.00	15.00(2)
Silver	–	–	–	4.00	–	0.00(2)
Cyanide	–	9.70	3.20	–	–	500(1)

– None detected
* Detected, but below background concentration.
J Detected, but below quantification limit (estimated value).
(1) Level based on typical background concentrations at similar sites.
(2) Shacklette and Boerngen (1984)

The C-PAH concentrations of SS-2, SS-3 and SS-4 were 123.9 ppm, 110.2 ppm and 11.1 ppm, respectively. The PAH concentrations of SS-2, SS-3 and SS-4 were 128.5 ppm, 204.3 ppm and 11.1 ppm, respectively (total concentrations include estimated (J) values). All of the surface soil samples contained elevated levels of the various metals also shown in Table 3. The background levels of metals are derived from Shacklette and Boerngen (1984). Cyanide was detected in SS-2 at a concentration of 9.7 ppm and in SS-3 at a concentration of 3.2 ppm. Relatively small quantities of dibenzofuran and 2-Methylnaphthalene (SVOCs) were detected in SS-2 and SS-3. SS-1 contained 0.4 pentachlorophenol (SVOC).

The PAHs, C-PAHs, dibenzofuran, 2-methylnaphthalene, and cyanide detected in the Clark Street Site surficial soils may be related to former MGP residues. The elevated levels of metals in the surface soils could have originated from several sources, and do not necessarily indicate association with MGP residues. Cyanides at MGP sites are associated with purifier residues and are complex cyanides which are stable under normal environmental conditions. Pentachlorophenol is not generally associated with MGP residues.

5.0 SCREENING RESULTS

The Clark Street MGP produced gas using the carburetted water gas process. Residuals commonly produced by the carburetted water gas process of producing gas were coal tar, coke, ash and clinker, purifier residues and phenolic compounds. Ash, coal, and a partially buried structure (suspected drip vessel) exuding a coal tar odor were observed at the Clark Street Site. VOCs, SVOCs, and PAHs associated with MGP operations, combustion, and fuel oils were detected in surficial soils and streambed sediments. Cyanide was detected in one streambed sediment sample and two surface soil samples. No MGP residues were detected in the surface water bordering the site.

The Clark Street Site in Auburn, New York received an actual risk score of 22.1 and a perceived risk score of 25.3 from the SSPS program. The major route of exposure to MGP residues according to the SSPS program was identified as direct contact with surficial soils. The SSPS scores reflect the assumption that subsurface MGP residues exist at the Clark Street Site, although no subsurface investigations were conducted. The answers to and the assumptions used to answer specific SSPS questions in order to ensure consistency between sites are detailed in Appendix A. The breakdown of exposure route and individual question scores is also listed in Appendix A.

6.0 RECOMMENDATIONS

The major route of exposure to contamination at the Clark Street Site based on available information was identified as direct contact with surficial soils. Surficial soils and streambed sediments contained VOCS, PAHs, dibenzofuran, 2-methylnaphthalene, and cyanide which may be indicative of MGP residues. PAHs, VOCs, dibenzofuran, and 2-methylnaphthalene are potentially harmful to humans if ingested or through direct contact. Cyanide at MGP sites are associated with purifier residue and are complex cyanides that are stable under normal environmental conditions.

The Clark Street Site received relatively high SSPS scores. These scores resulted from the detection of VOCs and relatively high concentrations of PAHs in surficial soils and streambed sediments. Based on the SSPS score relative to other sites and the discovery of a subsurface vessel most likely containing MGP residues at the site, a focused remedial investigation is recommended for the Clark Street Site. The investigation should include ground water and subsurface soil studies focusing in areas where former MGP structures existed, areas of vegetative stress, and where visual or olfactory residuals are evident in order to better assess the potential risks associated with the site.

7.0 REFERENCES

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2.0 METHODOLOGY

The SSPS (Site Screening and Priority Setting System) is a menu-driven program designed for IBM-compatible PCs. The Electric Power Research Institute (EPRI) developed SSPS to help utilities manage former MGP sites, but it is a general tool that can be applied efficiently to many types of contaminated sites. The SSPS assigns scores to individual site characteristics. The individual scores are used to calculate risks associated with four potential routes of exposure, namely surface water, ground water, direct contact and air. The scores are combined to produce final scores which are indicators of actual risk and perceived risk at each site.

The SSPS is simple to use and requires information that is relatively straightforward to obtain. It can screen and rank a large number of MGP sites for further investigation and analysis. It has been tested with a number of MGP sites where complete risk analyses have been conducted and has produced reliable rankings with a strong correlation between the SSPS risk scores and the results of the remedial investigation risk analyses. The system does not attempt to determine the ultimate level of site remediation.

The SSPS requires information regarding the site and the surrounding areas including site size and current use, waste containment efforts, nearby ground water and surface water use, soil and hydrological conditions, rainfall, chemical characteristics, and potential receptors. Initial site surveys were conducted at the NYSEG Western area and North Central area sites on October 23 and 24, 1990. During these surveys, information regarding site size, current use, surface water use, general soil conditions, waste containment, and potential receptors was recorded. Historical data, U.S. Geological Survey (USGS), New York State Department of Environmental Conservation (NYSDEC), Department of Health (DOH), National Oceanic Atmospheric Administration (NOAA), and Soil Conservation Service (SCS) files and publications provided insights to nearby ground water and surface water use, soil and hydrological conditions, rainfall, and waste containment.

The sampling program consisted of surface soil, surface water, and streambed sediment samples collected on November 27 and November 28, 1990. These media sampling points were chosen to assess the chemical concentrations at the potential exposure pathways that are present at the Clark Street Site.

No wells for ground water sampling exist at the site. Subsurface investigations were not conducted as part of the site evaluation. The potential effects of MGP residues on ground water and subsurface soils at the site were estimated for purposes of completing the SSPS forms. The quantities of potential MGP residues in the subsurface at the Clark Street Site were estimated by applying the geometric mean concentration of residues associated with MGPs to a percentage of the tar produced onsite based on the annual average gas production. The geometric mean concentrations of residues associated with MGPs were derived from the GRI-EPRI data base compiled by Atlantic Environmental Services, Inc. The percentage of tar produced was estimated from the Radian Report. The quantities of potential MGP residues in the subsurface at the Clark Street Site and the methods used to derive them are listed in Appendix A, questions 18 and 23.

APPENDIX A

SSPS SCORES, ANSWERS AND ASSUMPTIONS QUESTIONNAIRE

SSPS DATA ENTRY FORM

Site Name: AUBURN-CLARK STREET SITE   Actual Risk: 22.1

Type of Site: MGP SITE   Perceived Risk: 25.3

ACTUAL RISK:	22.1
Surface Water:	7.9
Target:	15.8
Runoff Potential:	1.7
Near-surface Contamination:	17.1
Containment:	25.0
Mobility:	38.9
Subsurface Release Potential:	9.0
Subsurface Contamination:	17.1
Containment:	100.0
Mobility:	52.4
Observed Release:	50.0
Ground Water:	0.0
Target:	0.0
Release Potential:	4.8
Subsurface Contamination:	17.1
Containment:	100.0
Mobility:	27.8
Observed Release:	75.0
Direct Contact:	43.4
Target:	50.6
Surface Contamination:	85.7
Air:	4.3
Target:	27.7
Release Potential:	15.4
Subsurface Contamination:	85.7
Containment:	30.0
Mobility:	60.0
Observed Release:	0.0
PERCEIVED RISK:	25.3
Site Characteristics:	50.6
Surface Water:	10.5
Target:	15.8
Runoff Potential:	10.4
Near-surface Contamination:	100.0
Containment:	25.0
Mobility:	41.7
Subsurface Release Potential:	66.7
Subsurface Contamination:	100.0
Containment:	100.0
Mobility:	66.7
Observed Release:	66.0

Ground Water:	0.0
Target:	0.0
Release Potential:	50.0
Subsurface Contamination:	100.0
Containment:	100.0
Mobility:	50.0
Observed Release:	100.0
Direct Contact:	50.6
Target:	50.6
Surface Contamination:	100.0
Air:	5.0
Target:	27.7
Release Potential:	18.0
Subsurface Contamination:	100.0
Containment:	30.0
Mobility:	60.0
Observed Release:	0.0
Community Characteristics:	0.5

Q1) Site Description: MANUFACTURED GAS PLANT

Q2) Service Region: North Central

Service Division: Auburn

Neighborhood Type: Residential/Commercial

Q3) How is the surface water used?

___ Not currently used (score = 1)
___ Industrial (2)
___ Recreational (3)
_X_ Irrigation, food preparation, or fishing (4)
___ Drinking water (5)

Select the appropriate answer with the highest score.

> Based on NYSDEC stream classifications. The Owasco River bordering the Clark Street Site is classified as a Class D surface water body which is used for fishing and recreation.

Score: 4.0

Q4) For each distance, check the appropriate row to indicate the number of people using the downstream surface water for the highest scoring purpose above.

	Distance			
Population	Within 5 km	Within 3 km	Within 1 km	Within 1/2 km
0	____ (0)	____ (0)	____ (0)	____ (0)
1 to 100	____ (1)	____ (2)	____ (3)	X (4)
101 to 1,000	____ (2)	____ (3)	X (4)	____ (6)
1,001 to 10,000	X (3)	X (4)	____ (6)	____ (8)
10,001 to 100,000	____ (4)	____ (6)	____ (8)	____ (10)
100,001 and up	____ (6)	____ (8)	____ (10)	____ (12)

Based on Donnelly Demographic Data.

Score: 4.0

Q5) Check the appropriate downstream distance from the site to the nearest of each type of sensitive surface water environment:

	Distance				
Target	Outside 4 km	Within 4 km	Within 2 km	Within 1 km	Within 1/2 km
Coastal wetland	X (0)	____ (1)	____ (6)	____ (12)	____ (16)
Freshwater wetland	X (0)	____ (1)	____ (3)	____ (7)	____ (16)
Endangered species	X (0)	____ (1)	____ (3)	____ (8)	____ (16)

Based on NYSDEC regulated wetlands and federally designated endangered species.

Score: 0.0

Q6) What is the slope of the terrain near the site:

On-site slope	Less than 3%	3% or greater	5% or greater	8% or greater	No intervening terrain
Less than 3%	____ (0)	____ (1)	____ (1)	____ (2)	____ (9)
Less than 5%	____ (0)	____ (1)	____ (2)	X (2)	____ (9)
Less than 8%	____ (0)	____ (2)	____ (2)	____ (3)	____ (9)
8% or greater	____ (0)	____ (2)	____ (3)	____ (3)	____ (9)

Based on site observations and the USGS 7.5 Minute Quadrangle Map of Auburn.

Score: 2.0

Q7) What is the expected maximum 24-hour rainfall over a year?

___ Less than 2 cm (0)
___ Less than 5 cm (1)
_X_ Less than 8 cm (2)
___ 8 cm or greater (3)

Based on the greatest of 24-hour rainfall in 1989 for Skaneateles, referenced in NOAA Climatological Data Annual Summary New York, 1989.

Score: 2.0

Q8) What is the distance to the nearest body of surface water?

___ Greater than 2 km (0)
___ Less than 2 km (1)
___ Less than 1/2 km (2)
_X_ Less than 100 meters (3)

Based on site observations and the Auburn Quadrangle map.

Score: 3.0

Q9) What is the physical state of the wastes within one-tenth of one meter (10 cm) of the site surface?

_X_ Solid, consolidated and stabilized (0)
___ Solid, unconsolidated and unstabilized (1)
___ Powder or fine material (2)
___ Liquid, gas, or sludge (3)

Default value - solid, consolidated, and stabilized because the only waste observed at the site fell into this category.

Score: 0.0

Q10) How well is the site designed to reduce runoff?

- Runoff blocked by high terrain (0)
- [✓ Waste covered (1)]
- Exposed waste, sound diversion system (2)
- Exposed waste, poor diversion system (3)
- Site in surface water (4)

Select the appropriate answer with the highest score.

Based on site observations made by Atlantic Environmental Services, Inc.

Score: 1.0

Q11) Fill out the table below describing the wastes present within one-tenth of a meter (10 cm) of the surface of the site. If data is not known exactly, approximations must be made. Include up to six chemicals.

Chemical Waste Name	Concentration (ppm)	Established Values (ppm)	Persistence (0-3)	Quantity (kg)
Arsenic	33.0	2.6	3	0.8
Cyanide	9.7	500	3	0.1
Lead	120.0	700	3	3.9
C-PAH	160.4	10	3	2.5
PAH	208.6	10	3	3.5
Nickel	22.0	15	3	0.6

Chemical Waste:	**Types of wastes were determined by mutual consent. They are defined below with C-PAHs and PAHs broken down into the specific compound detected in the surface soils at the Clark Street site.** **Arsenic** **Cyanide** **Lead** **C-PAHs: Benzo(a)anthracene, benzo(b) fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, indeno(1,2,3-cd) pyrene** **PAHs: Anthracene, acenaphthene, acenaphthylene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene** **Other: Nickel**
Concentration:	**The highest concentration detected in any of the samples was used. If none was detected, concentration = 0.**

Concentration:	C-PAHs: Concentration represents the sum of the highest concentrations of all C-PAHs detected. PAHs: Concentration represents the sum of the highest concentrations of all PAHs detected, not including C-PAHs.
Established Values:	Arsenic, Lead and Nickel - Used the background concentrations for arsenic and lead from Shacklett and Boergnen (1984). Cyanide, C-PAHs, PAHs - Used default values: Cyanide - 50 ppm (domestic land use) 500 ppm (industrial land use) C-PAHs - 10 ppm PAHs - 10 ppm
Persistence:	Based on values supplied in the SSPS help screen.
Quantity:	The quantity of waste represents the summation of the concentration of waste detected in each surface soil sample multiplied by the volume of soil contaminated. For samples SS-1 through SS-5, this volume was assumed to be 10 m^3 (10m x 10m x 10cm).

Score: 6.0

Q12) What is the physical state of all of the wastes at the site surface?

X Solid, consolidated and stabilized (0)
___ Solid, unconsolidated and unstabilized (1)
___ Powder or fine material (2)
___ Liquid, gas, or sludge (3)

Default value - solid, consolidated and stabilized.

Score: 0.0

Q13) What is the distance from the bottom of the site to the top of the water table?

___ Greater than 15 m (0)
___ Less than 15 m (1)
___ Less than 5 m (2)
X Less than 1 m (3)
___ Site in water table (6)

Default value - less than 1m as established by mutual consent. Assumed former MGP structures were below land surface, placing the bottom of the site below grade and therefore closer to the water table.

Score: 3.0

Q14) What is the expected annual net precipitation?

- ☐ Less than -25 cm (0)
- ☐ Greater than -25 cm (1)
- ☐ Greater than 10 cm (2)
- ☒ Greater than 25 cm (3)

Default value - greater than 25 cm as established by mutual consent.

Score: 3.0

Q15) What is the permeability of the soil between the site and the water table?

- ☐ Less than 1×10^{-7} (0)
- ☐ Greater than 1×10^{-7} (1)
- ☒ Greater than 1×10^{-5} (2)
- ☐ Greater than 1×10^{-3} (3)

Value based on Soil Conservation Survey data for Cazenovia Silt Loam (the nearest undisturbed soil type to the Clark Street Site).

Score: 2.0

Q16) What is the mobility of the primary chemicals in the saturated zone?

- ☒ Greater than 10,000 (0)
- ☐ Less than 10,000 (1)
- ☐ Less than 100 (2)
- ☐ Less than 1 (3)

Default value of greater than 10,000 - assuming the primary chemical to be benzene as established by mutual consent.

Score: 0.0

Q17) How well is the site designed to reduce leaching and subsurface release?

___ Non-permeable barrier and no ponding (0)
___ Non-permeable barrier and ponding (1)
___ Inadequate barrier and no ponding (2)
_X_ Inadequate barrier and ponding (3)

Based on site observations made by Atlantic Environmental Services, Inc. in 1990.

Score: 3.0

Q18) Fill out the table below describing all of the wastes present at the site. If data is not known exactly, approximations must be made. Include up to six chemicals.

Chemical Waste Name	Concentration (ppm)	Established Values (ppm)	Persistence (0-3)	Quantity (kg)
VOCs	706.6	1.0	2	43.3
PAH	52,889.0	10	3	3240.6
Cyanide	3,800.0	500	3	0.1
Lead	190.0	700	3	3.9
Nickel	88.0	15	3	0.6
Zinc	240.0	2.6	3	0.8

Chemical Waste: Determined to be volatile organics, PAHs, cyanide, and metals as arrived at by mutual consent.

Concentration: Used the geometric mean concentrations for tar waste, and conversion factor for tar (gallons) to tar (weight in kilograms) from the GRI EPRI data base. Cyanide concentration represents the highest level detected in surface soil samples. Metal concentrations represent the highest level detected in surface soil samples.

Established Values: Determined by mutual consent as follows:
Volatile Organics - 1 ppm
PAHs - 10 ppm
Cyanide - 50 ppm (domestic land use)
500 ppm (industrial land use)
Metals - Background concentrations (Shacklette and Boerngen, 1984).

Persistence:	Based on values supplied in the SSPS help screen.
Quantity:	Used the radian report to determine the average annual gas production for the years that the Clark Street MGP was in operation to be 52 MCF. This average was multiplied by the years of operation (41) and then by a constant (7.3) representing the Radian Report assumption that 730 gallons of tar are produced for every 1,000,000 ft^3 of gas manufactured and approximately 1% is lost as waste onsite. Metals - Same procedure as Question 11.

Score: 6.0

Q19) Fill out the table below describing wastes that have been detected in the nearest body of surface water. If wastes have not been detected, enter zeros for the concentrations. If a waste release was detected by sight or smell but not sampled analytically, an approximation must be made. Include up to six chemicals.

Chemical Waste Name	Concentration (ppb)	Government Standard (ppb)
VOCs	0	--

Chemical Waste:	Determined to be volatile organics, C-PAHs, PAHs, metals, and cyanide.
Concentration:	Determined from Surface Water Sample Analysis.
Government Standard:	Based on NYSDEC surface water classifications or as a default, drinking water standards. ONLY considered elements which exceeded NYSDEC ambient water quality standards and guidance values for Class D surface waters.

Score: 50.0

Q20) How is the ground water used?

_X_ Not currently used (score = 1)
___ Industrial with alternative (2)
___ Drinking water with alternative or industrial with no alternative (6)
___ Drinking water with no alternative (9)

Select the appropriate answer with the highest score.

Assumed ground water was not used based on USGS well records and the following DOH publications:

1) **Report on Ground Water Dependence in New York State, NYSDOH Division of Environmental Health Bureau of Public Water Supply, 1981.**

2) **Inventory of Community Water Systems - New York State Vol. 1 - Municipal, NYSDOH - Bureau of Public Water Supply, 1984.**

3) **Inventory of Community Water Systems - New York State Vol. 2 - Non-Municipal, NYSDOH - Bureau of Public Water Supply, 1984.**

Score: 1.0

Q21) For each distance, check the appropriate row to indicate the number of people using the downgradient drinking water for the highest scoring purpose above:

	Distance				
Population	Within 5 km	Within 3 km	Within 1 km	Within 1/2 km	Onsite
0	X (0)	x (0)	x (0)	x (0)	x (0)
1 to 100	___ (4)	___ (6)	___ (8)	___ (10)	___ (20)
101 to 1,000	___ (8)	___ (12)	___ (16)	___ (20)	___ (30)
1,001 to 10,000	___ (12)	___ (18)	___ (24)	___ (30)	___ (40)
10,001 to 100,000	___ (16)	___ (24)	___ (32)	___ (35)	___ (45)
100,001 and up	___ (20)	___ (30)	___ (35)	___ (40)	___ (50)

Downgradient is defined as being within 45 degrees of the gradient. If the ground water direction is not known, assume the worst possible direction.

Ground water is not used.

Score: 0.0

Q22) What is the distance from the bottom of the site to the top of the aquifer in use?

X Greater than 50 m (0)
___ Less than 50 m (1)
___ Less than 25 m (2)
___ Less than 5 m (3)
___ Site in aquifer (6)

> Used less than 5 m if ground water is being used. If ground water is not used in area, greater than 50 m is the default value.

Score: 0.0

Q23) Fill out the table below describing wastes that have been detected in the ground water. If wastes have not been detected, enter zeros for the concentrations. If a waste release was detected by sight or smell but not sampled analytically, an approximation must be made. Include up to six chemicals.

Chemical Waste Name	Concentration (ppb)	Government Standard (ppb)
Benzene	195.6	0.0
Xylene	214.1	5.0
Toluene	94.1	5.0
Cyanide	106.1	200.0
Naphthalene	237.6	10.0
Benzo(a)pyrene	32.9	0.0

Chemical Waste:	Benzene, xylene, toluene, cyanide, naphthalene, benzo(a)pyrene as determined by mutual consent.
Concentration:	Geometric mean concentration derived from the GRI EPRI data base.
Government Standard:	NYSDEC Class GA standards for ground water quality and NYSDOH MCLs.

Score: 75.0

Q24) Indicate the distance from the site to the nearest instance of each of the land uses below:

	Distance					
Land Use	Outside 4 km	Within 4 km	Within 2 km	Within 1 km	Within 1/2 km	Onsite
Commercial/ Industrial	(0)	(1)	(2)	(3)	x (6)	(9)
National Parks	x (0)	(1)	(1)	(2)	(3)	(4)
Agriculture	(0)	x (1)	(1)	(2)	(4)	(6)
Residential	(0)	(1)	(3)	(5)	X (8)	(15)

Based on USGS 7.5 Minute Quadrangle Maps and site observations made by Atlantic Environmental Services, Inc.

Score: 8.0

Q25) Indicate the number of people living or working within each of the specified distances.

	Distance				
Population	Within 5 km	Within 3 km	Within 1 km	Within 1/2 km	Onsite
0	(0)	(0)	(0)	(0)	x (0)
1 to 100	(9)	(12)	(15)	(18)	(28)
101 to 1,000	(12)	(15)	(18)	X (21)	(31)
1,001 to 10,000	(15)	(18)	x (21)	(24)	(34)
10,001 to 100,000	x (18)	x (21)	(24)	(27)	(37)
100,001 and up	(21)	(24)	(27)	(30)	(40)

Based on information from Donnelly Demographics.

Score: 21.0

Q26) Check the appropriate distance from the site to the nearest of each type of sensitive environments, without regard to direction:

	Distance				
Target	Outside 2 km	Within 2 km	Within 1 km	Within 1/2 km	Onsite
Coastal wetland	x (0)	(1)	(2)	(3)	(6)
Freshwater wetland	x (0)	(0)	(1)	(2)	(6)
Endangered species	X (0)	(0)	(1)	(2)	(6)

Based on NYSDEC regulated wetlands and federally designated endangered species.

Score: 0.0

Q27) What is the vapor pressure of the primary wastes?

___ 1 x 10^{-5} mm Hg or less (0)
___ Greater than 1 x 10^{-5} mm Hg (1)
___ Greater than 1 x 10^{-3} mm Hg (2)
_X_ Greater than 10 mm Hg (3)

Used default value for benzene assumed to be onsite.

Score: 3.0

Q28) What natural or artificial characteristics of the site prevent volatilization?

___ Covered by more than 10 cm of soil or other impermeable barrier (1)
_X_ Covered by 1 to 10 cm of soil (3)
___ Uncovered contaminated soil (7)
___ Covered by less than 1 cm soil (8)
___ Uncovered pure contaminants (10)

Select the appropriate answer with the highest score.

Based on site observations made by Atlantic Environmental Services, Inc.

Score: 3.0

Q29) What is the average wind speed at the site?

___ Less than 2 m/s (1)
___ More than 2 m/s (2)
_X_ More than 4 m/s (3)
___ More than 6 m/s (4)

Used default value from SSPS help screen for the region in which the site is located. More than 4 m/s.

Score: 3.0

Q30) What natural or artificial characteristics of the site prevent dust production?

___ Urban (1)
___ Woodland or forest (2)
_X_ Grassland (4)
___ Open field (10)

Select the appropriate answer with the highest score.

> Based on site observations made by Atlantic Environmental Services, Inc.

Score: 4.0

Q31) Fill out the table below describing the wastes present at the surface of the site. If the data is not known exactly, approximations must be made. Include up to six chemicals.

Chemical Waste Name	Concentration (ppm)	Established Values (ppm)	Persistence (0-3)	Contaminated Area (m^2)
Arsenic	11.0	2.6	3	500.0
Cyanide	9.7	500	3	200.0
Lead	120.0	700	3	500.0
C-PAH	160.4	10	3	500.0
PAH	208.6	10	3	500.0
Nickel	22.0	15	3	500.0

> Chemical Waste: Wastes are defined below with C-PAHs and PAHs broken down into the specific compound detected in the surface soils at the Clark Street Site.
> Arsenic
> Cyanide
> Lead
> C-PAHs: Benzo(a)anthracene, benzo(b) fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, indeno(1,2,3-cd) pyrene
> PAHs: Anthracene, acenaphthene, acenaphthylene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene
> Metals

Concentration:	The highest concentration detected in any of the samples was used. If none was detected, concentration = 0. C-PAHs: Concentration represents the sum of the highest concentrations of all C-PAHs detected. PAHs: Concentration represents the sum of the highest concentrations of all PAHs detected (not including C-PAHs).
Established Values:	Arsenic, lead, and nickel - Used the background concentrations for arsenic and lead from Shacklette and Boerngen (1984). Determined by mutual consent as follows: Cyanide - 50 ppm (domestic land use) 500 ppm (industrial land use) C-PAHs - 10 ppm PAHs - 10 ppm
Persistence:	Based on values supplied in the SSPS help screen.
Contaminated Area:	Assumed 100 square meters for composite samples SS-1 through SS-5.

Score: 30.0

Q32) Fill out the table below describing wastes that have been detected in the air. If wastes have not been detected, enter zeros for the concentrations. If a waste release was detected by sight or smell but not sampled analytically, an approximation must be made. Include up to six chemicals.

Chemical Waste Name	Concentration (ppm)	Government Standard (ppm)
None detected	0	—

Air sampling was not performed; no wastes were detected in the air.

Score: 0.0

Q33) What steps have been taken to reduce public access to the site?

___ Full barrier and guard (0)
___ Full barrier (1)
___ Guard (2)
___ Incomplete barrier (3)
_X_ No barrier, no guard (4)

Based on site observations made by Atlantic Environmental Services, Inc.

Score: 4.0

Q34) What is the distance from the site to the nearest residence or gathering point for children?

___ 100 m or more (1)
_X_ 10 m to 100 m (2)
___ 0 to 10 meters (5)
___ Onsite (10)

Based on site observations made by Atlantic Environmental Services, Inc.

Score: 2.0

Q35) What is the distance from the site to the nearest ground water well in use?

_X_ 10 km or more (1)
___ 1 km to 10 km (3)
___ 100 m to 1 km (6)
___ less than 100 m (10)

Based on USGS well records.

Score: 1.0

Q36) What are the characteristics of the site wastes?

___ Other types of wastes (1)
___ Acute, deadly toxins (4)
_X_ Carcinogens (7)
___ Radioactive wastes (10)

Select the appropriate answer with the highest score.

Used carcinogenic PAHs as default value.

Score: 7.0

Q37) Is offsite contamination evident?

☐ No (1)
☒ Yes, has been measured (7)
☐ Yes, is visible (9)
☐ Yes, has been smelled (10)

Select the appropriate answer with the highest score.

Used default value of no, unless wastes were detected in streambed sediment samples.

Score: 7.0

Q38) Describe the area near the site:

☐ Rural (1)
☐ Agricultural (2)
☐ Industrial (3)
☐ Commercial (4)
☒ Residential/Commercial (8)
☐ Residential (9)
☐ Urban (10)

Based on site observations made by Atlantic Environmental Services, Inc.

Score: 8.0

Q39) What is the total volume of soil that is contaminated above regulatory limits?

☒ Less than 10 m^3 (1)
☐ More than 10 m^3 (2)
☐ More than 100 m^3 (3)
☐ More than 1,000 m^3 (4)
☐ More than 10,000 m^3 (5)

Use default of less than 10 m^3. No applicable regulatory limit for soils in New York state.

Score: 1.0

Q40) How is onsite land used?

_X_ Other Gas Substation (1)
___ Agricultural (2)
___ Residential (6)
___ Industrial (9)

Based on site observations made by Atlantic Environmental Services, Inc.

Score: 1.0

APPENDIX B

SITE CHRONOLOGY AND HISTORICAL MAPS

AUBURN, NY
CLARK ST., MGP SITE

Location: NYSEG Clark St. substation (1989) and adjacent parking lot
Owner: NYSEG

Acquisition and Organization

NYSEG
to
Empire Gas and Electric Co.
Organized: April 11, 1911
Acquired: December 31, 1936
to
Auburn Gas Company
Organized: December 18, 1901
Acquired: August 11, 1911 (?)
to

Auburn Gas Light Company Organized: January 28, 1850 Acquired: December 28, 1901	and	Citizens Light & Power Company of Auburn, NY (Gas Department) Organized: May 7, 1900 Acquired: October 9, 1905

Remarks:

Clark St. gas works operated from 1905 to 1946 and were operated by Auburn Gas Light Co. and successors.

Real Estate Divestments or Acquisitions:

1989: NYSEG owns site

From Federal Commission of Gas & Electricity Report, 1907:

From Mayor's testimony December 30, 1905 (page 90)

- Coal gas plant of Auburn Gas Co. not in operation. Water gas plant of Citizen's Light and Power was operated part time (water gas plant acquired by Auburn Gas Co. on October 9, 1905).
- Also reported, page 160: Auburn Gas Co. purchased 92,139,000 cubic feet of gas.
- Gas not accounted for: 13.9%
- Auburn reported data gave calculated production from Citizen's facility of 5,040,500 additional cubic feet for 1905.
- Gas was supplied to the Auburn Gas Co. by Empire Coke Co. of Geneva (Border City) by pipeline (page 90) in 1906.

From Directory of Gas Utilities, Federal Power Commission, 1942

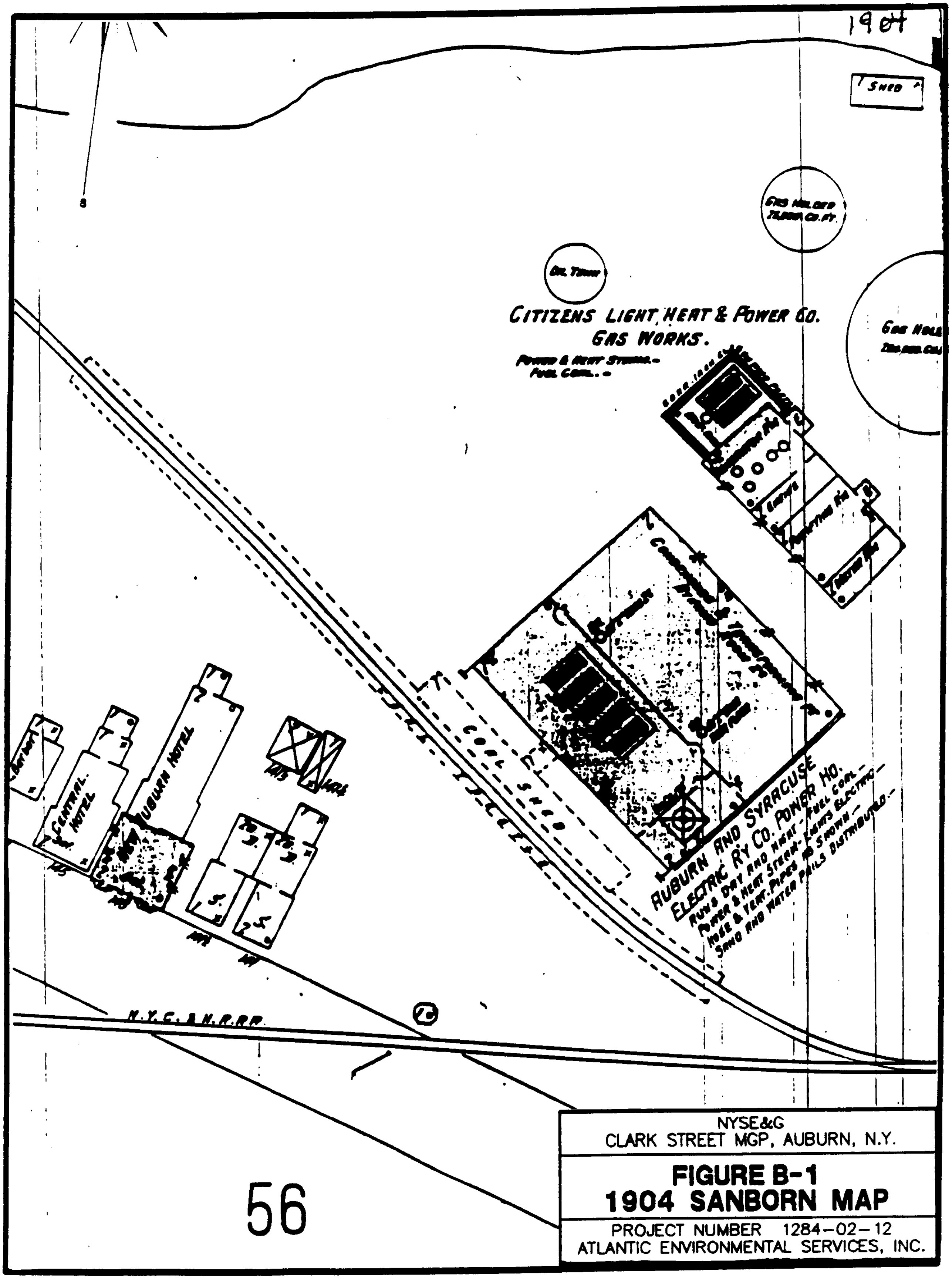
- on natural gas supplied by NYSEG

b:21.jch

TABLE 1

CHRONOLOGICAL SEQUENCE OF EVENTS
CLARK STREET SITE

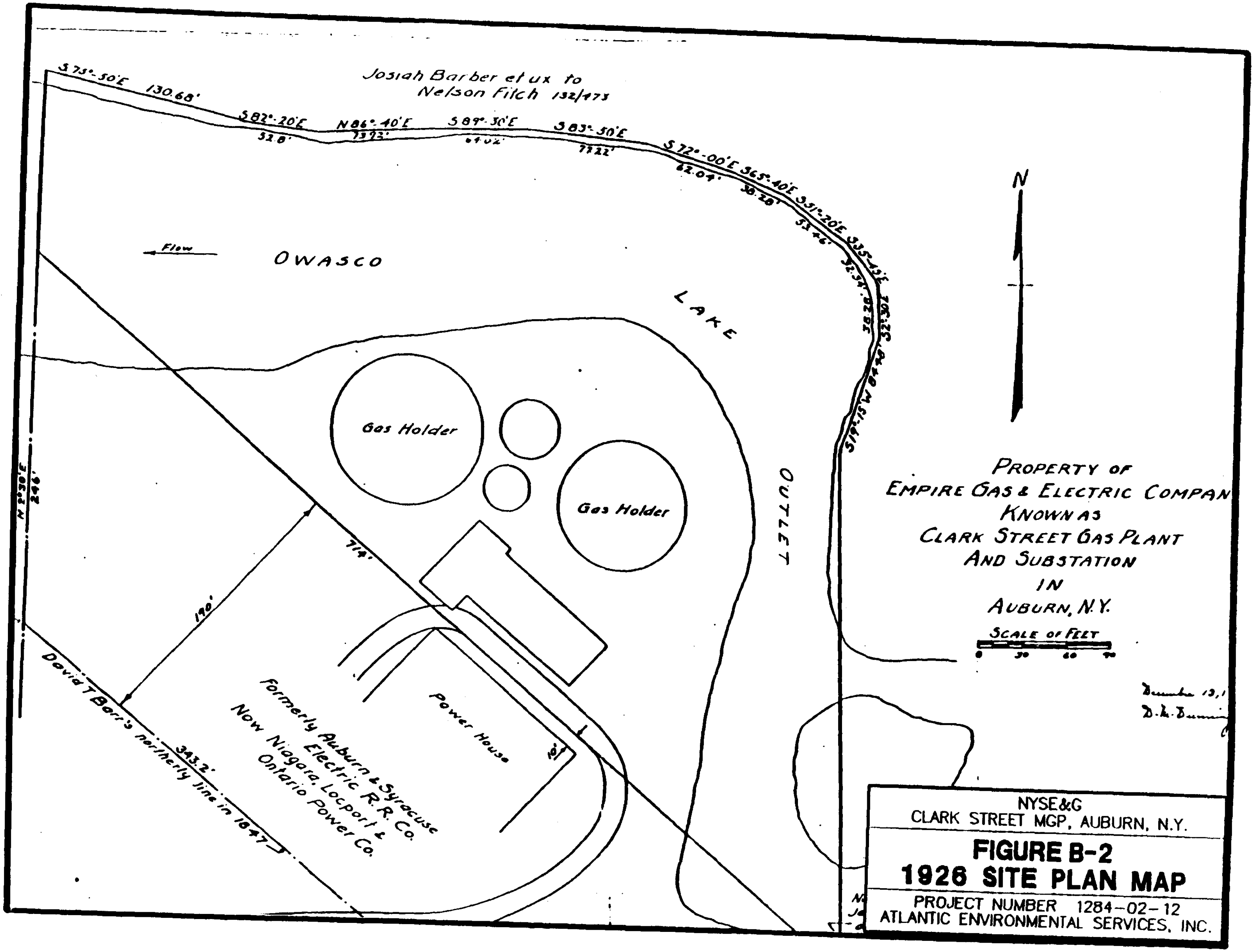
Prior to 1926	-	Gas manufacturing begins by Empire Gas and Electric Co.
1926	-	200,000 and 500,000 cubic foot gas holders on site. Small holder and an oil tank also present. Power house for Auburn and Syracuse Electric Railroad Co. on adjacent property now part of Niagara, Lockport and Ontario Power Co. (Figure 2).
1931	-	Small electric substation present southeast of gas house (Empire Gas & Electric Co.). Power house now abandoned (Figures 6 and 7).
1943	-	Smaller gas holders and oil tank removed (Figure 3).
1946	-	Tar pump house replaced by storage shed. Gas production at site ceases sometime prior to this date. Gas house now used for storage and a carpenter shop. Gas main bridge now present north of old gas house (crosses Owasco River, still standing in 1988).
1958	-	Large gas holder, storage shed now removed. Substation area southeast of old gas house now used for pipe storage. New substation constructed east of old gas house. Old powerhouse removed from adjacent property; area now used as an automobile junkyard (Figure 4).
Subsequent to 1961	-	Old gas house partially razed, small portion retained for gas regulator building. Remnants of old substation removed (Figure 5). Junkyard removed; replaced by woodlot.
Present	-	NYSEG substation and vacant lot now occupy site area.



NYSE&G
CLARK STREET MGP, AUBURN, N.Y.

FIGURE B-1
1904 SANBORN MAP

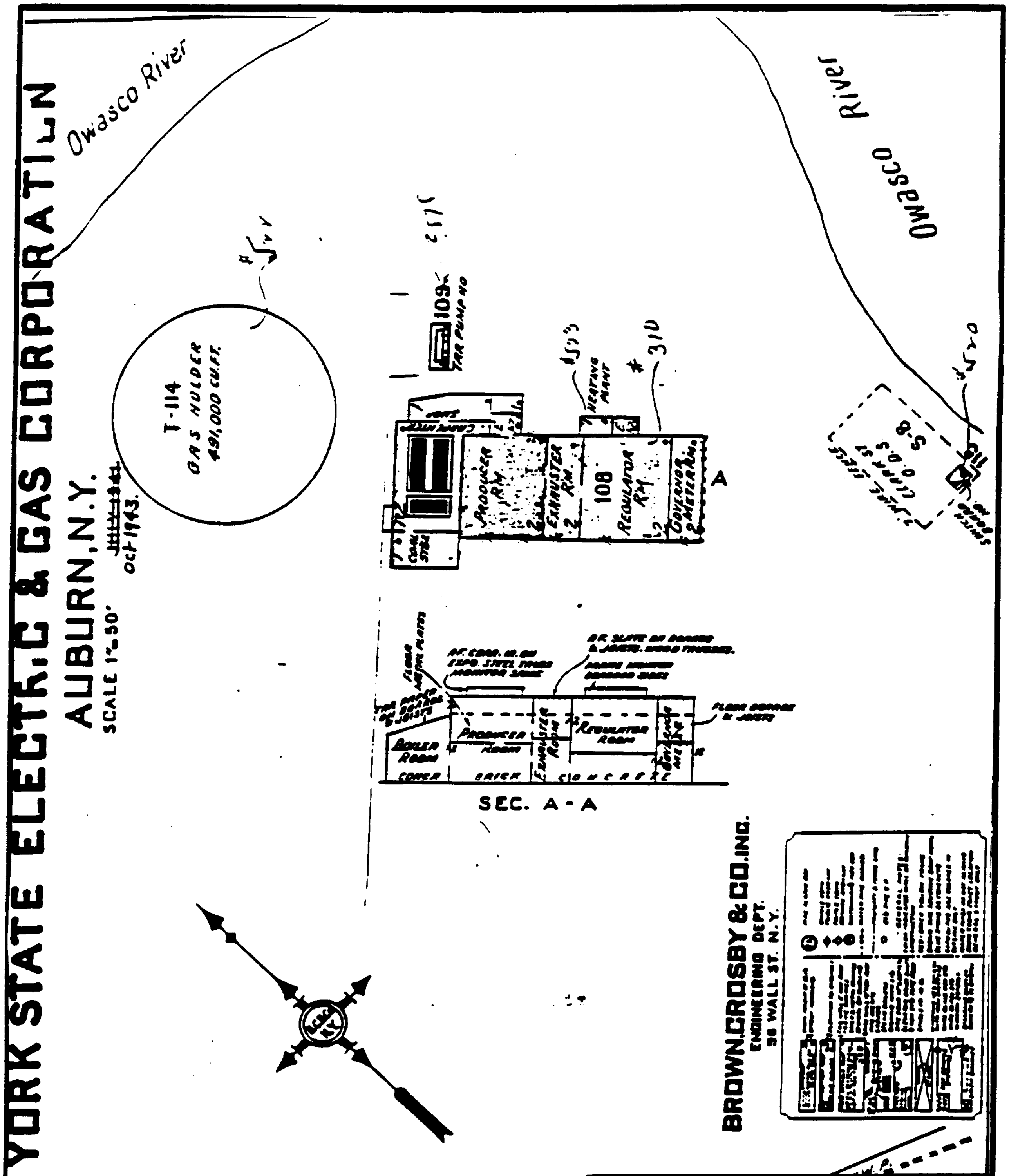
PROJECT NUMBER 1284-02-12
ATLANTIC ENVIRONMENTAL SERVICES, INC.



NYSE&G
CLARK STREET MGP, AUBURN, N.Y.

FIGURE B-2
1926 SITE PLAN MAP

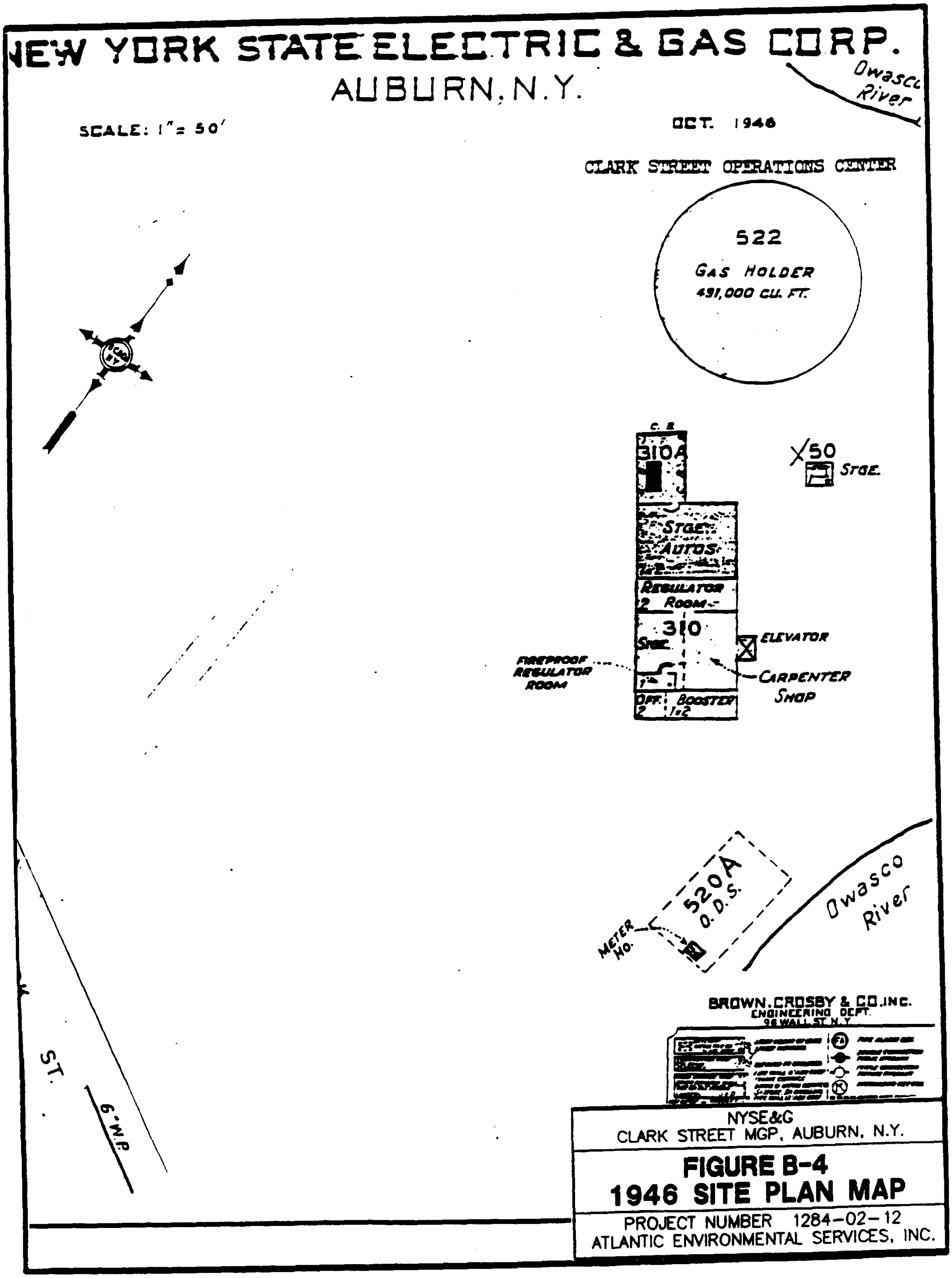
PROJECT NUMBER 1284-02-12
ATLANTIC ENVIRONMENTAL SERVICES, INC.



NYSE&G
CLARK STREET MGP, AUBURN, N.Y.

FIGURE B-3
1943 SITE PLAN MAP

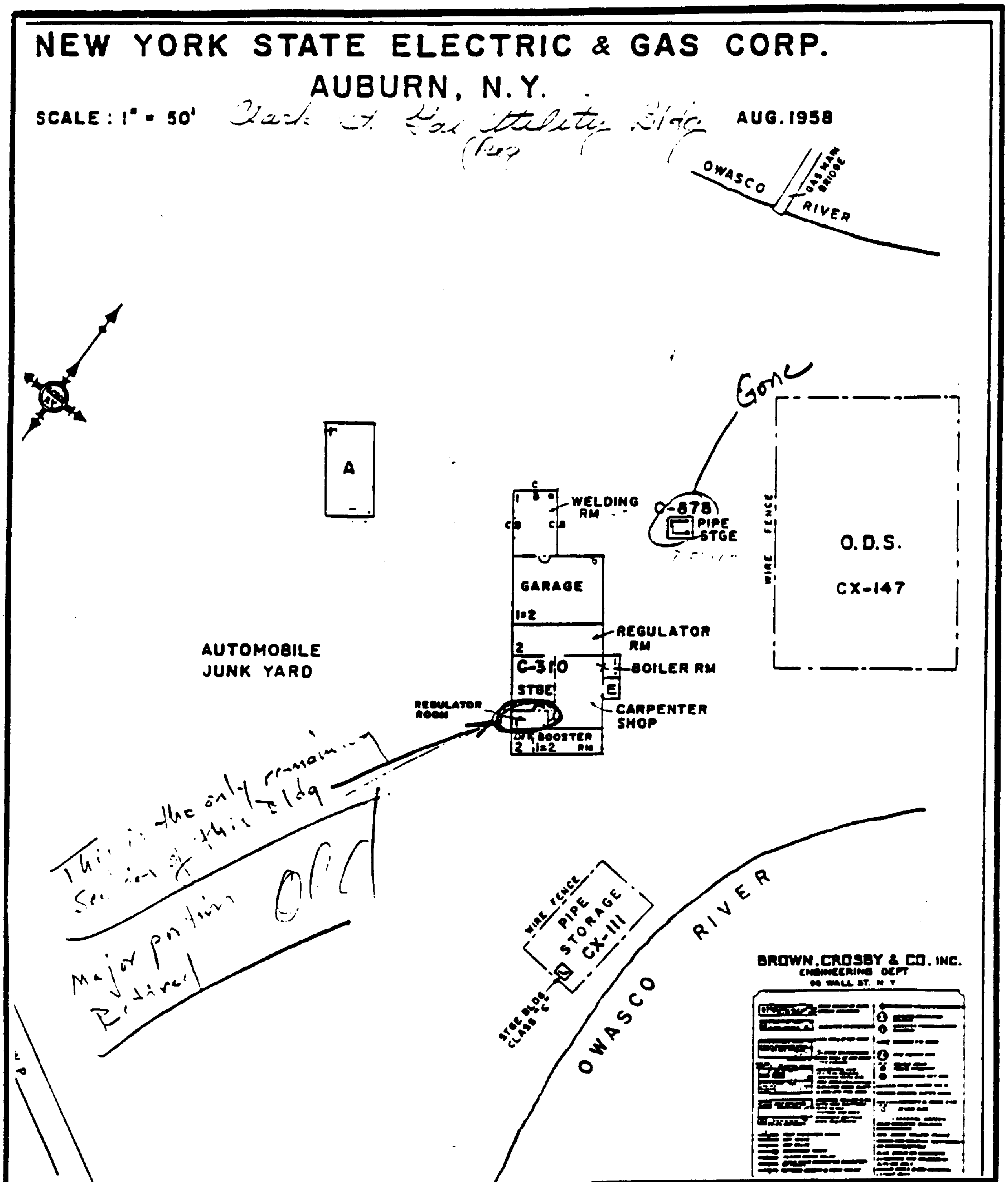
PROJECT NUMBER 1284-02-12
ATLANTIC ENVIRONMENTAL SERVICES, INC.



NYSE&G
CLARK STREET MGP, AUBURN, N.Y.

FIGURE B-4
1946 SITE PLAN MAP

PROJECT NUMBER 1284-02-12
ATLANTIC ENVIRONMENTAL SERVICES, INC.



NYSE&G
CLARK STREET MGP, AUBURN, N.Y.

FIGURE B-5
1958 SITE PLAN MAP

PROJECT NUMBER 1284-02-12
ATLANTIC ENVIRONMENTAL SERVICES, INC.

APPENDIX C

ATLANTIC ENVIRONMENTAL SERVICES, INC.
SITE SURVEYS, SAMPLING FIELD DATA, AND AERIAL PHOTOGRAPHS

10-23

Auburn - Clark St -
Rt 5 to Auburn Tech. Inc. (on left)
turn Rt, cross RR and
turn Rt - follow along tracks
to Substation -

Photo 1 - Reports

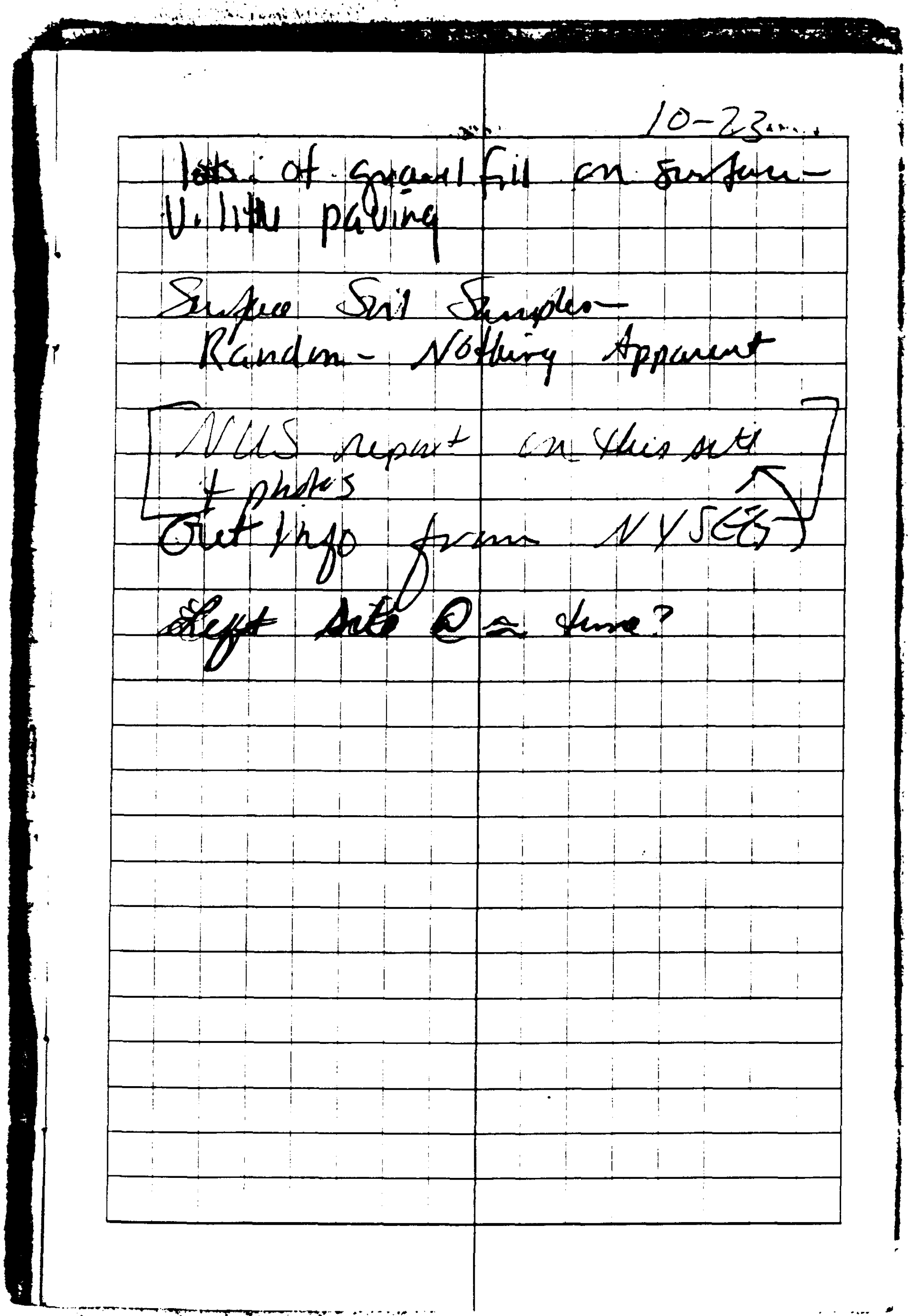
Poor drainage near distribution holder -
- ponding -

Photo 2 ponding by Substation -
maybe in fuel handling area

Photo 3 - Circular metal plate -
2 openings - pipe Drip? - oil tank
was nearby - bring wrenches
to open - depth + contents -
Coal tar odor on stick - extends
approx 2.5'

Fast moving stream. berm then
rocky banks - rubble - at base
NO sheen or odor

INITIAL SITE SURVEY NOTES
RECORDED BY ANNA SULLIVAN



10-23

lots of gravel fill on surface —
V. little paving

Surface Soil Samples —
Random — Nothing Apparent

NUS report on this site
+ photos
Get info from NYSEG

Left site @ ≈ time?

INITIAL SITE SURVEY NOTES
RECORDED BY ANNA SULLIVAN

10-23

Photo 4 + 5 - Stream + Bank + Small Discharge stream - (Little Ditch?)

Photo 6 - Banks Stream between Stream & NE corner of Substation

Photo 7 - from curb in road entering site towards Substation + old plant foundation
Stream Access limited by dense growth
Upstream Sample - SE corner of site at bend in stream - opposite [illegible]

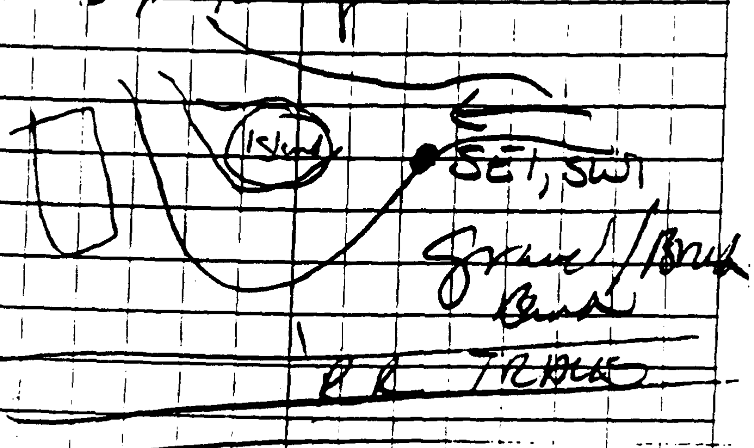
Onsite - where photo 4 + 5 are at little Rivulet into stream [illegible]

downstream - from bridge or from below midstream - East of bridge [illegible]
No indoor Air - No soil gas
NO visible contamination
V. little fine sed in stream to sample - Mostly boulders

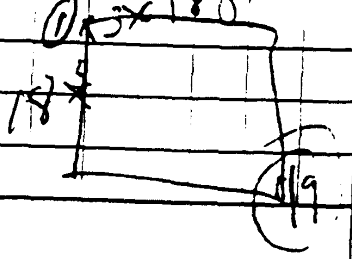
INITIAL SITE SURVEY NOTES
RECORDED BY ANNA SULLIVAN

SE-1 SW1
3:35 3:30

Around - curve in bend -
only place [illegible] [illegible] ft
Seds - large slab stones
on bank around bend
Adjacent to property



SS-4 Along old fire [illegible]
Area - On gravel !!

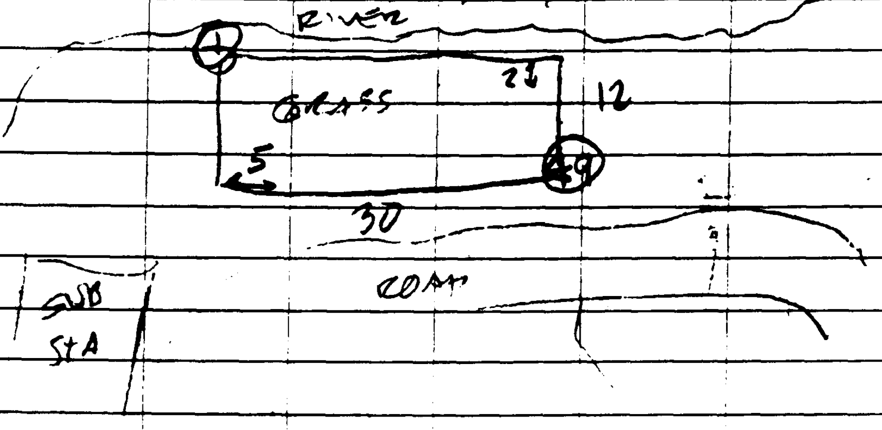


17, 24, 16, 8,
27 · 4:15 pm

SURFACE WATER AND SEDIMENT SAMPLE 1 AND
SURFACE SOIL SAMPLE 4
SAMPLING FIELD NOTES
RECORDED BY ANNA SULLIVAN

Andrew Clark 12:05 11-28-90

SS-5 19, 32, 25, 38 45



SS-2 ~~Composite~~ All Grid-

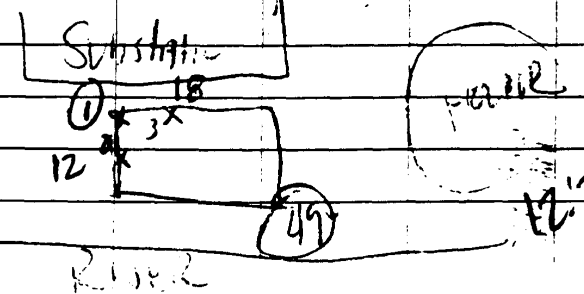
Grab along Rivulet to River

11:45 AM 11-28-90

SS3 - Moved from W. side of

Substation to N side due to

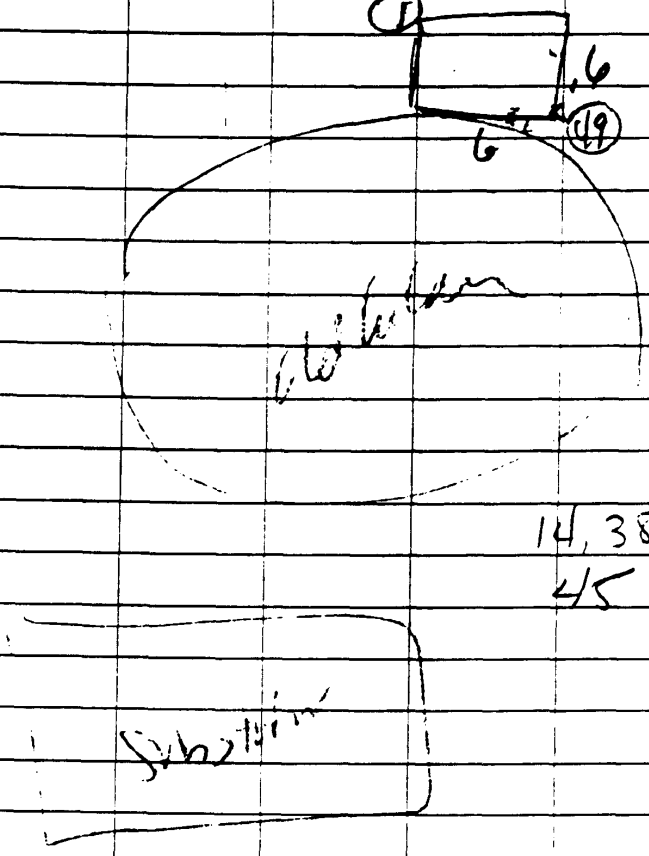
Gravel, fill in W. - RND- 11, 22, 9, 47, 31



12:25
11-28-90

SURFACE WATER AND SEDIMENT SAMPLES 3 AND 2
SAMPLING FIELD NOTES
RECORDED BY ANNA SULLIVAN

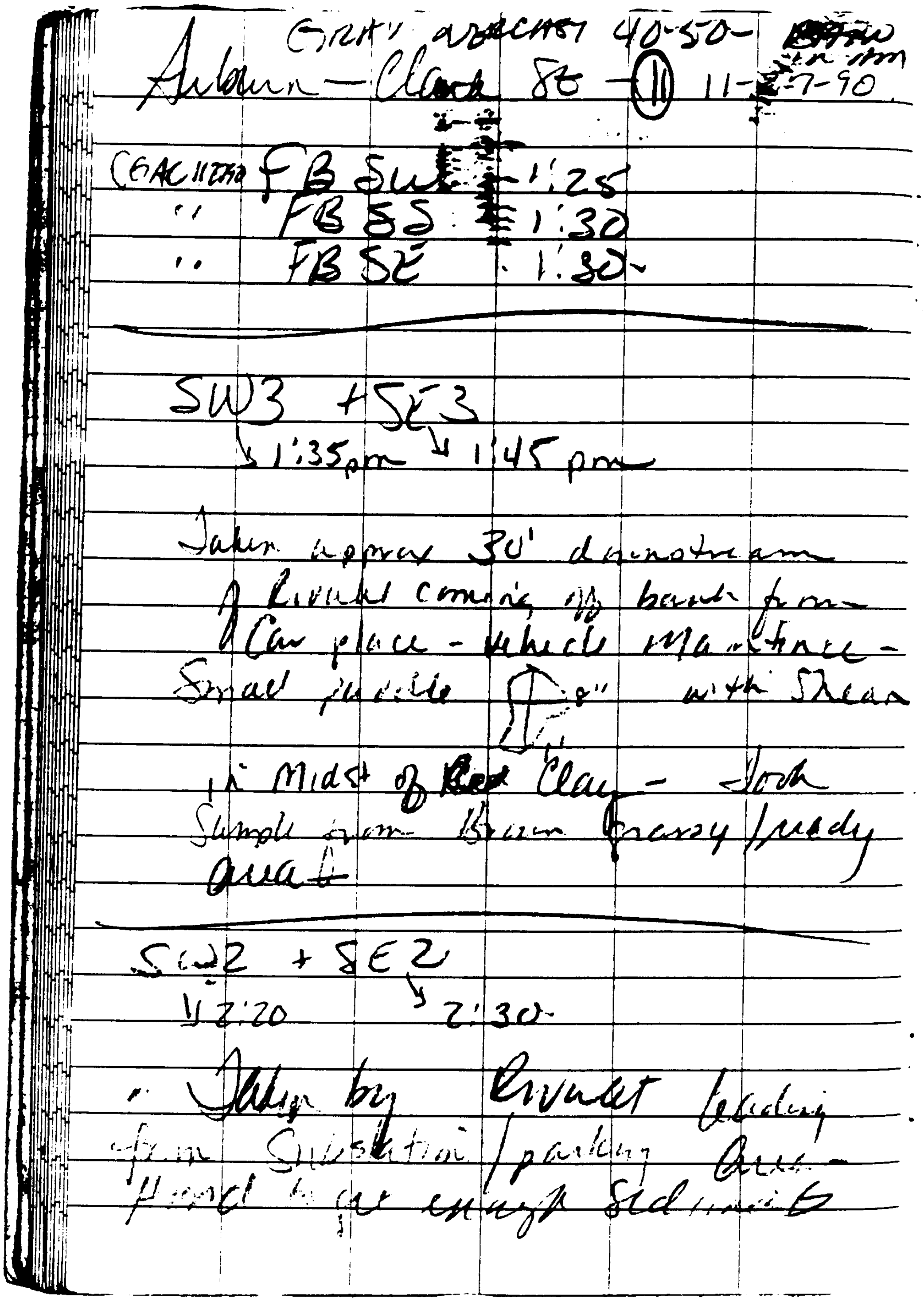
SS 1 Between old incinerator + Berm between Creek site



4:15 pm

14, 38, 30, 37, 45

SURFACE SOIL SAMPLE 1
SAMPLING FIELD NOTES
RECORDED BY ANNA SULLIVAN



Gray attache 40-50 - ~~[illegible]~~ in am

Auburn - Clark 86 - ⑪ 11-27-90

CGAC11270 FB SW 1:25
'' FB SS 1:30
'' FB SE 1:30

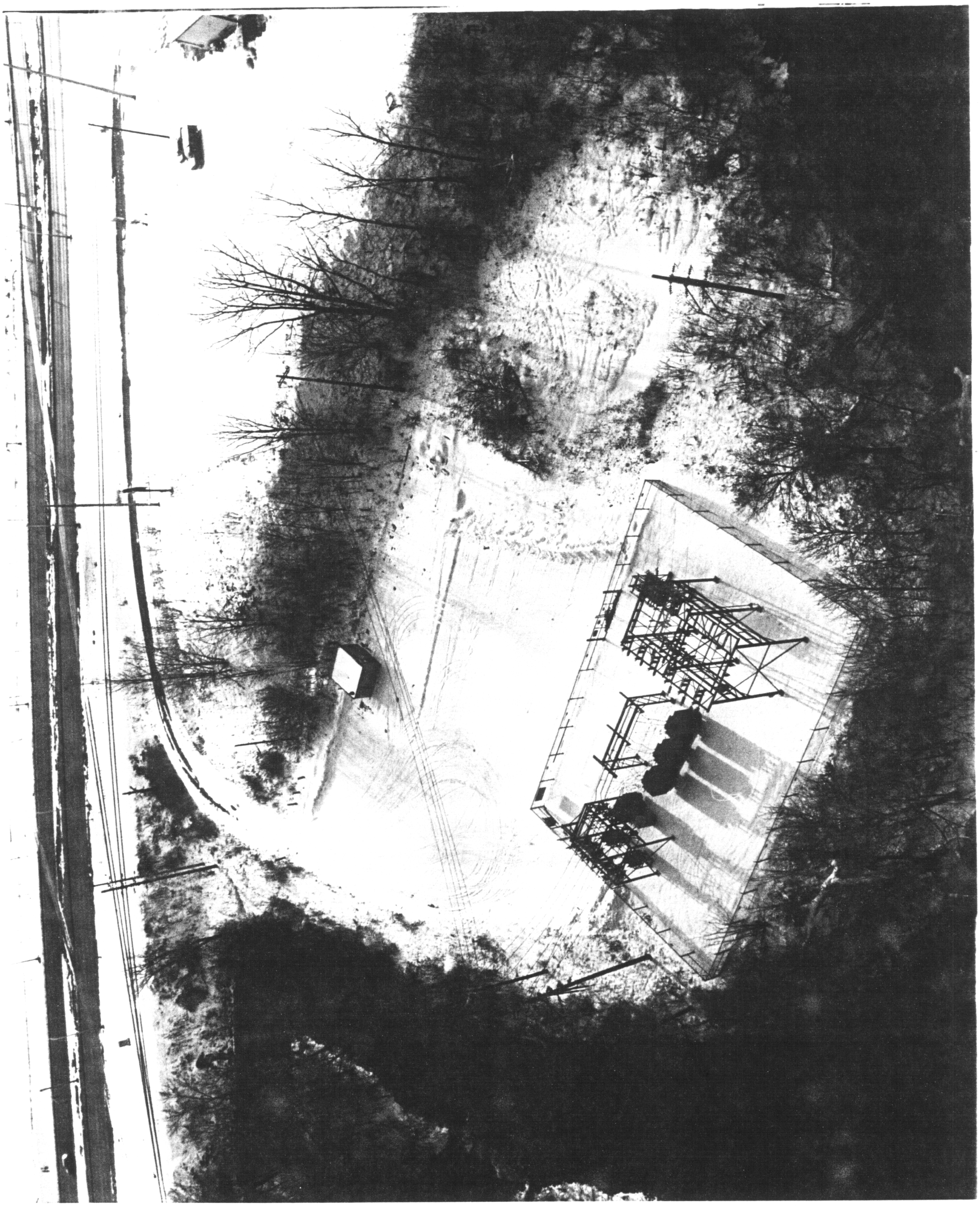
SW3 + SE3
1:35pm 1:45pm

Taken approx 30' downstream of rivulet coming off bank from car place - vehicle maintenance - small puddle 8" with stream in midst of ~~Red~~ Clay - took sample from brown greasy/muddy area

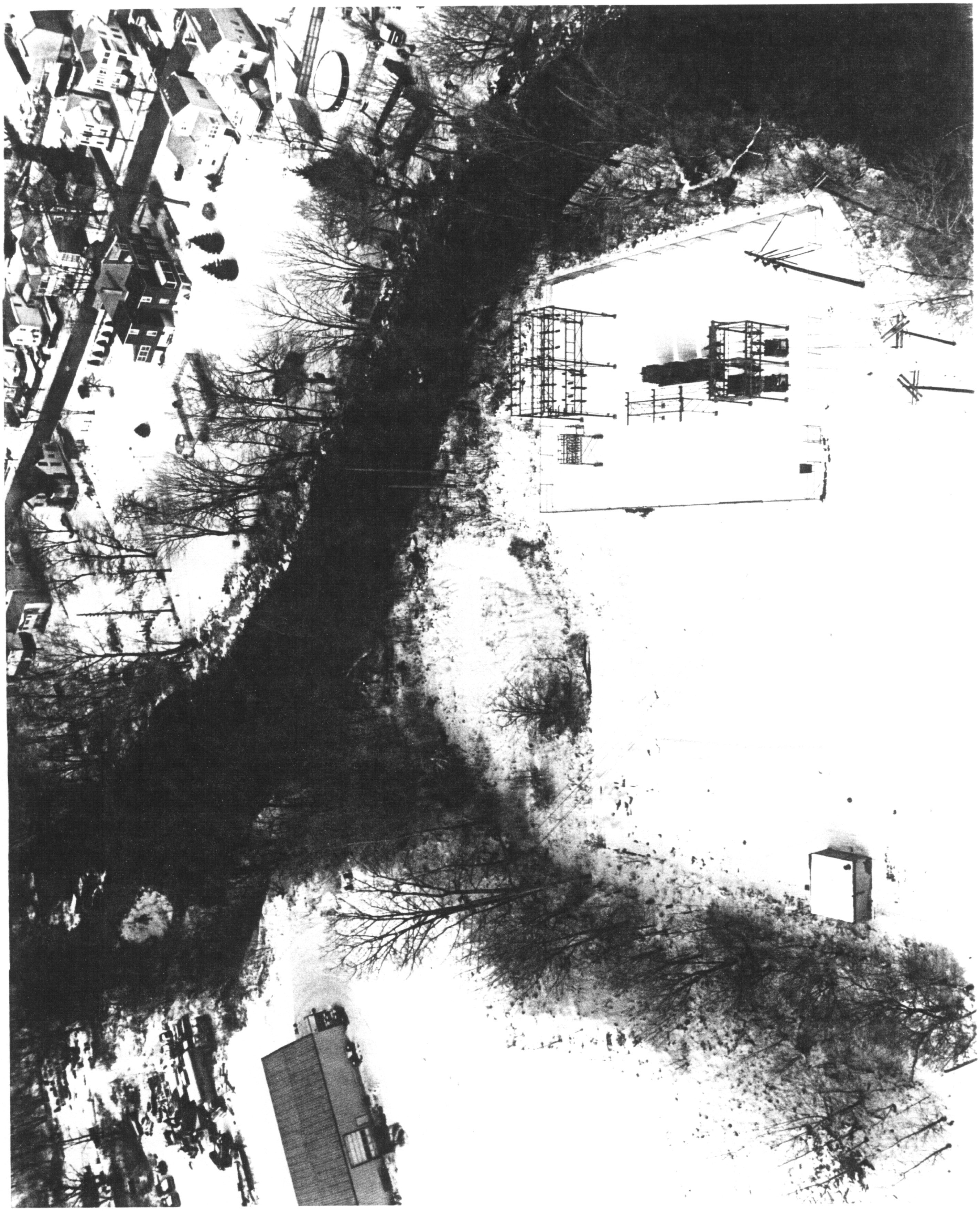
SW2 + SE2
2:20 2:30

Taken by rivulet leading from substation/parking area - hard to get enough sediments

SURFACE SOIL SAMPLES 5, 2 AND 3
SAMPLING FIELD NOTES
RECORDED BY ANNA SULLIVAN

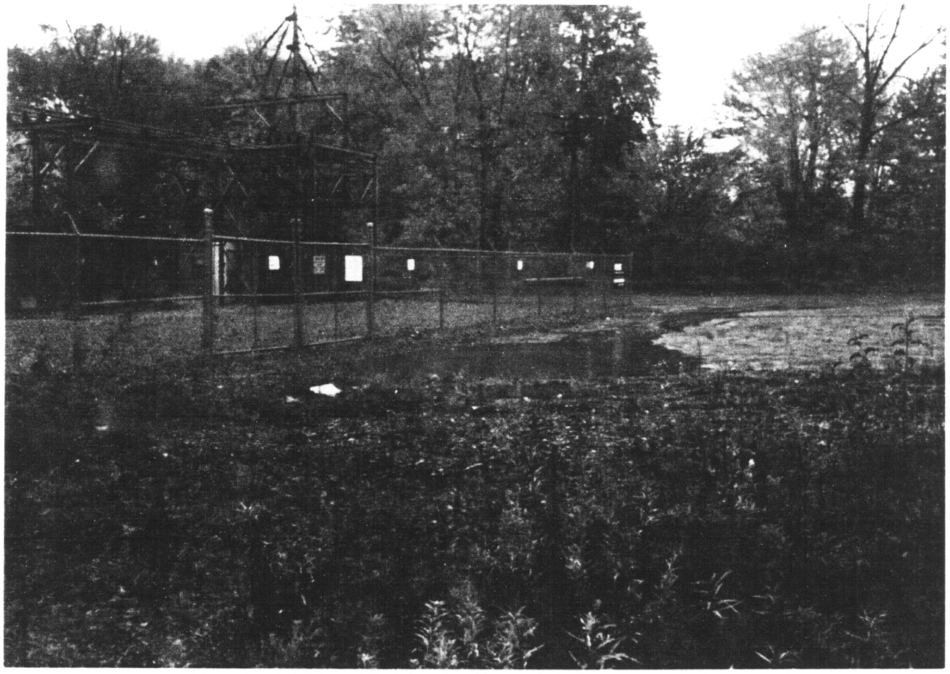


CLARK STREET SITE
AUBURN, NEW YORK



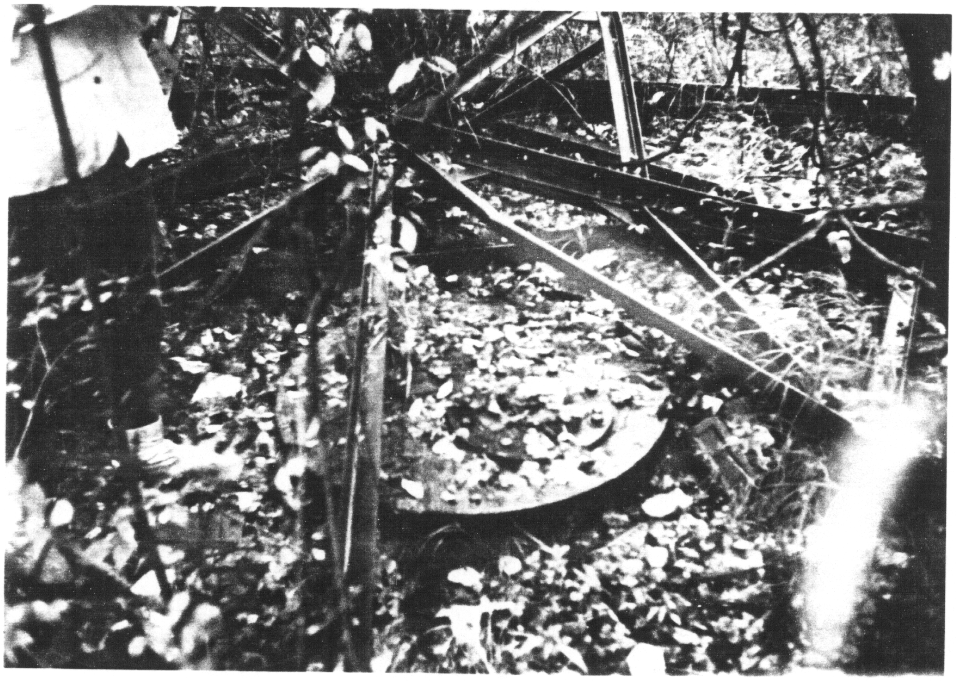
CLARK STREET SITE
AUBURN, NEW YORK

CLARK STREET SITE
AUBURN, NEW YORK



Substation, ponding of rainwater adjacent to substation fence, and vegetated area at the Clark Street Site. Photo orientation from former 491,000 cf holder east towards the substation.

Substation, gas regulator building and gravel lot at Clark Street Site. Photo orientation from entrance drive north towards the substation.



Top of subsurface structure containing contents with characteristic MGP odor at the Clark Street Site.

APPENDIX D

S.Y. KIM LAND SURVEYOR, P.C.
FIELD DATA

12-12-90

N.Y.S. G&E (92-1)

Clark St. Auburn

⊼ @ ℞ 10 0+00' on ℞ 13 (387.332)

to: ℞ 11 1) 17°29' 20"

2) 34°58' 40"

Avg. 17°29' 20"

10-11 = 389.163

HI @ ⊼ (TBM#1 (653.737) - (+0.938) = 652.799

to:

STA	∢	DIST	D/E	ELEV	DESC
TBM#1	331-14	413.3	+0.938		P.P. 20
T.O.S.	134-16	110.8	0.1		21
-11-	136-33	42.6	-0.3		22
-11-	317-56	26.9	-0.8		23
-11-	318-32	83.9	-1.2		24
-11-	320-22	144.5	+1.6		25
Grav. Mod	300°52'20"	[illegible]	[illegible]		26
T.O.S.	320-28	187.6	-0.8		27
-11-	322-31	247.7	-0.7		28
-11-	326-10	332.1	-0.3		29
℄ end Ditch	326-37	379.5	-0.3		30
℄ Ditch	325-47	316.7	-1.6		B.O.S 31
-11-	325-04	246.0	-3.6		-11- 32
℄ Ditch @	324-23	195.1	-5.9		CB Rim 33
B.O.S @	329-11	113.5	-7.6	641.4	18" c.m.p. FE 34 N 1 F.E.

---

250 Sonny

MF
JV

⊼ @ ℞ 10 0+00' on ℞ 13
Con't

STA	∢	DIST	D/E	ELEV	DESC
B.O.S.	03-57	69.0	-14.0		@ P.P. 35
P.P.	10-36	77.5	-15.5		36
Gas Reg	333-01	52.6			37
B.O.S.	42-24	33.4	-15.4		38
36" Conc Pipe	112-04	56.0	-14.3		Inv 39
N.Y.S. Plug opp.	116°27'50"	83.387			R.O.W. marker 40
M.H. Location	119°02'05"	119.852	-13.1	3 FE	of Sewer Outlet 41
B.O.S. @	[illegible]	[illegible]	-11.1	3 FE	Edge Water 42
Sewer Outlet	120-12	117.1			43
C Gas Sweep	122-03	157.8			S.I.C. Sample 44
B.O.S. @	90-07	59.6	-18.8	1 FE	edge water 45
Edge Water	62-30	53.6	-22.4		B.O.S. 46
-11-	37°33'	73.4	-22.4		-11- 47
-11-	36°41'	106.0	-22.4		-11- 48
T.O.S	43-51	196.6	-17.8		49
-11-	33-37	108.7	-18.9		@ end Wood Post 50
-11-	30-07	64.1	-16.2	636.60	51
B.O.S.	09-32	98.1	-15.2		52
-11-	347-24	92.6	-14.2		53
T.O.S. Beginning	85-39	41.4	-15.2		54
Wood Post @	24-51	133.8	-14.9		55 Edge Rd
Edge Water	46-27	192.8	-23.1		56 B.O.S.

12-12-90

N.Y.S. O & E

Clark St.

(HI=652.799) (CON'T)

⊼ @ P 10 0-00" on P 13

STA	∢	DIST	DIE	ELEV	DESC
E.P. Rd	11-12	111.8	-14.8		57
-11-	338-01	109.5	-10.5		58
-11-	326-37	172.1	-6.5		59
-11-	326-17	245.9	-2.7		60
-11-	327-07	325.5	-1.0		61
-11-	327-15	411.6	0.1		62
-11-	326-55	521.9	-0.6		63
-11-	328-52	523.1	-1.0		64
-11-	329-38	442.9	-0.4		65
-11-	329-48	398.8	-0.4		66
-11-	~~329~~-58	~~[illegible]~~	-1.4	651.40	67
-11-	330-16	237.8	-3.1		68
-11-	335-42	145.5	-9.1		69
-11-	355-35	119.5	-13.0		70
-11-	07-37	127.3	-14.6		71
Wood Post @	19-01	157.1	-16.2		E.P. Rd 72
Wood Post Fence	13-46	194.6	-16.5		73
B.O.S.	04-36	234.7	-17.7		74
-11-	04-47	188.7	-16.8		75
Sign P.P.	12-23	177.4			76
B.O.S.	352-43	149.0	-13.9		77
12" C.M.P. FE	346-31	127.0	-14.7		78

29° SUNNY

MF
JV

⊼ @ P 16 0-00" on P 13
(CON'T)

STA	∢	DIST	DIE	ELEV	DESC
B.O.S.	342-09	145.7	-12.7		79
-11-	335-21	178.2	-8.1		80
-11-	332-06	249.4	-4.0		81
-11-	331-16	352.6	-1.4		82
I.P.F.	332-25-20	354.074			83
Edge Water	59-05	271.4			84
-11-	56-29	398			85
-11-	54-06	379.9			86
-11-	49-59	439.9			87
TBM #2	219-27	21.8	+1.371	654.17	[illegible] on mark
					88

12-12-90 N.Y.S GEC Clark... A...

AAF
JV

⊼ @ B N 0-00 on B 10 (389.158)

to: B 13 1) 80° 22-35

2) 160° 45'-10"

AVG. 80° 22'-35"

11 - 13 = 118.035

HI @ ⊼ = (654.17 TBM #2) - (+21.942) = 632.228

to:

STA	∡	DIST	DIE	ELEV	DESC
CGAC SS5	345-07	231.7	2.3		89
Edge Gravel	346-26	224.1	2.4		90
-11-	326-30	184.3	1.6		91
Bend end Gravel	299-43	160.8	1.9		@ Fence Line 92
Fence Corner	295°15'	170.8	12.1		*3 FE TOB 93
-11-	321-42	132.5	1.2		94
Fence P.O.L.	312-18	80.1	1.4		95
Fence Corner	271-34	35.2	1.1		96
Fence P.O.L	258-46	73.3	1.5		97
Fence Corner	255-08	111.0	1.6		98
Fence P.O.L	270-09	121.1	1.9		99
CGAC SS-3	240-22	52.0	0.5		100
CGAC SS-2	190-54	70.8	-0.2		T.O.B 101
CGAC-SW E#2	186-06	75.8	-1.3		T.O.B. 102
Edge Water	187-42	84.0	-4.7		B.O.S. 103
CGAC SS1	126-54	70.6	-0.2		B.O.S. 104

⊼ @ B 11 - 00-00" on B 10

Cont'd

STA	∡	DIST	DIE	ELEV	DESC
T.O.B.	140-33	83.7	2.9		105
Edge Water	143-31	126.4	1.9	626.9	*2 FE B.O.S 106
Grade	141-47	96.4	1.2		107
CGAC SS4	344-32	81.9	1.3		108
Gas Valve	338-02	128.5			109
-11-	338-01	131.3			110
-11-	339-08	131.8			111
Conc Shed	359-34	158.7	6.0		1FE 112
-11-	07-28	153.5	6.1		-11- 113
-11-	01-58	145.1	5.7		-11- 114
Wood Post	22-56	126.9	7.1		1FE B.O.S 115
-11-	65-13	92.9	6.0		1FE B.O.S 116
					B.O.S.
P.P.	202-27	60.0	1.0		117
P.P.	205-22	65.3	0.5		118
Edge Water	215-14	91.2	-1.4		1FE 119
end Pipe	224-00	76.2	-0.5		over creek 120
Grade	06-07	42.5	1.3		121

12-12-90

N.Y.S. G&E
Clara St

π @ PZ 13 0°-00' on PZ 11 (118.035)
to: PZ 10 1) 82-08-30
2) 164-17-00
Avg 82°-08-30
[illegible] = 387.322
HI @ π = (TBM#2 654.17) - (±1.079) = 653.091

A:

STA	∢	DIST	D/E	ELEV	DESC
T.O.B.	230-21	216.0	-1.9		122
-11-	245-59	137.9	-1.4		123
-11-	260-38	56.8	-0.6		124
-11-	104-38	31.9	-0.8		125
-11-	86°48	120.0	-0.5		126
BLDG CORN	212-40	89.0	1.0		127
-11-	177-20	133.6	1.4		128
Bill Board	107-54	181.1	0.5		T.O.B. 129
P.P.	109-34	208.8	-2.5		130
T.O.B.	94-02	193.9	-1.0		131
-11-	122-35	172.9	0.5		132
Grnd	118-31	134.9	-0.3		133
P.P.	161-05	158.6			134
Edge Gravel @	165-33	213.3	6.5		RD. ZFE 135
-11-	167-32	195.7	6.6		ZFE 136
-11-	160-41	148.3	6.9		ZFE 137

40° Cloudy

MF
JV

π PZ 13 0°-00' on PZ 11
(CON'T)

A:

STA	∢	DIST	D/E	ELEV	DESC
Edge Gravel	158°43	70.8	+8.0		138 ZFE
-11-	221-28	61.3	0.8		139
-11-	233-32	108.3	0.0		140
-11-	221-05	158.0	1.1		141
B.O.S.	319-44	39.7	-18.3		142
-11-	16-43	30.2	-18.2		143
P.P.	54-41	67.0			144
-11-	35-52	267.5			145
-11-	32-50	271.0			146
-11-	25-52	265.9			147
-11-	24-00	282.9			148
B.O.S.	23-46	291.4	-24.0		edge water 149
					150
T.O.S	37-20	274.7	-19.1		151
B.O.S	37-59	290.6	-23.7		edge water 152
T.O.S.	352-35	213.8	-20.5		153
B.O.S.	349-29	231.1	-18.2	627.63	edge water ZFE 154

12-12-90

N.Y.S. G & E
Glann St.

π @ R 13 - 0-00 on R 11 (118.036)
to: Aux R 12 1) 243-21-40"
2) 126-43-30
Avg = 243-21-45
13-12 = 143.527

π @ Aux R 12 0-00" on R 13 (143.527)
to: HI @ π TBM #3 (654.017) - (+2.392) = 651.625

STA	∢	DIST	DIF	ELEV	DESC
Granite Mon	79-06-05	150.515	+2.392		TBM #3 155
BLDG Corn	73-10	142.2	2.7		156
-11-	72-37	62.2	2.5		157
P.P.	93-62	192.6	-0.5		158
Gravel drive	74-37	286.1	.014		159
-11-	83-07	119.0	2.4		160
B.O.S.	189-08	42.9	-23.9		161
SGACSW #3	204-59	70.3	-24.2		162
Edgewater	206°34'	73.9	-24.7		B.O.S. 163
B.O.S.	259°02'	40.6	-24.3		164
edge water	256°56'	50.4	-24.9		165
End Wood Post	322-20	63.6	-16.9		B.O.S. 166

40° Glover

NF
JV

π @ R Aux 12 - 0-00 on R 13
(Con't)

to:

STA	∢	DIST	DIF	ELEV	DESC
Edgewater	243-41	143.7			167
-11-	283-48	186.4			168
-11-	297-32	252.9			169
-11-	302-15	302.4			170
End Pipe ovr	292-19	257.2			171 Culvt

★ LEVEL RUN ★

STA	B.S	HI	F.S	ELEV	DESC
USGS R35	-7.126	653.636		646.51	
TBM #3			+0.381	654.017	
	+0.380	653.637			
USGS R35			-7.127	646.51	
	+	HI	-		
TBM #3	2.52	656.537		654.017	
TBM #1			2.80	653.737	
	2.79	656.527			
TBM #3			2.51	654.017	✓

APPENDIX E

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

This Health and Safety Plan (HASP) addresses the health and safety practices that will be employed by all site workers participating in the preliminary investigation of the NYSEG manufactured gas plant sites. The HASP takes into account the specific hazards inherent to the sites and presents procedures to be followed by Atlantic Environmental Services, Inc. (Atlantic) and its subcontractors in order to avoid and, if necessary, deal with potential health and/or safety problems. All activities performed under this HASP will comply with OSHA Regulations 29 CFR Part 1926 and 1910, particularly 1910.26.

This plan is based on an initial assessment of health and safety risks associated with the sites. The plan will be updated if necessary as additional information is obtained on the materials present at the sites and their associated health and safety risks. For example, additional hazardous substance data sheets may need to be included as more data are gathered.

Medical Surveillance Program

Atlantic maintains a continuous in-house medical surveillance program designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. Atlantic employs a company physician, Dr. Martin Cherniak, who is a specialist in occupational health. Yearly comprehensive examinations are conducted on all field personnel on Atlantic's staff.

Dr. Cherniak's address and telephone number are:

Office:

Lawrence & Memorial Occupational Health Center
Suite 2B, 404 Thames Street
Groton, Connecticut 06340

Telephone: 203-445-4551

Upon employment with Atlantic and prior to performing any major site investigation activities, all field personnel undergo a complete physical examination, including a detailed medical and occupational history. The following tests are performed as part of the examination:

- Complete blood workup (38 analyses), including screens for particular toxicants anticipated at various types of sites (see Exhibit E-1 for list of recommended blood tests).
- Urine analysis, including screens for metals and indicators of proper kidney and liver function.
- Pulmonary Function
- Electrocardiogram
- Chest X-ray
- Hearing and eye exam

Upon completion of these tests, the physician certifies whether personnel are fit for field work in general, and fit to use all levels of respiratory protection, in particular.

In the event that an employee of Atlantic or any other member of the field team is exposed to some form of hazardous substance or wishes to be rechecked because he shows symptoms of exposure, he must inform the site safety supervisor who will send the employee for an examination. The company's physician also acts as a consultant to all subcontractors participating in the field effort and will provide information on health risks associated with various chemical substances when needed. Material Safety Data Sheets for potential site contaminants are presented in Exhibit E-2.

[illegible], such as severe cuts and lacerations or burns, may require immediate

Preparation for Medical Emergencies

Before field work on the site commences, each person who will be working there or observing the operations will complete a medical data sheet that includes the following information:

1. Name, address, home phone
2. Age, height, weight
3. Name of person to be notified in case of emergency
4. All prescription and non-prescription medications currently being used
5. Allergies
6. Particular sensitivities
7. Does he/she wear contact lenses
8. Short medical history including list of previous illnesses
9. Name of personal physician and phone

These data sheets will be filled out before any work begins on the site. Their maintenance will be the responsibility of the designated site safety supervisor (see Exhibit E-3 for sample data sheet).

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

First Aid for Injuries Incurred During Field Work

All injuries, no matter how slight, will be reported to the site safety supervisor immediately. An accident report (Exhibit E-4) will be completed by the safety supervisor for all accidents.

First-aid equipment will be available onsite under the control of the site safety supervisor.

When possible, site workers will refrain from administering first aid for serious injury or illness and await the arrival of professional paramedics at the site to take the appropriate action. Unless they are in immediate danger, injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

First Aid Equipment List

The first aid kit that will be kept at the site will consist of a weatherproof container with individually sealed packages for each type of item. The kit will include at least the following items:

- Gauze roller bandages, 1 inch and 2 inch
- Gauze compress bandages, 4 inch
- Gauze pads, 2 inch
- Adhesive tape, 1 inch
- Bandaids, 1 inch
- Butterfly bandages
- Triangular bandages, 40 inch
- Ampules of ammonia inhalants
- Antiseptic applicators or swabs
- Burn dressing and sterilized towels
- Surgical scissors
- Eye dressing
- Emergency eye wash
- Tourniquet
- Alcohol
- Hydrogen peroxide

Record of Injuries Incurred Onsite

Occupational Injuries and Illnesses Form (OSHA 200)

All occupational injuries and illnesses that are required to be recorded under the Occupational Safety and Health Act will be registered on OSHA Form 200 (Exhibit E-5). Occupational injuries and illnesses will be recorded by the site safety supervisor within 48 hours of occurrence as required by statute.

Employer's First Report of Injury

This form (Exhibit E-6) will be completed by the site safety supervisor for all accidents involving worker injury at the site. Follow-up procedures will include investigation of each accident or near-miss by the safety engineer to assure that no similar accidents that may lead to injuries occur.

Training Programs

Formal health and safety training and specific onsite training are essential aspects of any successful investigation of a site suspected of containing hazardous or potentially hazardous materials. The following subsections address both formal health and safety training requirements and a specific onsite training program.

Health and Safety Training

All of Atlantic's field personnel have attended a health and safety training course in which they were taught the potential hazards of site work and how to avoid and deal with them. A list of Atlantic personnel who may work at the NYSEG sites are provided below with the titles and dates of the most recent safety courses they attended.

ATLANTIC PERSONNEL	COURSE	DATE
James Gould	Health and Safety Training for Hazardous Waste Activities - Geraghty and Miller	9/16/88
Anna Sullivan	Health and Safety Training for Hazardous Waste Activities - Geraghty and Miller	8/13/90
Peter Georgetti	Health and Safety Operations at Hazardous Materials Sites - Geo-Environmental Consultants	10/19/90

The training courses consist of classroom instruction, field demonstrations, use of respirators, use of appropriate protective clothing, and written and field tests. The training covers the OSHA and HAZWOPER requirements. They cover the following topics:

1. Identification of hazardous substances
2. Properties of hazardous substances
3. Routes of exposure
4. Toxicity of different substances and their synergistic effects
5. Practical considerations in health and safety management
6. Physical properties of chemicals
7. References for threshold limit values (TLV), lower explosion limits (LEL), toxicity data, cross references

8. Technical assistance organization
9. Air monitoring and survey instruments
10. Site entry and egress procedures
11. Heat stress monitoring
12. Levels of personal protection
13. Controlling access to work zones and other contaminated areas
14. Personnel decontamination
15. Equipment decontamination
16. Site/area safety planning

Everyone attending the courses was tested for the fit of their personal respirator and was trained in using self-contained breathing apparatus and Level B equipment. The courses also emphasized the importance and procedures of decontamination.

Health and safety training is an ongoing activity at Atlantic. Yearly refresher courses or site-specific training programs are presented as needed to keep field personnel up to date with proper health and safety practices.

Levels of Protection for Site Workers

Levels of protection specified by the EPA refer largely to requirements for respiratory protection. The lists below stipulate equipment for respiratory, clothing, and other types of protection that will be required for different tasks during the NYSEG site investigation. The designated levels of protection are based on evaluation of potential hazards and risks associated with work at the NYSEG site, and Atlantic's experience on other MGP sites.

Based on HNu (PID) readings in the work zone for each site activity, the criteria for maintaining or revising levels of protection are as follows:

Background (ambient)	Level D - Splash suit, rubber boots and goggles
5-50 ppm above ambient	Level C - Facepiece respirator, splash suit, rubber boots, gloves and goggles
50-500 ppm above ambient	Level B - Positive Pressure SCBA, hooded disposable coveralls, rubber boots, gloves and radio.
500-1000 ppm above ambient	Level A - Positive Pressure SCBA, chemical resistant encapsulated suit, inner and outer gloves and two-way radio.

If HNu (PID) readings greater than 50 ppm are detected, work will be stopped and workers will retreat and call for advice.

Anticipated Levels of Protection for Specific Site Activities

Site Activity	Health Risk	Level of Protection
1. Topographic Survey	Low	Modified D
2. Surface Soil Sampling	Low	Modified D
3. Surface Water Sampling	Low	Modified D
4. Sediment Sampling	Low	Modified D
5. Air Sampling	Low	Modified D

Modified Level D protection consists of long pants and shirts, and gloves and goggles (if needed) when sampling.

Signatures of Field Team Members and Observers

THIS SITE HEALTH AND SAFETY PLAN HAS BEEN READ BY:

(Signatures of site investigation team members and observers who have been through site safety briefing and have read this health and safety plan.)

Name	Signature	Date	Firm	Phone
Anna Sullivan	Anna Sullivan	11/1/90	Atlantic Env.	(203)537-0751
Peter Georgetti		11/13/90	Atlantic Env.	(203)537-0751

EXHIBIT E-1

RECOMMENDED BLOOD TESTS

EXHIBIT E-1 RECOMMENDED BLOOD TESTS

MEDICAL SURVEILLANCE PROGRAM

Function	Test	Example
Liver:	Blood Tests	Total protein, albumin globulin, total bilirubin (direct bilirubin if total is elevated).
Kidney:	Blood Tests	Blood urea nitrogen (BUN), creatinine, uric acid.
Blood-Forming Function:	Blood Tests	Complete blood count (CBC) with differential and platelet evaluation, including white cell count (WBC), red blood count (RBC), hemoglobin (HGB), hematocrit or packed cell volume (HCT), and desired erythrocyte indices. Reticulocyte count may be appropriate if there is a likelihood of exposure to hemolytic chemicals.

NOTE: From Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities; October 1985; DHHS (NIOSH) Publication No. 85-115.

EXHIBIT E-2

MATERIAL DATA SAFETY SHEETS

Material Safety Data Sheet

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

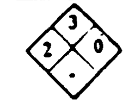
No. 316

BENZENE
(Revision D)
Issued: November 1978
Revised: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: BENZENE



Description (Origin/Uses): Used in the manufacture of medicinal chemicals, dyes, linoleum, airplane dopes, varnishes, and lacquers; and as a solvent for waxes, resins, and oils.

Other Designations: Benzol; Phene; Phenylhydride; C_6H_6; NIOSH *RTECS* No. CY1400000; CAS No. 0071-43-2

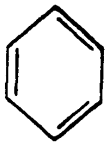
Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS

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

SECTION 2. INGREDIENTS AND HAZARDS

	%
Benzene, CAS No. 0071-43-2	Ca 100



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

EXPOSURE LIMITS

OSHA PEL
8-Hr TWA: 1 ppm
15-Min Ceiling: 5 ppm
Action Level: 0.5 ppm

ACGIH TLV, 1987-88
TLV-TWA: 10 ppm, 30 mg/m^3

Toxicity Data*
Human, Inhalation, LC_{Lo}: 2000 ppm/5 Min
Human, Oral, TD_{Lo}: 130 mg/kg
Human, Inhalation, TC_{Lo}: 210 ppm

SECTION 3. PHYSICAL DATA

Boiling Point: 176°F (80°C)
Melting Point: 42°F (5.5°C)
Vapor Pressure: 75 Torrs at 68°F (20°C)
Vapor Density (Air = 1): >1

Water Solubility (%): Slight
% Volatile by Volume: 100
Molecular Weight: 78 Grams/Mole
Specific Gravity (H_2O = 1): 0.87865 at 68°F (20°C)

Appearance and Odor: A colorless liquid; characteristic aromatic odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
12°F (-11.1°C) CC	928°F (498°C)	% by Volume	1.3%	7.1%

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to put out benzene fires. Water may be ineffective as an extinguishing agent because it can scatter and spread the fire. Use water to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.

Unusual Fire or Explosion Hazards: Benzene vapor is heavier than air and can collect in low-lying areas such as sumps or wells. Eliminate all sources of ignition there to prevent a dangerous flashback to the original liquid benzene. **Danger:** Explosive and flammable benzene vapor-air mixtures can easily form at room temperature; always use this material in a way that minimizes dispersion of its vapor into general work areas.

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

SECTION 5. REACTIVITY DATA

Benzene is stable in closed containers during routine operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Hazardous chemical reactions involving benzene and the following materials are reported in Genium reference 84: bromine pentafluoride, chlorine, chlorine trifluoride, chromic anhydride, nitryl perchlorate, oxygen, ozone, perchlorates, perchloryl fluoride and aluminum chloride, permanganates and sulfuric acid, potassium peroxide, silver perchlorate, and sodium peroxide.

Conditions to Avoid: Avoid all exposure to sources of ignition and to incompatible chemicals.

Hazardous Products of Decomposition: Toxic gases like carbon monoxide (CO) may be produced during benzene fires.

SECTION 6. HEALTH HAZARD INFORMATION

Benzene is listed as a suspected human carcinogen by the ACGIH.

Summary of Risks: Prolonged skin contact with benzene or excessive inhalation of its vapor may cause headache, weakness, loss of appetite, and lassitude. Continued exposure can cause collapse, bronchitis, and pneumonia. The most important health hazards are cancer (leukemia), bone marrow effects, and injuries to the blood-forming tissue from chronic low-level exposure.

Medical Conditions Aggravated by Long-Term Exposure: Ailments of the heart, lungs, liver, kidneys, blood, and central nervous system (CNS) may be worsened by exposure. Administer preplacement and periodic medical exams emphasizing these organs' functions and reassign workers who test positive. **Target Organs:** Blood, CNS, bone marrow, eyes, and upper respiratory tract (URT). **Primary Entry:** Skin contact, inhalation. **Acute Effects:** Dizziness, mental dullness, nausea, headache, fatigue, and giddiness. **Chronic Effects:** Possible cancer (leukemia).

FIRST AID

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes.
Skin: Immediately wash the affected area with soap and water.
Inhalation: Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.
Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. Do not induce vomiting because of the possibility of aspiration.

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

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.

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

OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U019
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any possibility of skin contact with this suspected human carcinogen. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of benzene below the OSHA PEL standard cited in section 2.

Safety Stations: Make eyewash stations, washing facilities, and safety showers available in use and handling areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale benzene vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store benzene in a cool, dry, well-ventilated area away from sources of ignition and incompatible chemicals.
Special Handling/Storage: Protect containers from physical damage. Electrically ground and bond all metal containers used in shipping or transferring operations. Follow all parts of 29 CFR 1910.1028.
Engineering Controls: All engineering systems (production, transportation, etc.) must be of maximum explosion-proof design (non-sparking, electrically grounded and bonded, etc.)
Comments: If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if it is absolutely essential.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Benzene	**DOT Label:** Flammable Liquid	**IMO Label:** Flammable Liquid
DOT Class: Flammable Liquid	**DOT ID No.** UN1114	**IMO Class:** 3.2

References: 1, 2, 12, 73, 84-94, 100, 103.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

Material Safety Data Sheet

Genium Publishing Corporation
1145 Catalyn Street
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(518) 377-8855

No. 317
TOLUENE
(Revision D)

Issued: August 1979
Revised: April 1986

SECTION 1. MATERIAL IDENTIFICATION

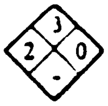
20

MATERIAL NAME: TOLUENE

OTHER DESIGNATIONS: Methyl Benzene, Methyl Benzol, Phenylmethane, Toluol, C_7H_8, CAS #0108-88-3

MANUFACTURER/SUPPLIER: Available from many suppliers, including:
Allied Corp., PO Box 2064R, Morristown, NJ 07960; Telephone: (201) 455-4400
Ashland Chemical Co., Industrial Chemicals & Solvents Div., PO Box 2219, Columbus, OH; Telephone: (614) 889-3844

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



R 1
I 3
S 2
K 4

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Toluene	ca 100	8-hr TLV: 100 ppm, or 375 mg/m³* (Skin)** Man, Inhalation, TCLo: 100 ppm: Psychotropic*** Rat, Oral, LD50: 5000 mg/kg Rat, Inhalation, LCLo: 4000 ppm/4 hrs. Rabbit, Skin, LD50: 14 gm/kg Human, Eye: 300 ppm

* Current (1985-86) ACGIH TLV. The OSHA PEL is 200 ppm with an acceptable ceiling concentration of 300 ppm and an acceptable maximum peak of 500 ppm/10 minutes.

** Skin designation indicates that toluene can be absorbed through intact skin and contribute to overall exposure.

*** Affects the mind.

SECTION 3. PHYSICAL DATA

Boiling Point ... 231°F (111°C)
Vapor Pressure @ 20°C, mm Hg ... 22
Water Solubility @ 20°C, wt. % ... 0.05
Vapor Density (Air = 1) ... 3.14

Evaporation Rate (BuAc = 1) ... 2.24
Specific Gravity (H_2O = 1) ... 0.866
Melting Point ... -139°F (-95°C)
Percent Volatile by Volume ... ca 100
Molecular Weight ... 92.15

Appearance and odor: Clear, colorless liquid with a characteristic aromatic odor. The odor is detectable to most individuals in the range of 10 to 15 ppm. Because olfactory fatigue occurs rapidly upon exposure to toluene, odor is not a good warning property.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
40°F (4°C) CC	896°F (480°C)	% by Volume	1.27	7.1

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Do not use a solid stream of water because the stream will scatter and spread the fire. Use water spray to cool tanks/containers that are exposed to fire and to disperse vapors.

UNUSUAL FIRE/EXPLOSION HAZARDS: This OSHA class IB flammable liquid is a dangerous fire hazard. It is a moderate fire hazard when exposed to oxidizers, heat, sparks, or open flame. Vapors are heavier than air and may travel a considerable distance to an ignition source and flash back.

SPECIAL FIRE-FIGHTING PROCEDURES: Fire fighters should wear self-contained breathing apparatus with full facepiece operated in a positive-pressure mode when fighting fires involving toluene.

SECTION 5. REACTIVITY DATA

CHEMICAL INCOMPATIBILITIES: Toluene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material is incompatible with strong oxidizing agents, dinitrogen tetraoxide, silver perchlorate, tetranitromethane, and uranium hexafluoride. Contact with these materials may cause fire or explosion. Nitric acid and toluene, especially in the presence of sulfuric acid, will produce nitrated compounds that are dangerously explosive.

CONDITIONS TO AVOID: Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition. Toluene will attack some forms of plastics, rubber, and coatings. Thermal decomposition or burning produces carbon dioxide and/or carbon monoxide.

SECTION 6. HEALTH HAZARD INFORMATION |TLV

Toluene is not considered a carcinogen by the NTP, IARC, or OSHA. SUMMARY OF RISKS: Vapors of toluene may cause irritation of the eyes, nose, upper respiratory tract, and skin. Exposure to 200 ppm for 8 hours causes mild fatigue, weakness, confusion, lacrimation (tearing) and paresthesia (a sensation of prickling, tingling, or creeping on the skin that has no objective cause). Exposure to higher concentrations may cause headache, nausea, dizziness, dilated pupils, and euphoria, and, in severe cases, may cause unconsciousness and death. The liquid is irritating to the eyes and skin. Contact with the eyes may cause transient corneal damage, conjunctival irritation, and burns if not promptly removed. Repeated and/or prolonged contact with the skin may cause drying and cracking. It may be absorbed through the skin in toxic amounts. Ingestion causes irritation of the gastrointestinal tract and may cause effects resembling those from inhalation of the vapor. Chronic overexposure to toluene may cause reversible kidney and liver injury. FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists.* SKIN CONTACT: Immediately flush skin (for at least 15 minutes) while removing contaminated shoes and clothing. Wash exposed area with soap and water. Get medical attention if irritation persists or if a large area has been exposed.* INHALATION: Remove victim to fresh air. Restore and/or support breathing as required. Keep victim warm and quiet. Get medical help.* INGESTION: Give victim 1 to 2 glasses of water or milk. Contact a poison control center. Do not induce vomiting unless directed to do so. Transport victim to a medical facility. Never give anything by mouth to a person who is unconscious or convulsing. * GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid, if indicated.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Limit access to spill area to necessary personnel only. Remove leaking containers to safe place if feasible. Cleanup personnel need protection against contact with liquid and inhalation of vapor (see sect. 8). WASTE DISPOSAL: Absorb small spills with paper towel or vermiculite. Contain large spills and collect if feasible, or absorb with vermiculite or sand. Place waste solvent or absorbent into closed containers for disposal using nonsparking tools. Liquid can be flushed with water to an open holding area for handling. Do not flush to sewer, watershed, or waterway. COMMENTS: Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator. Consider reclaiming by distillation. Contaminated absorbent can be buried in a sanitary landfill. Follow all Federal, state, and local regulations. TLm 96: 100-10 ppm. Toluene is designated as a hazardous waste by the EPA. The EPA (RCRA) HW No. is U220 (40 CFR 261). The reportable quantity (RQ) is 1000 lbs/454 kg (40 CFR 117).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be nonsparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 lfm (linear feet per minute) and be designed to capture heavy vapor. For emergency or nonroutine exposures where the TLV may be exceeded, use an organic chemical cartridge respirator if concentration is less than 200 ppm and an approved canister gas mask or self-contained breathing apparatus with full facepiece if concentration is greater than 200 ppm.
Safety glasses or splash goggles should be worn in all work areas. Neoprene gloves, apron, face shield, boots, and other appropriate protective clothing and equipment should be available and worn as necessary to prevent skin and eye contact. Remove contaminated clothing immediately and do not wear it until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, or open flame. Storage areas must meet OSHA requirements for class IB flammable liquids. Use metal safety cans for handling small amounts. Protect containers from physical damage. Use only with adequate ventilation. Avoid contact with eyes, skin, or clothing. Do not inhale or ingest. Use caution when handling this compound because it can be absorbed through intact skin in toxic amounts. SPECIAL HANDLING/STORAGE: Ground and bond metal containers and equipment to prevent static sparks when making transfers. Do not smoke in use or storage areas. Use nonsparking tools. ENGINEERING CONTROLS: Preplacement and periodic medical exams emphasizing the liver, kidneys, nervous system, lungs, heart, and blood should be provided. Workers exposed to concentrations greater than the action level (50 ppm) should be examined at least once a year. Use of alcohol can aggravate the toxic effects of toluene.
COMMENTS: Emptied containers contain product residues. Handle accordingly!
Toluene is designated as a hazardous substance by the EPA (40 CFR 116). DOT Classification: Flammable liquid. UN1294.
Data Source(s) Code: 1-9, 12, 16, 20, 21, 24, 26, 34, 81, 82. CR

Approvals J.O. Accrocco, 11/86.
Indust. Hygiene/Safety 10-86
Medical Review

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
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No. 318

XYLENE (Mixed Isomers)
(Revision D)
Issued: November 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: XYLENE (Mixed Isomers)

Description (Origin/Uses): Used as a raw material for the production of benzoic acid, phthalic anhydride, isophthalic and terephthalic acids and their dimethyl esters in the manufacture of polyester fibers; in sterilizing catgut; with Canadian balsam as oil-immersion in microscopy; and as a cleaning agent in microscopic techniques.

Other Designations: Dimethylbenzene; Xylol; C_8H_{10}; CAS No. 1330-20-7

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

Comments: Although there are three different isomers of xylene (*ortho*, *meta*, and *para*), the health and physical hazards of all three isomers are very similar. This MSDS is written for a xylene mixture of all three isomers, which is usually commercial xylene.

3
2 0
-
NFPA

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

R 1
I 3
S 2
K 3

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Xylene (Mixed Isomers), CAS No. 1330-20-7* *o-Xylene, CAS No. 0095-47-6 *m*-Xylene, CAS No. 0108-38-3 *p*-Xylene, CAS No. 0106-42-3 **Check with your supplier to determine if there are additions, contaminants, or impurities (such as benzene) that are present in reportable quantities per 29 CFR 1910. ***Immediately dangerous to life and health. **** See NIOSH, *RTECS* (No. ZE2100000), for additional data with references to reproductive, irritative, and mutagenic effects.	**	IDLH*** Level: 1000 ppm **OSHA PEL** 8-Hr TWA: 100 ppm, 435 mg/m³ **ACGIH TLVs, 1987-88** TLV-TWA: 100 ppm, 435 mg/m³ TLV-STEL: 150 ppm, 655 mg/m³ **Toxicity Data****** Human, Inhalation, TC_{Lo}: 200 ppm Man, Inhalation, LC_{Lo}: 10000 ppm/6 Hrs Rat, Oral, LD_{50}: 4300 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 275°F to 293°F (135°C to 145°C)*
Melting Point: -13°F (-25°C)
Evaporation Rate: 0.6 Relative to BuAc = 1
Specific Gravity (H_2O = 1): 0.86

Water Solubility (%): Insoluble
Molecular Weight: 106 Grams/Mole
% Volatile by Volume: Ca 100
Vapor Pressure: 7 to 9 Torrs at 68°F (20°C)
Vapor Density (Air = 1): 3.7

Appearance and Odor: A clear liquid; aromatic hydrocarbon odor.

*Materials with wider and narrower boiling ranges are commercially available.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
81°F to 90°F (27°C to 32°C)	867°F (464°C)	% by Volume	1%	7%

Extinguishing Media: Use foam, dry chemical, or carbon dioxide. Use water sprays to reduce the rate of burning and to cool containers.

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

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

SECTION 5. REACTIVITY DATA

Xylene is stable in closed containers during routine operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: This material may react dangerously with strong oxidizers.

Conditions to Avoid: Avoid any exposure to sources of ignition and to strong oxidizers.

Hazardous Products of Decomposition: Carbon monoxide (CO) may be evolved during xylene fires.

SECTION 6. HEALTH HAZARD INFORMATION

Xylene is not listed as a carcinogen by the IARC, NTP, or OSHA.

Summary of Risks: Liquid xylene is a skin irritant and causes erythema, dryness, and defatting; prolonged contact may cause blistering. Inhaling xylene can depress the central nervous system (CNS), and ingesting it can result in gastrointestinal disturbance; and possibly hematemesis (vomiting blood). Effects on the eyes, kidneys, liver, lungs, and the CNS are also reported. **Medical Conditions Aggravated by Long-Term Exposure:** Problems with eyes, skin, central nervous system, kidneys, and liver may be worsened by exposure to xylene. **Target Organs:** CNS, eyes, gastrointestinal tract, blood, liver, kidneys, skin. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Dizziness; excitement; drowsiness; incoordination; staggering gait; irritation of eyes, nose, and throat; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; and dermatitis. **Chronic Effects:** Reversible eye damage, headache, loss of appetite, nervousness, pale skin, and skin rash.

FIRST AID: **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have a trained person administer oxygen. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing. Vomiting may occur spontaneously, but do not induce it. If vomiting should occur, keep exposed person's head below his or her hips to prevent aspiration (breathing the liquid xylene into the lungs). Severe hemorrhagic pneumonitis with grave, possibly fatal, pulmonary injury can occur from aspiring very small quantities of xylene.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If exposure is severe, hospitilization for at least 72 hours with careful monitoring for delayed onset of pulmonary edema is recommended.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Cleanup personnel need protection against contact with and inhalation of xylene vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.

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

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste, No. U239

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), section 311 (b) (9)

SECTION 8. SPECIAL PROTECTION INFORMATION

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

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store xylene in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage.

Special Handling/Storage: Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Xylene	**DOT Label:** Flammable Liquid	**IMO Label:** Flammable Liquid
DOT ID No. UN1307	**DOT Hazard Class:** Flammable Liquid	**IMO Class:** 3.2 or 3.3

References: 1, 2, 12, 73, 84-94, 100, 103.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

Occupational Health Guideline for Coal Tar Pitch Volatiles

INTRODUCTION

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

SUBSTANCE IDENTIFICATION

Anthracene

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

Phenanthrene

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

Pyrene

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

Carbazole

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

Benzo(a)pyrene

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

PERMISSIBLE EXPOSURE LIMIT (PEL)

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

HEALTH HAZARD INFORMATION

- **Routes of exposure**

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

- **Effects of overexposure**

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

- **Reporting signs and symptoms**

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

- **Recommended medical surveillance**

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

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service   Centers for Disease Control
National Institute for Occupational Safety and Health

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

1. Initial Medical Examination:

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

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

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

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

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

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

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

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

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

- **Summary of toxicology**

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

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Anthracene**

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

- **Physical data—Phenanthrene**

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

- **Physical data—Pyrene**

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

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

- **Physical data—Carbazole**

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

- **Physical data—Benzo(a)pyrene**

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

- **Reactivity**

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

- **Flammability**

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

- **Warning properties**

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

MONITORING AND MEASUREMENT PROCEDURES

- **General**

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

- **Method**

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

RESPIRATORS

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

PERSONAL PROTECTIVE EQUIPMENT

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

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

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

SANITATION

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

COMMON OPERATIONS AND CONTROLS

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

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

EMERGENCY FIRST AID PROCEDURES

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

- **Eye Exposure**

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

- **Skin Exposure**

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

- **Breathing**

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

- **Rescue**

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

SPILL AND DISPOSAL PROCEDURES

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

1. Ventilate area of spill.

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

- Waste disposal method:

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

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RESPIRATORY PROTECTION FOR COAL TAR PITCH VOLATILES

Condition	Minimum Respiratory Protection* Required Above 0.2 mg/m^3
Particulate and Vapor Concentration	
2 mg/m^3 or less	A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter. Any supplied-air respirator. Any self-contained breathing apparatus.
10 mg/m^3 or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
200 mg/m^3 or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter.
400 mg/m^3 or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 400 mg/m^3 or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

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

Occupational Health Guideline for Naphtha (Coal Tar)

INTRODUCTION

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

SUBSTANCE IDENTIFICATION

- Formula: $C_7H_8 - C_8H_{10}$ (approximately)
- Synonyms: Naphtha, 49 degrees Be-coal tar type; crude solvent coal tar naphtha; high-solvent coal tar naphtha
- Appearance and odor: Reddish-brown, mobile liquid with an aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for coal tar naphtha is 100 parts of coal tar naphtha per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 400 milligrams of coal tar naphtha per cubic meter of air (mg/m³).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Coal tar naphtha can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Overexposure to coal tar naphtha can cause lightheadedness, drowsiness, and unconsciousness. It also may cause mild irritation of the eyes, nose, and skin.

2. Long-term Exposure: Prolonged overexposure to coal tar naphtha may cause irritation of the skin.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar naphtha.

- **Recommended medical surveillance**

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

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from coal tar naphtha exposure.

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

—Liver disease: Although coal tar naphtha is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although coal tar naphtha is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of coal tar naphtha might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Coal tar naphtha vapor is narcotic. Rats survived continuous exposure at 3200 ppm for two months: at 1800 ppm some animals showed damage to the liver and kidneys; above 1000 ppm there was evidence of narcotic action. Rats exposed at 567 ppm and 312 ppm for 18 to 20 hours a day for 7 days had some reduction in blood leukocytes, possibly the result of the presence of benzene. There are few if any well documented reports of industrial injury resulting from the inhalation of

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

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

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

September 1978

naphtha. However, exposure to high concentrations might be expected to cause lightheadedness, drowsiness, and possibly irritation of the eyes, nose, and throat. Repeated or prolonged contact with the liquid may result in drying and cracking skin due to defatting action. Coal tar (naphtha) is a non-uniform mixture of aromatic hydrocarbons and may contain benzene.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 110 (approximately)
2. Boiling point (760 mm Hg): 110 to 190 C (230 to 374 F)
3. Specific gravity (water = 1): 0.97
4. Vapor density (air = 1 at boiling point of coal tar naphtha): 3 (approximately)
5. Melting point: Data not available
6. Vapor pressure at 20 C (68 F): Less than 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Greater than 1

- **Reactivity**

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving coal tar naphtha.
4. Special precautions: Coal tar naphtha will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Flash point: 38 to 43 C (100 to 109 F) (closed cup)
2. Autoignition temperature: 482 to 510 C (900 to 950 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Dry chemical, foam, carbon dioxide

- **Warning properties**

1. Odor Threshold: Since the odor thresholds of the main constituents of coal tar naphtha are below their permissible exposure limits, the odor threshold of coal tar naphtha is assumed to be below the permissible exposure limit.
2. Eye Irritation Level: According to Grant, Gafafer states that the naphthas cause conjunctival irritation. Two of the main constituents of coal tar naphtha, xylene and toluene, cause noticeable eye irritation at concentrations of 200 and 300 ppm, respectively.
3. Evaluation of Warning Properties: Since the odor threshold of the main constituents of coal tar naphtha are well below their permissible exposure limits, coal tar naphtha is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

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

- **Method**

Sampling and analyses may be performed by collection of coal tar naphtha vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure coal tar naphtha may be used. An analytical method for coal tar naphtha is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).
026).

RESPIRATORS

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

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid coal tar naphtha.
- Clothing wet with liquid coal tar naphtha should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of

coal tar naphtha from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the coal tar naphtha, the person performing the operation should be informed of coal tar naphtha's hazardous properties.

- Non-impervious clothing which becomes wet with liquid coal tar naphtha should be removed promptly and not reworn until the coal tar naphtha is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid coal tar naphtha may contact the eyes.

SANITATION

- Skin that becomes wet with liquid coal tar naphtha should be promptly washed or showered with soap or mild detergent and water to remove any coal tar naphtha.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in preparation of coal-tar paints	Process enclosure; general dilution ventilation; personal protective equipment
Use in preparation of coumarone and indene	General dilution ventilation; personal protective equipment
Use as a solvent in rubber industry in manufacture of water-proof cloth, shoe adhesives, and rubber tires	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a solvent, diluent, or thinner in paint, varnish, and lacquer industries	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in formulations of nitrocellulose and ethylcellulose	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a solvent for polymerized styrol, short-oil phenolic varnishes, urea, resins, melamine, and other synthetic resins; use as a solvent for pesticides as DDT and Gammexane	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

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

- ***Eye Exposure***

If coal tar naphtha gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If coal tar naphtha gets on the skin, promptly wash the contaminated skin using soap or mild detergent. If coal tar naphtha soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists after washing, get medical attention.

- **Breathing**

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

- **Swallowing**

If coal tar naphtha has been swallowed, do not induce vomiting. Get medical attention immediately.

- **Rescue**

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

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely

clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Coal tar naphtha should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal methods:

Coal tar naphtha may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

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RESPIRATORY PROTECTION FOR NAPHTHA (COAL TAR)

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
5000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
10,000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 10,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

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

Material Safety Data Sheet

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No. 351

STYRENE MONOMER
(Revision C)
Issued: August 1979
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name: STYRENE MONOMER

Description (Origin/Uses): Used widely in making polystyrene plastics, protective coatings, styrenated polyesters, copolymer resins, and as a chemical intermediate. Styrene-butadiene rubber (SBR) is the most extensively used type of synthetic rubber.

NFPA

Other Designations: Phenyl Ethylene; Vinyl Benzene; Cinnamene; Ethylenylbenzene; Styrol; $C_6H_5CH=CH_2$; CAS No. 0100-42-5

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

R 1
I 3
S 2
K 0

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

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Styrene, CAS No. 0100-42-5 *This material can be absorbed through intact skin, which contributes to overall exposure. **See NIOSH, *RTECS* (WL3675000), for additional data with references to reproductive, mutagenic, tumorigenic, and irritative effects.	Ca 100	**OSHA PELs** 8-Hr TWA: 50 ppm, 215 mg/m³ 15-Min STEL: 100 ppm, 425 mg/m³ **ACGIH TLVs (Skin*), 1988-89** TLV-TWA: 50 ppm, 215 mg/m³ TLV-STEL: 100 ppm, 425 mg/m³ **Toxicity Data**** Human, Inhalation, LC_{Lo}: 10000 ppm (30 Mins) Human, Inhalation, TC_{Lo}: 600 ppm

SECTION 3. PHYSICAL DATA

Boiling Point: 293°F (145°C)
Melting Point: -23.08°F (-30.6°C)
Vapor Density (Air = 1): 3.6
Vapor Pressure: 4.3 Torrs at 59°F (15°C) and 10 Torrs at 87.44°F (30.8°C)
Evaporation Rate (n-Butylacetate = 1): 0.5

Molecular Weight: 104 Grams/Mole
Solubility in Water (%): Slight
Specific Gravity (H_2O = 1): 0.9059 at 68°F (20°C)
% Volatile by Volume: Ca 100

Appearance and Odor: A colorless-to-yellow, oily liquid; sweet, pleasant aromatic odor at low concentrations and unpleasant odor at high concentrations. The odor recognition threshold (100% of test panel, unfatigued) is 0.15 ppm in air.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method: 88°F (31°C) CC	Autoignition Temperature: 914°F (490°C)	LEL: 1.1% v/v	UEL: 6.1% v/v

Extinguishing Media: Use foam, dry chemical, or carbon dioxide. Use water spray to cool fire-exposed containers, to disperse the styrene vapor, and to protect personnel who are attempting to stop a styrene leak. In the case of large fires the fire-fighting should be done from a distance or from a remote, explosion-proof position. **Unusual Fire or Explosion Hazards:** Styrene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back to its origin. Violent polymerization inside heated containers of styrene can occur at elevated temperatures; explosive rupturing of these containers is possible. Styrene vapor is uninhibited and can form polymers that will block the vents or flame arresters of storage tanks. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Styrene is stable in closed containers during routine operations. Hazardous polymerization can occur if the inhibitor fails or if the styrene monomer is exposed to excessive heat, light, or catalytic materials such as peroxides and strong acids. **Chemical Incompatibilities:** Styrene reacts dangerously with oxidizing materials such as chlorosulfonic acid, oleum, and sulfuric acid. Additionally, it can self-polymerize if the inhibitor becomes depleted, is removed, or is otherwise rendered ineffective. **Conditions to Avoid:** Avoid any exposure to sources of ignition and to incompatible chemicals, especially catalytic materials that can initiate or promote hazardous polymerization. **Hazardous Products of Decomposition:** Toxic gases such as carbon monoxide are formed by the thermal-oxidative decomposition of styrene during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Styrene is not listed as a carcinogen by the NTP, IARC, or OSHA. Some studies indicate that styrene may be mutagenic and teratogenic. **Summary of Risks:** Workers exposed to styrene vapor at 200 to 700 ppm experienced drowsiness, nausea, headache, fatigue, dizziness, and possibly a metallic taste in their mouths. Exposures above 800 ppm are immediately irritating to the eyes, nose, and the respiratory system. Repeated or prolonged skin contact with liquid styrene can cause defatting, dermatitis, and irritation. Excessive exposure through inhalation can cause narcotic effects and even death. A death has been reported from a 30-minute exposure at 10000 ppm. "Styrene sickness" has been described with symptoms of nausea, vomiting, and an intoxicated sensation. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, and the central nervous sytem (CNS). **Primary Entry:** Inhalation, skin contact and absorption. **Acute Effects:** Skin and eye irritation; depression of the CNS symptomized by drowsiness,

SECTION 6. HEALTH HAZARD INFORMATION, cont.

unsteady gait, weakness, and loss of coordination. **Chronic Effects:** None reported. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water and then wash it with soap and water. If large skin areas are involved, continue to carefully monitor the exposed person for signs of developing depression of the CNS, because liquid styrene can penetrate intact skin rapidly by absorption. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** Unlikely. Should this type of exposure occur, slowly give the exposed person 4 to 8 glasses of milk or water to dilute the material, but do *not* induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Treat CNS effects symptomatically. Styrene is excreted as hippuric acid; urine levels of this metabolite can be useful in determining the level of exposure to the styrene.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate ventilation. Cleanup personnel need protection against skin or eye contact with this liquid as well as inhalation of its vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. **Waste Disposal:** Dispose of contaminated styrene promptly; do not store contaminated liquid styrene for any length of time. Reclamation of spilled liquid styrene is not recommended; its reactivity and the possibility of contaminant-induced polymerization make reclamation unattractive. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), § 311 (b) (4).

SECTION 8. SPECIAL PROTECTION INFORMATION

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

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store styrene in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Keep them out of direct sunlight. Protect containers from physical damage. Outside, isolated, or detached storage is recommended. **Special Handling/Storage:** Contamination of storage facilities, especially with polymerization initiators, must not occur. Store styrene in its original containers and remove from the storage area only the amount that is immediately needed. Control inventory carefully. Prolonged storage is strongly discouraged, and a first-in, first-out rotation system may be useful for proper stock rotation requirements. Check the styrene at least weekly to determine the inhibitor and polymer content if the material is being stored for any period of time in excess of 30 days at 90°F (32°C). Large tanks of styrene should be stored under a nitrogen blanket. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Ground and bond all containers and pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations to prevent static sparks. **Other:** Inhibited styrene can polymerize from frictional heat in a running centrifugal pump if the flow of the liquid is stopped.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Styrene Monomer, Inhibited
DOT Hazard Class: Flammable Liquid
ID No. UN2055
DOT Label: Flammable Liquid
DOT Packaging Exceptions: 49 CFR 173.118

IMO Shipping Name: Styrene Monomer, Inhibited
IMO Label: Flammable Liquid
IMO Hazard Class: 3.3
IMDG Packaging Group: II

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

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

MSDS # 355

PHENOL (Revision B)

Issued: September, 1980
Revised: September, 1985

From Genium's MSDS Collection, to be used as a reference.

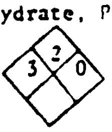
SECTION 1. MATERIAL IDENTIFICATION

1

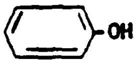
MATERIAL NAME: PHENOL

OTHER DESIGNATIONS: Carbolic Acid, Hydrobenzene, Oxybenzene, Phenic acid, Phenyl Hydrate, Phenyl hydroxide, Phenylic acid, Phenyl alcohol, CAS #000 108 952, C_6H_5OH

MANUFACTURER/SUPPLIER: Available from many suppliers, including:
Dow Chemical USA
2020 Dow Center
Midland MI 48640 (517) 636-1000



SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
PHENOL 	ca 100	8 hr TWA: 5 ppm, 19 mg/m^3 (Skin) STEL: 10 ppm, 38 mg/m^3 * Human, Oral LDLo: 140 mg/kg Rat, oral LDLo: 414 mg/kg Rat, skin LD50: 669 mg/kg

* Current OSHA PEL and ACGIH TLV/STEL (1984-85) (Skin) notation indicates a potential contribution to overall exposure via absorption through the skin.

NIOSH recommends a 10 hr. TWA of 20 mg/m^3 with a ceiling of 60 mg/m^3 for any 15 minute period.

SECTION 3. PHYSICAL DATA

Boiling Point @ 1 atm .... 359.4°F (181.9°C)
Vapor pressure @ 25°C 0.35
Vapor density (Air=1) 3.24
Solubility in water (% by wt.) ... 8.4 @ 20°C
(Sol. in all proportion @ temp. >66°C)

APPEARANCE & ODOR: White crystalline solid with a characteristic sharp medicinal sweet, tangy odor which is detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities or if it is exposed to heat or light.

Specific Gravity (H_2O=1):
Solid: 1.017 @ 25/4°C
Liquid: 1.0576 @ 41/4°C
Melting point .... 109.4°F (43°C)
Volatiles, % by vol @ 20°C .. ca 100
Evaporation rate (BuAc=1) ... <0.03
Viscosity, CPS, @ 80°C 1.51
Molecular weight 94.12

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
175°F (79°C) C.C.	1319°F (715°C)	% by volume	1.5	8.6

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, or alcohol type foam. Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool fire-exposed tanks/containers. Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers. When heated, it remits toxic fumes and vapors which will form explosive mixtures with air. Solid phenol burns with difficulty, giving off a heavy smoke.

Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving phenol. NOTE: Water containing phenol can cause severe chemical burns.

SECTION 5. REACTIVITY DATA

This material is stable at room temperature under normal handling and storage conditions. It does not undergo hazardous polymerization. Phenol is incompatible with strong oxidizing agents and halogens. Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc. Reaction with these materials causes phenol to become discolored. Do not heat phenol above 122°F (90°C).

Thermal decomposition or burning produces oxides of carbon and water.

Revised 9/85

MSDS # 355 Issued: 9/80 PHENOL (Rev. B)

SECTION 6. HEALTH HAZARD INFORMATION

TLV 5 ppm or 19 mg/m^3 (Skin)

Phenol is a general protoplasmic poison which is corrosive to body tissue. Poisoning can occur via skin absorption, vapor inhalation, or ingestion. Vapors of phenol are irritating to the eyes, nose, and throat. The liquid is rapidly absorbed through the skin. Contact with the skin causes a white wrinkled discoloration followed by a severe burn or systemic poisoning if not properly removed. Intense burning and pain from skin contact may be delayed. Absorption of phenol through skin may cause sudden collapse, or death. Symptoms develop rapidly. When ingested, phenol causes burning of the gastrointestinal tract, and blotches on the lips and in the mouth. Headache, nausea, dizziness, dyspnea, shock, convulsions, and death may follow exposures by any route. Chronic exposure to low concentrations of phenol may cause digestive disturbances, nervous disorders, skin eruptions, and death due to liver and kidney damage. The TLV is set to prevent systemic poisoning.

FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with copious amounts of running water for at least 30 minutes. Get medical attention! (Inplant, community, paramedic). SKIN CONTACT: Immediately flush skin for at least 30 minutes while removing contaminated clothing and shoes. Get medical attention! INHALATION: Remove victim to fresh air. Restore and/or support breathing as necessary. Keep person warm and quiet. Transport to a medical facility. INGESTION: Give victim large quantities of milk or water as quickly as possible. Induce vomiting by touching back of throat with finger. Do not give fluids or induce vomiting if victim is unconscious or is having convulsions. Contact a physician or Poison Control Center and transport to a medical facility.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from area, except for those involved in clean-up. Close the leak immediately, if possible. Absorb small spills on paper, vermiculite or other absorbent and place in a closed metal container for disposal. Dike large spills and allow material to cool and solidify. Shovel solid into steel containers for disposal. Flush spill area thoroughly with water and collect flushings and wash water for disposal. Do not allow phenol to enter sewer, watersheds, or waterways! Notify proper authorities including the National Response Center (800-424-8802). Clean-up personnel must wear a self-contained breathing apparatus and full personal protective clothing and equipment. DISPOSAL: Burn contaminated waste in an approved incinerator. Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping. A concentration of 1% by weight is required for economical recovery. Phenol is water soluble and is amenable to biological or chemical oxidation. Solutions can be chemically oxidized by chlorine, chlorine dioxide, or other oxidants. Phenol content of water supply not to exceed 0.001 mg/L. (DO NOT flush phenol down drains.) RCRA Hazardous Waste # U188 Reportable Spill Quantity ... 1000 lbs.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. When phenol is heated, vapor inhalation can be a serious hazard without proper precaution. For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved full face respirator. Fume hoods should maintain a minimum face velociry of 100 lfm. All electrical service in use or storage areas should have an explosion-proof design.

DANGER! Avoid any contact with this material. Full protective equipment, including splash goggles, faceshield impervious gloves, apron, boots, impervious shirt and trousers, hard hat with brim, acid suit and respirator should be available and worn as appropriate. Remove contaminated clothing immediately and do not reuse until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from heated surfaces, open flame and ignition sources. Outside or detached storage is preferred. Protect containers from physical damage.

Phenol is a very dangerous compound. Do not breathe vapor or allow liquid to come in contact with the skin. Wear appropriate protective equipment and remove contaminated clothing immediately. Use extreme caution when transporting phenol to prevent leaks. Vent containers before heating and do not heat above 140°F (60°C). Do not eat or smoke in areas where this material is being used or handled. Do not allow employees who have diseases of the central nervous system, liver, kidney, or lungs to work in area of phenol exposure. Provide preplacement and periodic medical exams to employees working with phenol. Do not allow untrained workers to handle this material (see also ASTM D2286-Sampling and Handling Phenol).

ICC & DOT - Class B Poison. LABEL: POISON

DATA SOURCE(S) CODE (See Glossary) 2-12, 15, 19, 23-24, 31, 34, 37, 38, 59, 79, R.

APPROVALS 11/85

INDUST. HYGIENE/SAFETY 11-85

MEDICAL REVIEW: Dec 85

Material Safety Data Sheet

from Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 385

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

SECTION 1. MATERIAL IDENTIFICATION

Material Name: ETHYL BENZENE

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

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

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

NFPA

HMIS

H	2	R	1
F	3	I	3
R	0	S	2
PPG*		K	4

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Ethyl Benzene, CAS No. 0100-41-4 *See NIOSH, *RTECS* (DA0700000), for additional data with references to reproductive, irritative, and mutagenic effects.	Ca 100	**OSHA PELs** 8-Hr TWA: 100 ppm, 435 mg/m³ 15- Min STEL: 125 ppm, 545 mg/m³ **ACGIH TLVs, 1988-89** TLV-TWA: 100 ppm, 435 mg/m³ TLV-STEL: 125 ppm, 545 mg/m³ **Toxicity Data*** Human, Inhalation, TC_{Lo}: 100 ppm (8 Hrs) Rat, Oral, LD_{50}: 3500 mg/kg

SECTION 3. PHYSICAL DATA

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

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

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

SECTION 4. FIRE AND EXPLOSION DATA

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

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

SECTION 5. REACTIVITY DATA

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

SECTION 6. HEALTH HAZARD INFORMATION

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

SECTION 6. HEALTH HAZARD INFORMATION, cont.

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

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

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

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

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

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

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

Transportation Data (49 CFR 172.101-2)

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

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

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

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

Material Safety Data Sheet

From Genium's Reference Collection
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No. 409

CRESOL

(Revision A)
Issued: December 1978
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

26

Material Name: CRESOL*

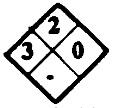
Description (Origin/Uses): Used as a solvent, disinfectant, fumigant; in photographic developers and explosives; and to make synthetic resins.

Other Designations: Cresylic Acid; $CH_3C_6H_4OH$; CAS No. 1319-77-3

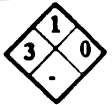
Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

*See Genium Industrial MSDS 560 for data specific to *ortho*-cresol.

**Fire diamond for Cresol mixture Not Found.



*ortho*** NFPA



meta and *para*** NFPA

HMIS

H	3	R	1
F	2	I	4
R	1	S	4
PPG*		K	1

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%
Cresol, CAS No. 1319-77-3	*
ortho-Cresol, CAS No. 0095-48-7	*
meta-Cresol, CAS No. 0108-39-4	*
para-Cresol, CAS No. 0106-44-5	*

*Cresol is a commercial mixture of three isomers (*ortho*, *meta*, and *para*). Contact your supplier to determine the percent by weight of each isomer and to determine if hazardous ingredients/contaminants such as phenol, xylene, or benzene are present in reportable quantities.

**This material can be absorbed through intact skin, which contributes to overall exposure.

***See NIOSH, *RTECS* (GO5950000, mixed cresol; GO6125000, *meta*; GO6300000, *ortho*; GO6475000, *para*), for additional data with references to reproductive, tumorigenic, mutagenic, and irritative effects.

EXPOSURE LIMITS

OSHA PEL (Skin)**
8-Hr TWA: 5 ppm, 22 mg/m³ (All Isomers)

ACGIH TLV (Skin), 1987-88**
TLV-TWA: 5 ppm, 22 mg/m³

Toxicity Data***
Rat, Oral, LD_{50}: 1454 mg/kg
Mouse, Oral, LD_{50}: 760 mg/kg
Rabbit, Skin, LD_{50}: 2000 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point*
Specific Gravity (H_2O = 1): 1.1
Vapor Pressure*

Water Solubility (%): Slight
Molecular Weight: 108 Grams/Mole
pH: Acidic

Appearance and Odor: A colorless, yellowish, brownish yellow, or pinkish liquid that darkens upon exposure to air and light; phenolic odor. Appearance and odor depend upon the supplier and the exact composition of the purchased cresol.

*Contact your supplier to determine the specific physical properties of the cresol product.

SECTION 4. FIRE AND EXPLOSION DATA

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

Extinguishing Media: *Contact your supplier for this data. Cresol burns; treat it as a moderate fire hazard and a slight explosion hazard when exposed to heat or flame. Use foam, dry chemical, carbon dioxide, and water spray to extinguish cresol fires.

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

SECTION 5. REACTIVITY DATA

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

Chemical Incompatibilities: This material reacts dangerously with chlorosulfonic acid, nitric acid, oleum, and strong oxidizing agents.

Conditions to Avoid: Hot cresol can attack copper, aluminum, magnesium, zinc, and lead. Stainless steel is recommended for use with cresol. Avoid direct contact with incompatible chemicals or exposure to sources of ignition. Many organic polymers will dissolve or soften when exposed to hot cresol.

Hazardous Products of Decomposition: Toxic gases such as carbon monoxide and heated cresol and/or cresol derivatives like phenol may be produced during fires.

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

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

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

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

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

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

- **Summary of toxicology**

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

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Potassium cyanide**

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

- **Physical data—Sodium cyanide**

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

- **Reactivity**

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

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

Occupational Health Guideline for Cyanide

INTRODUCTION

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

APPLICABILITY

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

SUBSTANCE IDENTIFICATION

Potassium cyanide

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

Sodium cyanide

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

PERMISSIBLE EXPOSURE LIMIT (PEL)

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

HEALTH HAZARD INFORMATION

- **Routes of exposure**

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

- **Effects of overexposure**

1. Short-term Exposure: Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing, and die. In some cases, there are convulsions. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache, and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears, it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyanide salts are corrosive and may produce ulcers.

2. Long-term Exposure: Effects from chronic exposure to cyanide are non-specific and rare.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cyanide.

- **Recommended medical surveillance**

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

1. Initial Medical Examination:

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

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

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

SECTION 6. HEALTH HAZARD INFORMATION

Naphthalene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Renal shutdown (kidney failure), hemolytic effects (breakdown of red blood cells), hematuria (blood in the urine), oliguria (low volume of urine), jaundice, eye damage, and depression of the central nervous system (CNS) are the primary health concerns associated with exposure to naphthalene. The ACGIH TLVs in section 2 are set to prevent eye damage. These recommended exposure limits may not be low enough to prevent blood changes in genetically hypersensitive individuals.
Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver, and kidneys. Administer medical exams emphasizing these organs. **Target Organs:** Eyes, skin, kidneys, liver, blood (red blood cell effects), and CNS.
Primary Entry: Inhalation, skin contact. **Acute Effects:** Inhalation of naphthalene vapor causes excitement, confusion, headache, nausea, and loss of appetite. **Chronic Effects:** Increased incidence of cataracts.
FIRST AID
Eye Contact: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes to remove particles.
Skin Contact: Immediately wash the affected area with soap and water.
Inhalation: Remove victim to fresh air; restore and/or support his breathing as needed.
Ingestion: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Administer a gastric lavage followed by saline catharsis. Monitor blood and electrolytic balance. Other sources recommend giving the victim several glasses of water to drink.

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

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

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

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

SECTION 8. SPECIAL PROTECTION INFORMATION

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

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

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

DOT Shipping Name: Naphthalene	**DOT ID No.** UN1334
DOT Hazard Class: ORM-A	**IMO Label:** Flammable Solid
IMO Class: 4.1	**DOT Label:** None

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

Approvals
Indust. Hygiene/Safety
Medical Review

Material Safety Data Sheet

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

No. 624

NAPHTHALENE

Issued: November 1987

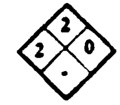
SECTION 1. MATERIAL IDENTIFICATION

Material Name: NAPHTHALENE

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

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

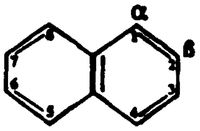
Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref. 73) for a list of suppliers.



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

R 1
I 4
S 1
K 2

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Naphthalene, CAS No. 0091-20-3  *Immediately dangerous to life and health **See NIOSH *RTECS* for additional data with references to irritative, mutagenic, reproductive, and tumorigenic effects.	ca 100	IDLH* Level: 500 ppm **ACGIH TLVs, 1987-88** TLV-TWA: 10 ppm, 50 mg/m³ **OSHA PEL** 8-Hr TWA: 10 ppm, 50 mg/m³ **Toxicity Data**** Child, Oral, LD_{Lo}: 100 mg/kg Man, Unknown, LD_{Lo}: 74 mg/kg Rat, Oral, LD_{50}: 1250 mg/kg

SECTION 3. PHYSICAL DATA

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

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

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

SECTION 4. FIRE AND EXPLOSION DATA

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

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

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

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

SECTION 5. REACTIVITY DATA

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

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

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

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

SECTION 6. HEALTH HAZARD INFORMATION

Cresol is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Cresol is corrosive to any body tissue it touches. Skin absorption can occur and may lead to delayed, possibly fatal, systemic poisoning. Absorption of cresol causes central nervous system (CNS) depression characterized by mental confusion, depression, dyspnea, irregular and rapid respiration, and weak pulse. Damage to the liver, kidneys, lungs, skin, and eyes are also expected from exposure to cresol. Exposures to cresol are emergencies; immediately consult a qualified physician.

Medical Conditions Aggravated by Long-Term Exposure: Preexisting kidney or hepatic (liver) problems.

Primary Entry: Skin absorption/contact, inhalation. **Acute Effects:** Skin and eye burns, difficulty in breathing, and respiratory failure. **Chronic Effects:** Infrequently, prolonged skin contact with cresol results in a chronic disorder called ochronosis, which is a darkening of the skin, conjunctiva, and cartilage of the nose and ears.

FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Treat for eye burns. **Skin.** Immediately wash the affected area with soap and water because of the increased exposure hazard from skin absorption. Watch for chemical skin burns and treat them accordingly. If contact is gross, remove contaminated clothes and shoes *under* the safety shower. Further washing of skin with isopropyl alcohol or 20% glycerine in water, followed by a water rinse, may be useful. **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Have trained personnel administer oxygen. **Ingestion.** Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. If he or she is responsive, give exposed person 1 to 2 glasses of milk or water to drink to dilute the material. Induce vomiting with emetic.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. NOTE TO PHYSICIAN: Wash the affected skin area with a mixture of polyethylene glycol 300/industrial methylated spirits (PEG 300/IMS-2:1 by volume) or a similar preparation that will absorb the phenolic component. Personnel administering this treatment should wear rubber gloves. Hospitalize persons with serious exposures to monitor acidosis, shock, convulsions, and fluid balance. Thorough cleaning of the exposed person is required, especially matted hair, skin folds, and underneath fingernails, where the cresol may concentrate.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Limit access to the spill area to necessary personnel only. Cleanup personnel need protection against contact with and inhalation of cresol (see sect. 8). Contain large spills and collect waste. Use water spray to direct cresol away from incompatible chemicals (see sect. 5). Absorb the waste with sand, earth, or vermiculite and place it into containers suitable for eventual disposal or reclamation. Do not flush waste to a sewer.

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste; No. U052

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), Section 311 (b) (4) and the Resource Conservation and Recovery Act (RCRA), Section 3001

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield as a supplementary protective measure. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent skin contact with cresol. **Ventilation:** Install and operate both general and local exhaust ventilation systems powerful enough to maintain airborne concentrations of cresol below the OSHA PEL standard cited in section 2. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store cresol in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5) and sources of ignition.

Special Handling/Storage: Preplan for routine use and emergency response. Build all storage facilities of nonflammable materials that are resistant to chemical attack by cresol. Protect containers from physical damage. Avoid using alloys of zinc, copper, or brass in storage and processing equipment that could be in contact with cresol.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Cresol
DOT Hazard Class: Corrosive Material
DOT Label: Corrosive
DOT ID No. UN2076
IMO Class: 6.1
IMO Label: Poison

References: 1, 2, 26, 38, 84-94, 100, 112, 113, 114.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

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

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

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

- **Flammability**

1. Not combustible

- **Warning properties**

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

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

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

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

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

- **Ceiling Evaluation**

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

- **Method**

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

RESPIRATORS

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

PERSONAL PROTECTIVE EQUIPMENT

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

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

SANITATION

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

COMMON OPERATIONS AND CONTROLS

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

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

EMERGENCY FIRST AID PROCEDURES

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

- **Eye Exposure**

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

- **Skin Exposure**

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

- **Breathing**

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

- **Swallowing**

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

RESPIRATORY PROTECTION FOR CYANIDE

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

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

EXHIBIT E-3

SAMPLE MEDICAL DATA SHEET

CONFIDENTIAL

THE FOLLOWING INFORMATION IS REQUESTED TO DETERMINE YOUR CURRENT MEDICAL STATUS

Date

1. Name (Last, First, Middle Initial)

3. Social Security Number

2. Employee Address (Number & Street) City - State Zip Code

4. Telephone Number

5. Sex* ☐ M ☐ F

6. Birth Date*

7. Name and Address of Person to Notify in an Emergency

8. Telephone Number

9. Personal Physician Address Telephone Number

11. Type of Examination
☐ Pre-Placement
☐ Periodic
☐ Other (Specify)

10. Which Division or Facility Position

12. I.D. or Clock No.

13. Work Location

14. Please Check if You Have Been Immunized For:

☐ Tetanus	☐ Smallpox	☐ Polio	☐ Others
☐ Don't Know	☐ Don't Know	☐ Don't Know	☐ Don't Know
LAST DATE	LAST DATE	LAST DATE	LAST DATE

15. Are You:
☐ Right Handed
☐ Left Handed
☐ Ambidextrous

16. Family History*

RELATION	AGE	STATE OF HEALTH	IF DEAD, CAUSE AND AGE	CHECK EACH BOX (If answer is yes, state blood relationship).	YES	NO	RELATION
Father				Cancer			
Mother				Diabetes			
Spouse				Stomach Trouble			
Grandparents				Kidney Trouble			
				Heart Trouble			
				Tuberculosis			
				Mental Disorder			
Brothers nd Sisters				Convulsions			
				Arthritis			
				Allergies			
				Other			
Children							

17. Personal History*

DO YOU HAVE, OR HAVE YOU EVER HAD ANY OF THE FOLLOWING. (Check Each Box)

	YES	NO		YES	NO		YES	NO
nemia			Female Disorders			Malaria		
thma			Foot Trouble			Nervous Breakdown		
Cancer, Cyst, Tumor or Growth			Frequent Indigestion or Heartburn			Nervous Trouble of Any Sort		
Chest Pain or Shortness of Breath			Frequent or Painful Urination			Numbness, Weakness		
hills, Fever, Night Sweats			Frequent Trouble Sleeping			Palpitation or Pounding Heart		
Chronic Cough or Colds			Gall Bladder Trouble			Prostate Trouble		
Convulsions, Fits,			Goiter or Thyroid Problem			Reaction from Medicines		
or Falling Sickness			Hayfever or Allergies			Recent Gain or Loss of Weight		
oughing Up, Spitting, or			Headaches, Frequent or Severe			Rheumatism or Arthritis		
Vomiting Blood			Heart Trouble			Scarlet Fever or Rheumatic Fever		
epression or Excessive Worry			Hemorrhoids or Rectal Trouble			Skin Rash or Hives		
abetes, or Sugar in Urine			Hernia or Rupture			Stomach Trouble, Ulcers		
Dizziness			High Blood Pressure			Swelling of Ankles or Feet		
Ear, Nose, or Throat Trouble			Jaundice or Hepatitis			Swollen or Painful Joints		
Epilepsy			Kidney Trouble or Blood in Urine			Tuberculosis or Pleurisy		
Eye Trouble			Liver Trouble			Varicose Veins		
Fainting			"Locked" Knee or "Trick Joint"			Veneral Disease		
atigue, Chronic or Frequent			Loss of Appetite, Chronic			Other		

18. Injuries: Please Check Any Injuries You Have Had

☐ Fractures/Broken Bones
☐ Severe Burns
☐ Other Injury
☐ Severe Cuts
☐ Dislocations
☐ None
☐ Loss of Consciousness
☐ Low Back Pain
☐ Back Injury
☐ Loss of Arm, Leg, Finger, Toe

19. Check Yes or No. If Yes, Give Details in Blank Area.

	YES	NO	
a. Any Time Loss From Work Past Two Years Due to Illness.			
b. Any Brace or Support Worn			
c. Discharged or Disqualified From Armed Services for Any Reason.			
d. Military Service - Dates and Locations.			
e. Applied for, or Received Workmen's Compensation.			
f. Been Exposed to Work With Dusts, Radiation, Excessive Noise, Chemicals.			
g. Have You Been Unable to Hold a Job Because of:			
1. Sensitivity to Chemicals, Dust, Sunlight, etc.			
2. Inability to Perform Certain Motions.			
3. Inability to Assume Certain Positions.			
4. Other Medical Reasons.			
h. Been a Patient in a Hospital or Sanitarium.			
i. Had Surgery Recommended or Performed Date and Type.			
j. Are You Taking Medicines Now.			
k. Have You Been Turned Down on a Physical Examination or Been Informed of Any Abnormal Findings From a Physical Examination.			
l. Do You Smoke - If Yes, Quantity Per Day.			
m. Do You Use Alcoholic Beverages - If Yes, Quantity Per Day.			
n. Have You Lived or Travelled Outside the Continental U.S.A.			
o. Allergies.			

EXHIBIT E-4

ACCIDENT REPORT FORM

ACCIDENT REPORT

Report No. ______

SITE: ______________________________ PROJECT NO.: ______________

Location: ____

Date of Report: ___________ Preparers Name: ______________________

Name and Address of Injured: ________ SSN: ___________ Age: ______

____________________________________ Sex: ______

Years of Service: ___ Time on Present Job: ___ Title/Classification: _

Division/Department: _______ Date of Accident: ________ Time: ______

Accident Category: ___ Motor Vehicle ____ Property Damage ___ Fire

___ Chemical Exposure ____ Near Miss ___ Other

Severity of Injury or Illness: ____ Non-disabling ____ Disabling

____ Medical Treatment ____ Fatality

Amount of Damage: $________________ Property Damaged: ___________

Estimated Number of Days Away from Job: ______________________________

Nature of Injury or Illness: ____

CLASSIFICATION OF INJURY:

____ Fractures
____ Dislocations
____ Sprains
____ Abrasions
____ Lacerations
____ Punctures
____ Bites

_____ Heat Burns
_____ Chemical Burns
_____ Radiation Burns
_____ Bruises
_____ Blisters
_____ Toxic Respiratory Exposure
_____ Toxic Ingestion

______ Cold Exposure
______ Frostbite
______ Heat Stroke
______ Heat Exhaustion
______ Concussion
______ Faint/Dizziness
______ Toxic Respiratory Allergy
______ Dermal Allergy

Part of Body Affected: ____

Degree of Disability: ____

Date Medial Care was Received: ______________________________

Where Medical Care was Received: ______________________________

Address (if off-site): ______________________________

ACCIDENT LOCATION: ______________________________

Was weather a factor: ______________________________

Unsafe act by injured and/or others contributing to the accident (Be specific, must be answered):

____

____

____

Personal factors (Improper attitude, lack of knowledge of skill, slow reaction, fatigue):

____

____

____

Level of personal protection equipment required in Site Safety Plan: ____

____

Modifications: ______________________________

Was injured using required equipment: ______________________________

If not, how did actual equipment use differ from plan: ______________

____

Detailed narrative description (How did accident occur, why; objects, equipment, tools used, circumstance assigned duties) (Be specific):

____

____

____

(Use back of sheet, as required)

Witnesses to accident: ____

____

Signature of Preparer ______________________

Signature of Site Leader ______________________

EXHIBIT E-5

OSHA FORM 200

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illnesses

U.S. Department of Labor

For Calendar Year 19 ______ Page ___ of ___

NOTE: **This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties.** ***(See posting requirements on the other side of form.)***

RECORDABLE CASES: You are required to record information about every occupational death, every nonfatal occupational illness, and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). ***(See definitions on the other side of form.)***

Company Name

Establishment Name

Establishment Address

Form Approved
O.M.B. No. 1220-0029
See OMB Disclosure Statement on reverse

Case or File Number	**Date of Injury or Onset of Illness**	**Employee's Name**	**Occupation**	**Department**	**Description of Injury or Illness**	**Extent of and Outcome of INJURY**						**Type, Extent of, and Outcome of ILLNESS**													
						Fatalities	**Nonfatal Injuries**					**Type of Illness**							**Fatalities**	**Nonfatal Illnesses**					
						Injury Related	**Injuries With Lost Workdays**				**Injuries Without Lost Workdays**	**CHECK Only One Column for Each Illness** ***(See other side of form for terminations or permanent transfers.)***							**Illness Related**	**Illnesses With Lost Workdays**				**Illnesses Without Lost Workdays**	
Enter a nonduplicating number which will facilitate comparisons with supplementary records.	Enter Mo./day.	Enter first name or initial, middle initial, last name.	Enter regular job title, not activity employee was performing when injured or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another department at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part or parts of body affected. Typical entries for this column might be: Amputation of 1st joint right forefinger. Strain of lower back; Contact dermatitis on both hands. Electrocution—body	Enter DATE of death. Mo./day/yr.	Enter a CHECK if injury involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if injury involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 1 or 2 but the injury is recordable as defined above.	Occupational skin diseases or disorders	Dust diseases of the lungs	Respiratory conditions due to toxic agents	Poisoning (systemic effects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupational illnesses	Enter DATE of death Mo./day/yr.	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both	Enter a CHECK if illness involves days away from work	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 8 or 9.	
(A)	(B)	(C)	(D)	(E)	(F)	(1)	(2)	(3)	(4)	(5)	(6)	(7)							(8)	(9)	(10)	(11)	(12)	(13)	
												(a)	(b)	(c)	(d)	(e)	(f)	(g)							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]																				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]																				

INJURIES

ILLNESS

Certification of Annual Summary Totals By ______________ Title ______________ Date ______________

OSHA No. 200

FOLD

OSHA No. 200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

OMB DISCLOSURE STATEMENT

We estimate that it will take from 4 minutes to 30 minutes to complete a line entry on this form, including time for reviewing instructions; searching, gathering and maintaining the data needed; and completing and reviewing the entry. If you have any comments regarding this estimate or any other aspect of this recordkeeping system, send them to the Bureau of Labor Statistics, Division of Management Systems (1220-0029), Washington, D.C. 20212 and to the Office of Management and Budget, Paperwork Reduction Project (1220-0029), Washington, D.C. 20503.

Instructions for OSHA No. 200

I. Log and Summary of Occupational Injuries and Illnesses

Each employer who is subject to the recordkeeping requirements of the Occupational Safety and Health Act of 1970 must maintain for each establishment a log of all recordable occupational injuries and illnesses. This form (OSHA No. 200) may be used for that purpose. A substitute for the OSHA No. 200 is acceptable if it is as detailed, easily readable, and understandable as the OSHA No. 200.

Enter each recordable case on the log within six (6) workdays after learning of its occurrence. Although other records must be maintained at the establishment to which they refer, it is possible to prepare and maintain the log at another location, using data processing equipment if desired. If the log is prepared elsewhere, a copy updated to within 45 calendar days must be present at all times in the establishment.

Logs must be maintained and retained for five (5) years following the end of the calendar year to which they relate. Logs must be available (normally at the establishment) for inspection and copying by representatives of the Department of Labor, or the Department of Health and Human Services, or States accorded jurisdiction under the Act. Access to the log is also provided to employees, former employees and their representatives.

II. Changes in Extent of or Outcome of Injury or Illness

If, during the 5 year period the log must be retained, there is a change in an extent and outcome of an injury or illness which affects entries in columns 1, 2, 6, 8, 9, or 13, the first entry should be lined out and a new entry made. For example, if an injured employee at first required only medical treatment but later lost workdays away from work, the check in column 6 should be lined out, and checks entered in columns 2 and 3 and the number of lost workdays entered in column 4.

In another example, if an employee with an occupational illness lost workdays, returned to work, and then died of the illness, any entries in columns 9 through 12 should be lined out and the date of death entered in column 8.

The entire entry for an injury or illness should be lined out if later found to be nonrecordable. For example: an injury which is later determined not to be work related, or which was initially thought to involve medical treatment but later was determined to have involved only first aid.

III. Posting Requirements

A copy of the totals and information following the fold line of the last page for the year must be posted at each establishment in the place or places where notices to employees are customarily posted. This copy must be posted no later than ***February 1 and must remain in place until March 1.***

Even though there were no injuries or illnesses during the year, zeros must be entered on the totals line, and the form posted.

The person responsible for the ***annual summary totals*** shall certify that the totals are true and complete by signing at the bottom of the form.

IV. Instructions for Completing Log and Summary of Occupational Injuries and Illnesses

Column A – CASE OR FILE NUMBER. Self explanatory.

Column B – DATE OF INJURY OR ONSET OF ILLNESS.
For occupational injuries, enter the date of the work accident which resulted in injury. For occupational illnesses, enter the date of initial diagnosis of illness, or, if absence from work occurred before diagnosis, enter the first day of the absence attributable to the illness which was later diagnosed or recognized.

Columns C through F – Self explanatory.

Columns 1 and 8 – INJURY OR ILLNESS-RELATED DEATHS.
Self-explanatory.

Columns 2 and 9 – INJURIES OR ILLNESSES WITH LOST WORKDAYS.
Self-explanatory.

Any injury which involves days away from work, or days of restricted work activity, or both must be recorded since it always involves one or more of the criteria for recordability.

Columns 3 and 10 – INJURIES OR ILLNESSES INVOLVING DAYS AWAY FROM WORK. Self-explanatory.

Columns 4 and 11 – LOST WORKDAYS--DAYS AWAY FROM WORK.
Enter the number of workdays (consecutive or not) on which the employee would have worked but could not because of occupational injury or illness. The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.

NOTE: For employees not having a regularly scheduled shift, such as certain truck drivers, construction workers, farm labor, casual labor, part-time employees, etc., it may be necessary to estimate the number of lost workdays. Estimates of lost workdays shall be based on prior work history of the employee AND days worked by employees, not ill or injured, working in the department and/or occupation of the ill or injured employee.

Columns 5 and 12 – LOST WORKDAYS--DAYS OF RESTRICTED WORK ACTIVITY.
Enter the number of workdays (consecutive or not) on which because of injury or illness:

(1) the employee was assigned to another job on a temporary basis, or
(2) the employee worked at a permanent job less than full time, or
(3) the employee worked at a permanently assigned job but could not perform all duties normally connected with it.

The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.

Columns 6 and 13 – INJURIES OR ILLNESSES WITHOUT LOST WORKDAYS. Self-explanatory.

Columns 7a through 7g – TYPE OF ILLNESS.
Enter a check in only *one* column for each illness.

TERMINATION OR PERMANENT TRANSFER–Place an asterisk to the right of the entry in columns 7a through 7g (type of illness) which represented a termination of employment or permanent transfer.

V. Totals

Add number of entries in columns 1 and 8.
Add number of checks in columns 2, 3, 6, 7, 9, 10, and 13.
Add number of days in columns 4, 5, 11, and 12.
Yearly totals for each column (1-13) are required for posting. Running or page totals may be generated at the discretion of the employer.

If an employee's loss of workdays is continuing at the time the totals are summarized, estimate the number of future workdays the employee will lose and add that estimate to the workdays already lost and include this figure in the annual totals. No further entries are to be made with respect to such cases in the next year's log.

VI. Definitions

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from an exposure involving a single incident in the work environment.
NOTE: Conditions resulting from animal bites, such as insect or snake bites or from one-time exposure to chemicals, are considered to be injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

The following listing gives the categories of occupational illnesses and disorders that will be utilized for the purpose of classifying recordable illnesses. For purposes of information, examples of each category are given. These are typical examples, however, and are not to be considered the complete listing of the types of illnesses and disorders that are to be counted under each category.

7a **Occupational Skin Diseases or Disorders**
Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants, oil acne, chrome ulcers, chemical burns or inflammations, etc.

7b **Dust Diseases of the Lungs (Pneumoconioses)**
Examples: Silicosis, asbestosis and other asbestos-related diseases, coal worker's pneumoconiosis, byssinosis, siderosis, and other pneumoconioses.

7c **Respiratory Conditions Due to Toxic Agents**
Examples: Pneumonitis, pharyngitis, rhinitis or acute congestion due to chemicals, dusts, gases, or fumes, farmer's lung, etc.

7d. **Poisoning (Systemic Effect of Toxic Materials)**
Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals, poisoning by carbon monoxide, hydrogen sulfide, or other gases, poisoning by benzol, carbon tetrachloride, or other organic solvents, poisoning by insecticide sprays such as parathion, lead arsenate, poisoning by other chemicals such as formaldehyde, plastics, and resins, etc.

7e. **Disorders Due to Physical Agents (Other than Toxic Materials)**
Examples: Heatstroke, sunstroke, heat exhaustion, and other effects of environmental heat, freezing, frostbite, and effects of exposure to low temperatures, caisson disease, effects of ionizing radiation (isotopes, X-rays, radium), effects of nonionizing radiation (welding flash, ultraviolet rays, microwaves, sunburn), etc.

7f. **Disorders Associated With Repeated Trauma**
Examples: Noise-induced hearing loss, synovitis, tenosynovitis, and bursitis, Raynaud's phenomena, and other conditions due to repeated motion, vibration, or pressure.

7g **All Other Occupational Illnesses**
Examples: Anthrax, brucellosis, infectious hepatitis, malignant and benign tumors, food poisoning, histoplasmosis, coccidioidomycosis, etc.

MEDICAL TREATMENT includes treatment (other than first aid) administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does NOT include first-aid treatment (one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care) even though provided by a physician or registered professional personnel.

ESTABLISHMENT: A single physical location where business is conducted or where services or industrial operations are performed (for example: a factory, mill, store, hotel, restaurant, movie theater, farm, ranch, bank, sales office, warehouse, or central administrative office). Where distinctly separate activities are performed at a single physical location, such as construction activities operated from the same physical location as a lumber yard, each activity shall be treated as a separate establishment.

For firms engaged in activities which may be physically dispersed, such as agriculture; construction; transportation; communications; and electric, gas, and sanitary services, records may be maintained at a place to which employees report each day.

Records for personnel who do not primarily report or work at a single establishment, such as traveling salesmen, technicians, engineers, etc., shall be maintained at the location from which they are paid or the base from which personnel operate to carry out their activities.

WORK ENVIRONMENT is comprised of the physical location, equipment, materials processed or used, and the kinds of operations performed in the course of an employee's work, whether on or off the employer's premises.

EXHIBIT E-6

FIRST REPORT OF INJURY FORM

1. INSURER FILE NUMBER/LARS Loc. Case

2. EMPLOYER FILE NUMBER:

3. EMPLOYER'S CONNECTICUT REGISTRATION NUMBER (CRN):

WORKERS' COMPENSATION COMMISSION OF CONNECTICUT

EMPLOYER'S FIRST REPORT OF OCCUPATIONAL INJURY OR DISEASE

(Please type or print in ink)

4. WCC FILE NUMBER

5. REASON FOR REPORT CHECK ALL THAT APPLY
- LOST TIME — ONE OR MORE DAYS ☐
- MEDICAL/HEALTH CARE ☐
- OCCUPATIONAL DISEASE (Note item 41 below) ☐
- CORRECT PRIOR REPORT ☐

EMPLOYER INFORMATION

6. EMPLOYER NAME:

7. EMPLOYER MAILING ADDRESS AND PHONE, including Town

8. LOCATION IF DIFFERENT FROM MAILING ADDRESS:

9. NATURE OF BUSINESS:

10. NAME OF WC INSURER:

11. POLICY NUMBER: POLICY PERIOD

EMPLOYEE INFORMATION

12. LAST NAME: FIRST NAME: M.I.

13. SOCIAL SECURITY NUMBER:

14. ADDRESS — NUMBER AND STREET:

15. CITY: STATE: ZIP:

16. HOME PHONE:

17. DATE OF BIRTH:

18. AGE:

19. SEX: MALE ☐ FEMALE ☐

20. OCCUPATION:

21. DEPARTMENT:

22. DATE OF HIRE:

23. DATE CURRENT DUTIES BEGAN:

24. WEEKLY WAGE AT TIME OF INJURY:

INJURY OR EXPOSURE INFORMATION

25. DATE AND TIME OF INJURY: : AM ☐ PM ☐

26. DID INJURY OR EXPOSURE OCCUR ON EMPLOYER'S PREMISES SHOWN ABOVE? YES ☐ NO ☐

27. IF NO, PLACE WHERE INJURY OR EXPOSURE OCCURRED, INCLUDING TOWN

28. DESCRIBE THE EVENTS WHICH RESULTED IN THE INJURY OR DISEASE. (GIVE FULL DETAILS ON ALL FACTORS THAT LED OR CONTRIBUTED TO THE INJURY OR THE ONSET OF DISEASE.)

N

P

S

T

A

29. NAME THE OBJECT, SUBSTANCE, OR EXPOSURE WHICH DIRECTLY BROUGHT ABOUT THE INJURY OR DISEASE.

30. DESCRIBE THE INJURY OR DISEASE AND INDICATE PART OF BODY AFFECTED.

31. PHYSICIAN (NAME AND ADDRESS):

32.
- FIRST AID
- HOSPITAL
- EMERGENCY ROOM
- OUT-PATIENT

33. HOSPITAL (NAME AND ADDRESS):

34. DATE EMPLOYER NOTIFIED:

35. TIME EMPLOYEE'S WORKDAY BEGAN: AM ☐ PM ☐

36. DID EMPLOYEE LOSE ONE OR MORE DAYS WORK? YES ☐ NO ☐ IF NO, SKIP BOXES 38, 39, 40, AND 41.

37. EXTENT OF ACCIDENT/HEALTH AND LIFE INSURANCE COVERAGE FOR EMPLOYEE:

38. DATE INCAPACITY BEGAN:

39. HAS EMPLOYEE RETURNED TO WORK? YES ☐ NO ☐ IF YES, GIVE DATE:

40. DID EMPLOYEE DIE? YES ☐ NO ☐ IF YES, GIVE DATE:

41. FOR OCCUPATIONAL DISEASE
DATE OF LAST EXPOSURE:
DATE OF DIAGNOSIS AS OCCUPATIONALLY RELATED:

PREPARER INFORMATION

42. PREPARER'S NAME AND TITLE (TYPE OR PRINT):

SIGNATURE (FORM MUST BE SIGNED)

DATE:

Form WCC-15 (10-85)

SEE REVERSE SIDE FOR WAGE STATEMENT

Form LC-4706-2 Printed in U.S.A.

EXHIBIT E-7

RECORD OF SAFETY MEETINGS

SAFETY MEETING RECORD

Safety Meeting Date/Time: 11/1/90 10:00 a.m.

Given By: Dennis Unites

Topics Discussed: Routes to hospitals for each site, sampling protocol, decontamination measures, and level of protection.

Present at Safety Meeting (signature):

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.

APPENDIX F

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENT

QUALITY ASSURANCE PROJECT PLAN

This section presents those elements of project control which are necessary to ensure quality of the overall preliminary investigation at the NYSEG MGP Sites and outlines the procedures and guidelines Atlantic will follow to ensure the reliable collection and handling of sampling and analysis data. This basic elements normally included in an EPA Quality Assurance Plan and/or Quality Assurance Project Management Plan are addressed in this section.

Brief Description of Field Activities

The field investigation program will consist of the following subtasks:

- Topographic and Property Survey
- Surface Soil Sampling
- Surface Water Sampling
- Sediment Sampling
- Air Sampling

Each of these subtasks is discussed in detail in Section 2.0 of this Work Plan.

Field Procedures

Atlantic Environmental Services has developed a number of technical procedures which have been applied to site investigations including work performed at CERCLA sites. A list of relevant Atlantic procedures for the NYSEG MGP Sites field investigation are as follows.

Procedure Number	Procedure Title
1020	Field Procedures for Collection of Surface Soil Samples
1022	Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination

1040NY	Sample Preservation for Solid and Liquid Matrices for Work Conducted in New York State
1041	Sample Chain-of-Custody Procedure
1042	Shipping Procedures for Environmental Field Samples
1051	Operation and Calibration of the HNu Systems Photoionizer Model PI-101
1060	Cleaning Procedure for Sampling Devices Used in Environmental Site Investigations

Each of these listed Atlantic Technical Procedures are presented in Appendix F.

Project Organization and Responsibility

Atlantic will perform the quality assurance elements described in this section in accordance with EPA guidance to assure consistency throughout the program. Specific personnel have been identified who are responsible for implementing the quality control aspects of the project. Primary responsibility rests with the Project Manager.

The following is a list of personnel responsible for various aspects of the project.

Function	Person Responsible
Sample Collection	Anna Sullivan (Atlantic)
QA/QC Coordinator	Robert Breeding (Atlantic)
Data Quality Review	Robert Breeding (Atlantic)
Data Processing QA	James Gould (Atlantic)
Sample QA	Anna Sullivan (Atlantic)
Lab Analysis	John Flaherty (Wadsworth)
Lab QA	Renee Gigliotti (Wadsworth)
Overall Project Coordination	Dennis Unites (Atlantic)

The Project Manager, Dennis Unites, P.G., will assume prime responsibility for technical, financial and scheduling matters. He will be Atlantic's principal point of contact with NYSEG and the DEC. James Gould, P.E., will be the Senior Technical Review for the project, responsible for overall technical content of

Atlantic's work. Robert Breeding will coordinate the overall project QA/QC program. Anna Sullivan will oversee all aspects of the field investigation.

Quality Assurance and Quality Control

This section describes the QA/QC requirements for the field activities.

Field Instrument Calibration and Preventative Maintenance

Atlantic procedure 1051 (HNu P1-101/Organic Vapor Meter) describes calibration and maintenance procedures for HNu P1-101.

A master calibration/maintenance file will be maintained which will include the following information:

- device/instrument serial and/or I.D. number;
- frequency of calibration;
- date of calibration;
- results of calibration;
- name of person performing the calibration; and
- identification of calibration gas.

QA/QC Sample Collection and Frequency

Trip Blanks

A trip blank is an aliquot of deionized organic-free water that is sealed in a sample bottle prior to initiation of field work. Glass vials (40 ml) will be used for VOA Trip Blanks. These sealed bottles are subsequently placed within a cooler and accompany field personnel during the sampling activities. For each day of aqueous sampling, a trip blank will also be sent for analysis. In this manner, any possible cross-contamination occurring among samples during shipment can be assessed. A trip blank will be taken for each day of aqueous volatile organics sampling.

Field Blanks

A field blank is an aliquot of deionized, organic free water which has been used to rinse the field sampling equipment after decontamination. A field blank will be taken for each media sampled (i.e., for each type of equipment used) at a frequency of one field blank per day per media. In this manner, any possible cross-contamination occurring among samples due to the repeated use of the same sampling equipment can be assessed.

Replicate Samples

Replicate samples will be analyzed to check laboratory reproducibility of analytical data from two aliquots of a sample taken at one location. Approximately ten percent of the total number of aqueous samples will be replicated in order to evaluate the precision of the methods used.

Sample Identification System

Each sample will be designated by alphanumeric code which will identify the project site, sample type, sampling location, sample depth, and addition designation if needed. Replicates will not be specifically identified as such in the sample number, but will have a different (sequential) number which will be noted in the sample logbook.

The sample code will use the following format: Lockport-CGLS

- Date of Sampling
- Sample Type: SS (surface soil), SW (surface water), SE (sediment), A (air)
- Sample Number

Where: CGLS-111290-SS3

Indicates:
CGLS - Lockport State Road Site
111290 - November 12, 1990
SS - Surface Soil
3 - Sample Number 3

Sample Holding Times

Sample holding times are specified in Atlantic Procedure No. 1040NY.

Sampling Packaging and Shipping

Samples should be packaged and shipped according to Atlantic Procedure No. 1042. When sample shipments are to be sent, the receiving laboratory will be telephoned on that day or the following morning, and notified of the shipment date, airbill number, and number and type of samples being shipped. All samples will be shipped in the afternoon (the end) of each day to ensure that samples will be shipped within twenty-four (24) hours of sampling. Samples will be labeled as per 40 CFR 261.4, "Research Samples" or "Environmental Samples".

Sample and Field Activity Documentation

Custody of samples must be maintained and documented at all times. Chain-of-custody begins with the collection of the samples in the field. Procedures are detailed in Atlantic Procedure No. 1041.

A bound/weatherproof master sample log shall be maintained by the field team. The Field Operations Leader, or designee, shall record information related to sampling or field activities. The information will include sample number, sample time, shipping information, sample location, sample description, sample method used, weather conditions, field measurements, sampler's name, unusual events, etc.

A site logbook will be maintained by the Field Operations Leader or designee. The book will contain a summary of the day's activities, including site visitors, daily telephone contacts, and decision points.

QA Objectives for Precision, Accuracy and Completeness

Environmental measurements have inherent limitations arising from equipment problems, procedural deviations, and changes in ambient conditions. Most environmental measurements are analyses made for extremely low concentrations of constituents and are subject to chemical interferences, instrument limitation and uncertainties that affect the accuracy of the determination. It is essential to minimize these factors so that the measurements accurately reflect the character of the sample collected.

All data gathered during the course of the NYSEG MGP Site study by Atlantic or processed by the laboratory will meet objectives of accuracy, precision, completeness, representativeness, and comparability, as referenced in Stanley and Verner (1983). These characteristics are defined below:

- <u>Accuracy</u> - the degree of agreement of a measurement, X, with an accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T. Accuracy is a measure of the bias in a system.
- <u>Precision</u> - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions".
- <u>Completeness</u> - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.
- <u>Representativeness</u> - expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- <u>Comparability</u> - expresses the confidence with which one data set can be compared to another.

APPENDIX G

ATLANTIC ENVIRONMENTAL SERVICES, INC.
TECHNICAL PROCEDURES

ATLANTIC PROCEDURE NO. 1020

FIELD PROCEDURES FOR COLLECTION OF SURFACE SOIL SAMPLES

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
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ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

Procedure No. 1020
Revision No. 1
Date April 21, 1989
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SECTION PAGE

SECTION 1.0: PURPOSE

To insure a standard procedure for collection of surface soil samples for the identification of chemical parameters.

SECTION 2.0: SCOPE

The following procedure describes the logistics, chain-of-events, collection techniques and documentation requirements for collecting surface soil samples designated for chemical analysis.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Chemist, Geologist or Engineer - Second

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Selection of Sampling Locations

The selection of sampling locations in and around a project site will be based on a review of existing site data, the site topography and surface features, results of preliminary site surveys using portable geophysical and air monitoring equipment and the initial estimates as to the extent of and migration pathways of the waste present. At the start of the investigation, a number of surface soil samples are usually allocated. Only after initial field reconnaissance are the final locations selected. At a minimum, the following should be included as sampling points:

- Upgradient soil surfaces to determine background levels.
- Soil surfaces within the immediate area of contamination.
- Downgradient soil surfaces to determine any spread of contamination resulting from storm water runoff.

Sampling locations may be selected in the following areas at the site:

- Areas where chemicals may have been stored, handled or disposed.
- Areas where motor vehicles hauling chemicals may have traveled on the site.
- Areas where water may have ponded during storm events.

6.2 Equipment List

The following is to be considered a minimum listing of required field equipment for collecting soil samples. Other tools required for accessing soils beneath paved area, etc. should be included when necessary.

- Boots, latex gloves, chemical resistant gloves, appropriate level of protection.
- Sample container - 1 each 1 liter glass jar with a teflon lined cap.
- Teflon coated or stainless steel sample spoons.
- Wooden stakes and spray paint (highly visible)
- Field notebook
- Sample bottle labels
- Chain-of-custody forms

6.3 Order of Samples

Surface soil samples should be taken in all locations prior to all other site sampling events. This is to prevent the possibility of cross-contamination between sampling points by site personnel or equipment (backhoe, drill rigs, equipment vehicles, etc. . .). For consistency with other sampling programs, the upgradient samples should be collected first.

6.4 Location and Collection of Samples

Surface soils, depending upon the contaminants of interest, can be either individual or composite samples. Composites represent samples taken from a number of individual locations which are equally blended to form a sample representing a larger area. Certain state agencies are discouraging the use of composite samples when looking for aromatic volatile and halogenated volatile organic compounds because of dilution and the difficulty of forming a "true" composite. Therefore prior to sampling, the use of composites should be checked with the agency which will have final approval of actions regarding a site in which surface soil samples are used in developing certain actions regarding clean up.

If statistical techniques are to be employed in collecting surface soil samples using a random grid, the procedure provided in Chapter 5 of Methods of Soil Analysis, Part I by C.A. Black et al, American Society of Agronomy, Academic Press, N.Y. 1965 and Section I of EPA-SW 846 Test Methods for Evaluating Solid Waste. Physical Chemical/Methods are suggested protocols.

Once the general locations have been chosen, sampling can begin. Normally a sample representing the top 3 to 6 inches of soil is taken. Samples are collected using a dedicated, precleaned stainless steel or Teflon spoon and immediately stored in the glass jar. Organic debris (ie.

leaves, twigs, bark) along with large pieces of gravel should be avoided. The sample should be representative of the area soil; it is best represented by the finer grains of the topsoil. The jars must be filled completely so as to avoid creating a head space where volatiles may escape. After each jar is filled the threads should be wiped clean so that the cap can be threaded on without creating an air gap.

Latex or rubber gloves should be worn to protect the sampling person and to avoid cross contamination through handling.

All filled jars must be labelled with the following as a minimum:

- project number
- sampling time and date
- sample number
- analysis
- collector's initials

The sample chain-of-custody form is then immediately filled out and kept with the sample. The sample is then stored in a refrigerated container until delivery to the analytical lab.

The location, depth of sample, sample type, time of sample, and other associated data (ie. organic vapor readings, color of the ground, odors, texture, etc.) will be documented in the field notebook when the sample is taken. If sampling is performed under a paved area or in fill, a description of these unique areas will also be included.

6.5 Sample Verification

After each sample of soil is taken, an indicator should be used to mark the location in the event it will be surveyed at a later time. Once all the surface soil samples are collected, the sample numbers and locations should be reviewed before leaving the site or progressing to other tasks in a program. All used sampling devices will be kept together, separate from clean tools, so that they can be cleaned according to appropriate decontamination and cleaning procedure. In no event will a used sampling device be used for two or more samples without full cleaning between samples.

ATLANTIC PROCEDURE NO. 1022

FIELD PROCEDURES FOR COLLECTION OF SURFACE WATER AND SEDIMENT SAMPLES FOR HAZARDOUS WASTE DETERMINATION

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
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ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

Procedure No. 1022
Revision No.
Date July 1, 1986
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SECTION PAGE

1.0 PURPOSE

To insure a standard procedure for collection of surface water (streams, ponds, lakes, impoundments) and sediments for the identification of chemical composition.

2.0 SCOPE

The following procedure describes the logistics, chain-of-events, collection techniques and documentation requirements for collecting surface water and sediment samples designated for chemical analysis.

3.0 RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Sampling Technicians - Third

4.0 SUPPORTING PROCEDURES

Atlantic Procedure No. 1060 Decontamination Procedure for Sampling Devices

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure.

5.0 REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp.,
Tacoma, Washington

6.0 PROCEDURE

6.1 Selection of Sampling Locations

The selection of sampling locations in and around an project site will be based on a review of existing site data, the site topography and surface features, results of preliminary site surveys using portable geophysical and air monitoring equipment and the initial estimates as to the extent of the waste. At the start of the investigation, a number of surface water and sediment samples are usually allocated. Only after initial field reconnaissance are the final locations selected. At a minimum the following should be included as sampling points.

- Upstream and upgradient of the waste site to determine background levels of pollutants.
- In leachate, runoff or intermittent flow paths passing through or from the site.
- In downgradient streams, swales, runoff channels or sewers draining the site to determine limits of surficial deposition.

6.2 Equipment List

The following lists are examples of equipment to be used for sampling. Site specific checklists of equipment should be designed based on the characteristics of each sample and location.

6.2.1 Surface Water Sampling

- Boots, latex gloves, chemical resistant gloves, appropriate level of protection.
- Sample containers (depending on sample requirements of the analytical laboratory) may include for each location:
  - 4 each 1 liter glass jars with teflon lined caps.
  - 8 each 40 ml. glass vials with teflon lined septas.
  - 1 each 500 ml. plastic containers for metals analysis.
  - 1 each 500 ml. plastic containers for mercury analysis.
- Wooden stakes and spray paint.
- Stainless steel Kemmerer bottle, Van Dorn bottle or sterile glass samplers (if required)
- Remote samplers
- Field Notebook
- Sample bottle labels
- Chain-of-custody forms

6.2.2 Sediment Sampling

- Boots, latex gloves, chemical resistant gloves, appropriate level of protection.
- Dedicated stainless steel spoons (tablespoon size)
- Dedicated teflon spoons (if required)
- Sample containers for each sample
  - 1 each 1 liter glass jars with teflon lined caps
- Wooden stakes and spray paint.

- Field Notebook
- Sample bottle labels
- Chain-of-custody forms

6.3 Order of Samples

If both stream sediment and water samples are to be collected concurrently, the water samples should be taken first in order to avoid introducing pollutants in the water column from sediment collection activities.

In flowing streams or runoff channels samples should be collected from the furthest downstream point first. The remaining samples will be taken progressing upstream.

6.4 Sample Collection

6.4.1 Surface Water Samples

Surface water samples are collected in a manner to be representative of the water column from which the samples are taken. A two man team is required for the collection as a safety precaution. The person collecting the samples in most cases will have entered the water body. For flowing streams this will necessitate the donning of boots or waders and wearing latex inner gloves and chemical resistant outer gloves. All samples in flowing water bodies will be taken facing upstream. Samples taken from small lakes or ponds should be taken from a small boat using a Kemmerer or teflon lined Van Dorn bottle. Samples taken from standing puddles, pools, drainage ditches should be taken without disturbing the sediments. This may be accomplished by the use of a remote sampler, e.g. a sample bottle held on along pole with a gimballed yoke.

For pre-preserved sample containers the following procedure will be followed:

o Prior to collecting any water samples place a waterproof sample label on each container which specifies the following:

Sample number
Date
Time
Analysis
Preservative
Project number
Initials of the collector

Fill in the information with a waterproof ink pen. This will prevent difficulty in filling out the labels on a wet jar after it is filled.

o Face upstream, wearing gloves, take a 1 liter glass container with no preservative and submerge it closed to mid-depth.

o Open the jar with the mouth facing upstream; fill it and; close it while submerged.

o Take the filled jar and use it to fill the 40 ml. vials making sure no air is trapped in the vials.

- o Repeat steps 1 and 2 with the same container and fill those containers having preservative avoiding any overflow since this will dilute the preservative.
- o Repeat steps 1 and 2 with the same container and fill the remaining sample containers. The last container filled, will be the original container used to fill the other jars.
- o If dissolved metals analysis are required, an extra bottle (no preservative) will be filled and the metals container (pre-preserved with nitric acid) will remain empty. Only after the water sample is field filtered will it be poured into the pre-preserved metals container.
- o Place all sample containers into a sample shipping container, cool with ice packs and fill in the chain-of-custody form.
- o Detail in the field notebook the following:
  - sample identification number
  - location of the sample (sketch of the sample point)
  - time and date sample was taken
  - personnel performing the task
  - visual or sensory description of the sample (color, odor, turbidity, etc.)
  - weather conditions during sampling
  - runoff conditions
  - other pertinent observations

- o Place a wooden stake at the edge of the stream or near the sample point with sample number on it. The stake may be located by survey for inclusion on a site map.

Note:

- o It is understood that all sample containers and collection devices will be cleaned prior to field use following the appropriate cleaning procedures depending on the type of analysis to be performed.
- o If sampling devices are to be dedicated to a particular sample location, they will be placed in a plastic bag after its use and marked or tagged "DEDICATED TO PROJECT NO. _____ SAMPLE LOCATION NO. ________".

6.4.2 <u>Sediment Samples</u>

Stream sediment samples are collected in a manner to be representative of deposits of sediment carried off of a site. Again the use of protective boots, and gloves will be necessary. All priority pollutant and organic analysis of sediments can be performed on a 1 liter sample. The following procedure will be followed:

- o Select a sample location that is representative of sediment depositional areas. This might mean a sandbar in the middle of a stream, the inside corner of a stream bed in a meander, or a deep pool where water velocities are reduced.

- Place a waterproof sample label on the glass container which specifies the following:

  Sample number
  Date
  Time
  Preservative
  Project number
  Initials of the collector

  Fill in the information with a waterproof ink pen prior to collecting the sample.

- Use either a pre-cleaned dedicated stainless steel spoon or teflon coated spoon, that will fit inside the sample jar, to collect a sample.

- All samples should be taken within the top 3 inches of the stream bed. Remove any vegetation debris (leaves, roots, bark) along with any large stones from the sample so that only the finer soil material is collected.

- Fill out the chain-of-custody form and place the sediment sample into the shipping container. Cool as required.

- Detail in the field notebook the following:

  - sample identification number
  - location of the sample (sketch of the sample point)
  - time and date sample was taken
  - personnel performing the task

  - visual or sensory description of the sample
  - brief sediment descriptions (color, texture, appearance)
  - weather conditions during sampling
  - runoff or flow conditions
  - other pertinent observations

- Place a wooden stake at the edge of the stream or near the sample point with the sample number on it. This stake will be located by survey for inclusing on a site map.

6.4.3 <u>General Site Rules</u>

Surface water and sediment samples, depending on the particular site, can be collected from a variety of locations. Instead of having a procedure for each type of location, the following general rules should be used for any site.

- The sample must be representative of the water body or sediments deposited in an area.
- Avoidance of cross contamination between sampling points can be accomplished by the use of dedicated sampling devices.
- Care must be taken to not disturb the sample location conditions or chemistry, e.g. facing upstream in a river, collecting sediments from areas not stepped on by the collectors.

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Revision No.
Date July 1, 1986

- In lakes or ponds, samples of the water column, at a minimum, will be a composite of surface, mid-depth and bottom (1 foot above floor) samples. Sediments need only be sampled by grab method.
- Only pre-cleaned sampling devices and sample containers are to be used.
- Proper field documentation and chain-of-custody procedures must be followed.

ATLANTIC PROCEDURE NO. 1040-NY

SAMPLE PRESERVATION FOR SOLID AND LIQUID MATRICES FOR PROGRAMS CONDUCTED IN NEW YORK STATE

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: James E. Gould — Engineer
JAMES E. GOULD — TITLE

Approved By: Paul Burgess — Principal
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ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

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TABLE

SECTION 1.0: PURPOSE

To insure a standard procedure for preservation of solid and liquid samples collected at a site for hazardous waste determination.

SECTION 2.0: SCOPE

The following procedure is established to provide a set of standards which follow recommended NYSDEC preservation techniques and holding times for various analytical groups as per the NYSDEC Analytical Services Protocol (ASP) published in 1989.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1020 Field Procedures for Collection of Surface Soil Samples

Atlantic Procedure No. 1021 Field Procedures for Collection of Subsurface Soils

Atlantic Procedure No. 1022 Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination

Atlantic Procedure No. 1023 Field Procedures for Collection of Groundwater Samples for Hazardous Waste Determination

Atlantic Procedure No. 1042 Shipping Procedure for Environmental Field Samples

SECTION 5.0: REQUIRED FORMS

1. Field Notebook No. 351. Published by the J.L. Darling Corp., Tacoma, Washington
2. Master Sample Log

SECTION 6.0: PROCEDURE

6.1 General Procedure

All sample preservations will be performed in the field as soon after sample collection as possible. In many instances sample containers supplied by the analytical laboratory will be pre-preserved so that no additional preservations will be required. In the event preservations are required, Atlantic personnel will use the following format:

1. For those water samples requiring target compound list (TCL), the procedures in Table 6-1 will be followed.

2. All glass or plastic containers must be cleaned prior to sampling according to appropriate cleaning procedures. In no case will sample containers be rinsed with a sample before the actual sample is containerized.

3. In no case shall methylene chloride or acetone be used as a cleaning agent in any glassware or field equipment used on a site investigation. Methylene chloride and acetone are listed wastes and if used, cleaning may cause errors in evaluating field data.

4. All soils samples collected for TCL analysis be placed in a one liter glass jar with teflon lined cap. This jar also must be cleaned prior to sampling according to appropriate cleaning procedure. To avoid losing volatile organics to the head space within a jar, all soil jars will be filled completely. Care must be taken to avoid getting soil on the threads of a sample jar. This can cause a faulty seal.

5. All samples will be held in insulated shipping containers and kept cool to a temperature of 4°C until they are delivered to the analytical laboratory.

6. When samples are preserved in the field, the type of preservation will be listed on the label along with all other appropriate label information. Also the details of each sample will be logged in the Master Sample Log, maintained at the field office.

7. If Atlantic personnel plan to perform field preservations the analytical laboratory must be consulted to verify those particular procedures to be followed. In some instances different laboratories may require more sample volume than those listed or wish no preservative be used.

8. Table 6-1 is taken directly from the NYSDEC ASP. Soils rarely require preservation and the laboratory should always be consulted before collecting soil samples. Occasionally the NYSDEC may update the holding times and this can be found by calling the NYSDEC headquarters in Albany, New York.

9. All field preservations should be performed using proper safety precautions especially when handling acids and caustics. A reference for proper chemical handling techniques is found in <u>Basic Laboratory Skills</u> for Water and Wastewater Analysis by

Douglas W. Clark, New Mexico Water Resources Research Institute, Report No. 125, 1980. Also latex or chemical resistant gloves should be worn during all field preservations. Proper ventilation is necessary when performing preservations in enclosed areas.

6.2 Sample Preservation and Holding Time Requirements

Table 6-1 provides a schedule for sampling, preservation, and holding times for samples being analyzed for convention parameters and target compound list (TCL) parameters.

The laboratory shall adhere to the preservation procedures and holding times listed in Table 6-1 below unless specifically directed otherwise by the Bureau of Technical Services and Research. All holding times are from Verified Time of Sample Receipt (VTSR) at the laboratory.

The laboratory shall provide all necessary preservatives to properly stabilize the samples. The laboratory must adhere to all analytical holding times. Failure to do so will result in the imposition of any contract specified penalties.

TABLE 6-1

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES			
Bacteriological Tests:			
Total Coliform	Sterilized P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	6 hours
Fecal Coliform	Sterilized P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	6 hours
Fecal Streptococci	Sterilized P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	6 hours
Inorganic and Conventionals Tests:			
Acidity	P,G	Cool, 4°C	12 days
Alkalinity	P,G	Cool, 4°C	12 days
Ammonia	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
BOD_5	P,G	Cool, 4°C	24 hours
BOD_{20}	P,G	Cool, 4°C	24 hours
Bromide	P,G	Cool, 4°C	26 days
$CBOD_5$	P,G	Cool, 4°C	24 hours
COD	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Chloride	P,G	Cool, 4°C	26 days
Color	P,G	Cool, 4°C	24 hours
Cyanide, Total	P,G	Cool, 4°C NaOH to pH>12	12 days

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Cyanide, Amenable to Chlorination	P,G	Cool, 4°C NaOH to pH>12, 0.6 g ascorbic acid(5)	12 days(6)
Fluoride	P only	Cool, 4°C	26 days
Hardness	P,G	HNO_3 to pH<2	6 months
Kjeldahl Nitrogen	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Organic Nitrogen	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Metals(7), except Chromium+6 and Mercury	P,G	HNO_3 to pH<2	6 months
Chromium+6	P,G	Cool, 4°C	24 hours
Mercury	P,G	HNO_3 to pH<2	26 days
Nitrate + Nitrite	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Nitrate	P,G	Cool, 4°C	24 hours
Nitrite	P,G	Cool, 4°C	24 hours
Oil and Grease	G only	Cool, 4°C H_2SO_4 to pH<2	26 days
Total Organic Carbon	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Orthophosphate	P,G	Cool, 4°C	24 hours
Total Phenols	G only	Cool, 4°C H_2SO_4 to pH<2	26 days

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Phosphorous, Total	P,G	Cool, 4°C H_2SO_4 to pH<2	26 days
Residue, Total	P,G	Cool, 4°C	5 days
Residue, Filterable	P,G	Cool, 4°C	24 hours
Residue, Non-Filterable	P,G	Cool, 4°C	5 days
Residue, Settleable	P,G	Cool, 4°C	24 hours
Residue, Volatile	P,G	Cool, 4°C	5 days
Silca	P only	Cool, 4°C	26 days
Specific Conductance	P,G	Cool, 4°C	26 days
Sulfate	P,G	Cool, 4°C	26 days
Sulfide	P,G	Cool, 4°C, add zinc acetate plus NaOH to pH>9	5 days
Surfactants (MBAS)	P,G	Cool, 4°C	24 hours
Turbidity	P,G	Cool, 4°C	24 hours
Organic Tests(8):			
Purgeable Halocarbons	G, teflon lined septa	Cool, 4°C	7 days
Purgeable Aromatics	G, teflon lined septa	Cool, 4°C	7 days
Acrolein and Acrylonitrile	G, teflon lined septa	Cool, 4°C, 0.008% $Na_2S_2O_3$(5) adjust to pH 4-5(9)	7 days

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Phenolics(10)	G, teflon lined septa	Cool, 4°C, 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Benzidines(10,11)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction(12)
Phthalate esters(10)	G, teflon lined septa	Cool, 4°C	5 days after VTSR until extraction; 40 days for analysis(12)
Nitrosamines(10,14)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5) Store in dark	5 days after VTSR until extraction; 40 days for analysis(12)
PCBs(10)	G, teflon lined septa	Cool, 4°C	5 days after VTSR until extraction; 40 days for analysis(12)
Nitroaromatics and Isophorone(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5) Store in dark	5 days after VTSR until extraction; 40 days for analysis(12)

TABLE 6-1 (CONTINUED)

REQUIRED CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

PARAMETER NAME	CONTAINER(1)	PRESERVATIVE(2),(3)	MAXIMUM HOLDING TIME(4)
AQUEOUS SAMPLES (continued)			
Polynuclear Aromatic Hydrocarbons(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5) Store in dark	5 days after VTSR until extraction; 40 days for analysis(12)
Haloethers(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Chlorinated Hydrocarbons(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Chlorinated Dioxins and Furans(10)	G, teflon lined septa	Cool, 4°C 0.008% $Na_2S_2O_3$ (5)	5 days after VTSR until extraction; 40 days for analysis(12)
Pesticides(10)	G, teflon lined septa	Cool, 4°C Adjust pH to 5-9(14)	5 days after VTSR until extraction; 40 days for analysis(12)
Radiological Tests:			
Alpha, beta and Radium	P,G	HNO_3 to pH<2	6 months

SOIL/SEDIMENT/SOLID SAMPLES

The same containers and holding times as listed for aqueous samples are to be used for soil/sediment/solid samples. Preservation for all analyses is limited to cooling to 4 C.

Footnotes for Table 6-1

1. Polyethylene (P) or Glass (G).

2. Sample preservation should be performed immediately upon collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

3. When any samples is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For preservation requirements of Table 6-1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric Acid (HCL) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric Acid (HNO_3) in water solutions at concentrations

of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric Acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium Hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the monitoring laboratory has data on file to show that specific types of samples under study are stable for the longer time, and has received written permission prior to analysis form the Regional Administrator under 40 CFR Part 136.3(e) AND from the Bureau of Technical Services and Research. Some samples may not be stable for the maximum time period given in the table. A monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability.

5. Should only be used in the presence of residual chlorine.

6. Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

7. Samples should be filtered immediately onsite before adding preservative for dissolved metals.

8. Guidance applies to samples to be analyzed by GC, LC or GC/MS for specific compounds.

9. The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

10. When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to

4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for five days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzidine).

11. If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement of benzidine.

12. This does not supercede the contract requirement of a 30 day reporting time.

13. Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

14. For the analysis of diphenylnitrosamine, add 0.008% sodium thiosulfate and adjust the pH to 7-10 with NaOH within 24 hours of sampling.

15. The pH adjustment may be preformed upon receipt in the laboratory and may be omitted if the samples are extracted with 72 hours of collection. For the analysis of aldrin, add 0.008% sodium thiosulfate.

Procedure No. 1041
Revision No.
Date July 1, 1986
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SECTION 1.0: PURPOSE

To provide the project manager with a record of the custody of any environmental field sample from time of collection to final analysis. Once a sample has been submitted to the laboratory, internal laboratory chain-of-custody will take over in the form of "Request for Analysis" forms, analytical notebooks, and "Reports of Analysis" forms.

SECTION 2.0: SCOPE

This procedure details how a sample is traced through the Chain-of-Custody-Form.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Technician - Third

SECTION 4.0: SUPPORTING PROCEDURES

None

SECTION 5.0: REQUIRED FORMS

Atlantic Chain-of-Custody Form No. 1041

SECTION 6.0: PROCEDURE

This procedure describes the use of a Chain-of-Custody Form to accompany all sample containers from the time of collection to submission to the analytical laboratory.

For sampling programs where a large number of samples are to collected or where various laboratories will be receiving the samples, a Chain-of-Custody Form is to accompany each group of samples (see attached form). This form presents general sample information in tabular form listing sample number, date and time of sampling, whether the sample was a composite or grab and information regarding the number of containers, size of container and preservative used for each. If for instance a sample consisted of two 40 ml. vials with no preservation and one 500 ml vial preserved with nitric acid, the number of containers box would designate three while the first diagonal box would list 40 ml vial/PRSV.-NONE and the box beneath listing two and the second diagonal box listing 500 ml glass jar/PRSV.-HNO_3 and the box beneath listing one.

The bottom of the form is the chain-of-custody with dates and times of transfer indicated with the appropriate signatures. The sample collector is always the first signature while the analytical laboratory is the final. Theoretically all individuals handling the samples between collection and laboratory should sign the form. However if a common carrier (ie. Federal Express, Purolator) are used for shipping only one signature is required.

This form can be used as a legal document to guarantee samples were not mishandled and that they were delivered to the laboratory within the time frame necessary to start analysis.

On occasion, the analytical laboratory will provide their own Chain-of-Custody form. Usually the same information is included but in a different format from the Atlantic form. Chain-of-Custody forms from the analytical laboratories are acceptable documentation.

Since these forms are basically sample transmittal documents a copy of the form should remain with the sampling personnel. Upon completion of the analysis the laboratory will provide a complete set of all Chain-of-Custody forms for inclusion with analytical reports.

ENVIRONMENTAL SERVICES, INC

[illegible] 41

CHAIN OF CUSTODY FORM

PROJECT NO.:

PROJECT NAME:

SAMPLERS (SIGNATURE):

SAMPLE NO.*	DATE	TIME	COMP	GRAB	NO. OF CONTAINERS	PRSV.	PRSV.	PRSV.	PRSV.	PRSV.	PRSV.	REMARKS

***SOURCE CODES:**	Test Pit Soil...(TP)	Boring Hole Soil...(BH)	Surface Soil...(SS)	Waste...(W)
	Ground Water...(GW)	Surface Water...(SW)	Sediment...(SD)	Waste Water...(WW)

RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE/TIME:	REMARKS:	

Distribution Original accompanies shipment, copy to coordinator field files

ATLANTIC PROCEDURE NO. 1042

SHIPPING PROCEDURES FOR ENVIRONMENTAL FIELD SAMPLES

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
4.				

ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

Procedure No. 1042
Revision No.
Date July 1, 1986
Page 1 of 5

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SECTION 1.0: PURPOSE

To insure a standard procedure for shipment of water, soil and other environmental samples that are controlled by chain-of-custody and strict analytical starting times.

SECTION 2.0: SCOPE

The following procedure is established to avoid mishandling, delays and mislabeling of samples normally collected and shipped from a field site to a designated analytical laboratory.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Technicians - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1040 Sample Preservation for Solid and Liquid Matrices

Atlantic Procedure No. 1041 Sample Chain-Of-Custody Procedure

SECTION 5.0: REQUIRED FORMS

Receipt of Airweigh Bill or Weighbill Forms

Chain-of-Custody Form Standard Form No. 1041

SECTION 6.0: PROCEDURE

6.1 Prior to mobilization to a field site, the field operations manager or his designee will select a shipper based on proximity to the site and ability to ship overnight.

6.2 Upon selection of a shipper the following information will be gathered before any samples are shipped. This can be done over the phone or by correspondence.

1. Location of the shipping depot or local pickup office in case samples are to be delivered directly to the depot by the field team.
2. Name and phone number of a contact at the shipper.
3. Rates of shipping per package size and weight
4. Special instructions as to container sizes and weights.
5. A set of weighbills for the field team.
6. A copy of the shipper's brochure which will provide information on the format for the various types of weigh bills.
7. Times for calling in a pickup from the job site and normal pickup times.

6.3 The Atlantic field manager will give the shipper a street address where samples can be picked up by the courier near the job site.

6.4 Once all samples have been collected, preserved and containerized for shipment, the field supervisor will call the shipper to arrange for pick up.

6.5 All samples, unless so designated for ground transportation, will be shipped by air express for overnight delivery. This is the standard method since samples collected for Method 625 organics have only a 72-hour holding time between collection and the start of analysis.

6.6 The following steps will be followed in the field to prepare the sample shipping containers for pick up.

   1. A standard chain-of-custody form will be filled-out, signed by the courier as a custodian, and placed inside each shipping container before final sealing.
   2. The Atlantic field supervisor or his designee will insure that all weighbills have been filled-in properly for air express. If the contract laboratory is within ground transportation distance for overnight delivery, then the weighbills should reflect guaranteed overnight delivery.
   3. A copy of all weighbills must be kept by the field supervisor and the weighbill number associated with each group of samples logged into the Master Sample Log. The name of courier must be written in this log also in case there is a problem in tracing samples.
   4. If possible, to save shipping fees, the sample shipping containers can be strapped together.

5. An estimated time of delivery for the samples will be logged in the Master Sample Log, (e.g., ETA 12 noon 3/14/83).

6.7 Once the samples have been shipped, the field supervisor will call the analytical laboratory and provide a listing of samples to be delivered, the shipping company's name, and the weighbill numbers. As soon as the samples are delivered, the contract laboratory will inform Atlantic of their arrival and report, any damage associated with the samples or whether any sample containers are missing.

ATLANTIC PROCEDURE NO. 1051

OPERATION AND CALIBRATION OF
THE HNu SYSTEMS PHOTOIONIZER
MODEL PI-101

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
4.				

ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

ATLANTIC PROCEDURE NO. 1041

SAMPLE CHAIN-OF-CUSTODY PROCEDURE

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

REVISIONS

NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED BY
1.				
2.				
3.				
4.				

ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

Procedure No. 1051
Revision No. 1
Date April 21, 1989
Page 1 of 6

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SECTION 1.0: PURPOSE

To insure a standard procedure for the calibration and operation of the HNu Systems Photoionizer Model PI-101.

SECTION 2.0: SCOPE

The following procedure details those steps necessary for the collection and operation in the survey mode of the HNu Photoionizer. A listing of calibration data needed for proper documentation is supplied at the end of this procedure.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

None

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington (or equivalent), or a conventional paper, bound laboratory notebook (Nalge 6301 or equivalent).

SECTION 6.0: PROCEDURE

6.1 General Description

The HNu Photoionizer is a survey tool for determining general levels of organic vapors in air. The instrument is comprised of a readout module which contains all controls and the battery power supply and a photoionizer probe which contains the photo-cell. The readout module also contains terminals for connection to a recorder. This module is carried by a strap held across the shoulder while the probe is held by hand.

6.2 Instrument Startup

First connect the probe unit to the readout module by attaching and turning the connector terminal. Note this fitting is "keyed" and must be attached in only one orientation.

Second turn the main switch to battery. The needle should deflect to the upper end of the green scale. If it doesn't deflect into the green area or is at the low end of the scale, the instrument needs to be charged. A battery charger is located in the instrument cover and it plugs into the side of the readout module. For a full day's operation the battery should be charged overnight.

Third turn on the main switch to any range (ie. 0-2,000 ppm, 0-200 ppm or 0-20 ppm). Look into the probe through the sample tube and observe the violet light of the photo cell. If the light is not on, check the following:

1. Make sure the probe is attached properly to the readout module.
2. An etch mark should be scribed on the probe where it can be unscrewed to replace the photo cell. This mark shows the exact position that the top of the probe takes so that the air inlet ports are lined up. If not lined up,unscrew the probe and assemble it properly.
3. Check the photo cell lamp and replace it if necessary.

Once the battery and photo cell are operating, perform a calibration.

6.3 Calibration

The PI 101 Analyzer is designed for trace gas analysis in ambient air and is calibrated at HNu with certified standards of benzene, vinyl chloride and isobutylene.

Some general points to consider when calibrating the PI 101 are that the analyzer is designed for operation at ambient conditions and therefore the gas standards used for calibration should be delivered to the analyzer at ambient temperatures and pressure and at the proper flow rates. The PI 101 is a non-destructive analyzer; calibrations using toxic or hazardous gases must be done in a well ventilated area.

The frequency of calibration should be twice daily as a minimum. The instrument should be calibrated at the beginning of the day (or when the instrument is first turned on) and at the end of the day (or when use of the instrument is completed). If the instrument is turned off during the day for any significant length of time, it should be calibrated when turned on. An accurate and reliable method of calibration check is to use analyzed gas cylinders of "hydrocarbon-free" air and isobutylene (prepared by HNu).

Step 1. Zero set - Turn the function switch to STANDBY. In this position the lamp is OFF and no signal is generated. Set the zero point with the ZERO set control. The zero can also be set with the function switch on the X1 position and using a "Hydrocarbon-free" air. In this case "negative" readings are possible if the analyzer measures a cleaner sample when in service.

Step 2. 0-20 or 0-200 range - For calibrating on the 0-20 or 0-200 range only one gas standard is required. Turn the function switch to the range position and note the meter reading. Adjust the SPAN control setting as required to read the ppm concentration of the standard. Recheck the zero setting (Step 1). If readjustment is needed, repeat Step 2. This gives a two-point calibration; zero and the gas standard point.

6.4 Documentation

In the field notebook, or in the bound laboratory notebook, at the start of the project (or if there is a change in instruments), record the following:

1. Site name
2. Instrument model and serial number S/N
3. Types of calibration gases
4. Note the size of the photo cell lamp used in the particular probe. This is useful to know which organic compounds the HNu is sensitive toward.

In the field notebook, or in the bound laboratory notebook, at the start of each calibration, record the following:

1. Date
2. Time
3. Name of person performing the calibration
4. Span setting before beginning calibration
5. That the instrument was zeroed, and whether the instrument was on standby or if "hydrocarbon-free" air was used.
6. The new span setting, if necessary, to calibrate instrument reading
7. Repeat Step 5 if span was adjusted during Step 6
8. Note that the second calibration reading was correct

APPENDIX H

LABORATORY ANALYSES

PERFORMED BY:

Wadsworth/Alert Laboratories, Inc.
450 William Pitt Way
Pittsburgh, PA 15238

Thomas Tomayko
Project Manager

John M. Flaherty
Laboratory Manager - Pittsburgh

PROPERTY OF

NEW YORK STATE DEPARTMENT OF HEALTH

DAVID AXELROD, M.D. *COMMISSIONER*

Expires 12:01 AM April 1, 1991
ISSUED September 26, 1990

INTERIM CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

(Issued in accordance with the Laws of New York State)

pursuant to Section 502 of the Public Health Law

Laboratory ID. Number 11182

Director: Mr. John D Flaherty

Laboratory Name: Wadsworth Alert Lab - PA
Number & Street: 450 William Pitt Way
City,State,Zip : Pittsburgh PA 15238

VALID AT THIS ADDRESS ONLY

is hereby APPROVED as an Environmental Laboratory for the category

NON-POTABLE WATER

All approved subcategories and analytes are listed on the attached addendum

Herbert W. Dicke

Herbert W. Dickerman, M.D., Ph.D.
Director
Wadsworth Center for Laboratories and Research

FORM LR 23.F

7445

NEW YORK STATE DEPARTMENT OF HEALTH

DAVID AXELROD, M.D. *COMMISSIONER*

Expires 12:01 AM April 1, 1991
ISSUED September 28, 1990

INTERIM CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

(Issued in accordance with the Laws of New York State)

pursuant to Section 502 of the Public Health Law

Laboratory ID. Number 11182

Director: Mr. John Flaherty

Laboratory Name: Wadsworth Alert Lab PA
Number & Street: 450 William Pitt Way
City,State,Zip : Pittsburgh PA 15238
VALID AT THIS ADDRESS ONLY

is hereby APPROVED as an Environmental Laboratory for the category

ENVIRONMENTAL ANALYSES/SOLID AND HAZARDOUS WASTE

All approved subcategories and/or analytes are listed below:

- Characteristic Testing :
  - Corrosivity
  - Ignitability
  - Toxicity
- Haloethers (ALL)
- Nitroaromatics Isophorone (ALL)
- Phthalate Esters (ALL)
- Purgeable Aromatics (ALL)
- Miscellaneous :
  - Cyanide, Total
  - Hydrogen Ion (pH)
  - Sulfide (as S)
- Metals I (ALL)
- Polynuclear Aromatic Hydrocarbons (ALL)
- Priority Pollutant Phenols (ALL)
- Purgeable Halocarbons (ALL)
- Acrolein and Acrylonitrile (ALL)
- Chlorophenoxy Acid Pesticides (ALL)
- Chlorinated Hydrocarbon Pesticides (ALL)
- Chlorinated Hydrocarbons (ALL)
- Metals II (ALL)
- Polychlorinated Biphenyls (ALL)

Herbert W. Dicke

Herbert W. Dickerman, M.D., Ph.D.
Director
Wadsworth Center for Laboratories and Research

FORM LR 23.F

The following list correlates Atlantic Environmental Services, Inc. sample identification number with NYSEG's Manufactured Gas Plant Sampling Identification Protocol.

SAMPLE IDENTIFICATION

Atlantic Codes	NYSEG Codes
CGAC-SW1	ACCUSS9001G
CGAC-SW2	ACCISS9002G
CGAC-SW3	ACCDSS9003G
CGAC-SE1	ACTUSF9001G
CGAC-SE2	ACTISF9002G
CGAC-SE3	ACTDSF9003G
CGAC-SS1	ACEISF9001L
CGAC-SS2	ACEISF9002L
CGAC-SS3	ACEISF9003L
CGAC-SS4	ACEISF9004L
CGAC-SS5	ACEISF9005L

ANALYTICAL RESULTS - AUBURN/CLARK STREET
NOVEMBER 27 AND 28, 1990

	SURFACE WATER					SEDIMENT				SURFACE SOIL					
	CGAC–SW1	CGAC–SW2	CGAC–SW3	FIELD BLANK	TRIP BLANK	CGAC–SE1	CGAC–SE2	CGAC–SE3	FIELD BLANK	CGAC–SS1	CGAC–SS2	CGAC–SS3	CGAC–SS4	CGAC–SS5	FIELD BLANK
VOLATILE ORGANICS (CAS NO.)															
Acetone (67–64–1)	<50	<50	<50	—	<50	<110	<8700	<82	—	<96	<78	<78	<6800	<7600	—
Benzene (71–43–2)	<5	<5	<5	—	<5	<11	1000	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Bromodichloromethane (75–27–4)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Bromoform (75–25–2)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Bromomethane (74–95–3)	<10	<10	<10	—	<10	<22	<1700	<16	—	<19	<15	<15	<1400	<1500	—
2–Butanone (78–93–3)	<50	<50	<50	—	<50	<110	<8700	<82	—	<96	<78	<78	<6800	<7600	—
Carbon disulfide (75–15–0)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Carbon tetrachloride (56–23–5)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Chlorobenzene (108–90–7)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Chloroethane (75–00–3)	<10	<10	<10	—	<10	<22	<1700	<16	—	<19	<15	<15	<1400	<1500	—
Chloroform (67–66–3)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Chloromethane (74–87–3)	<10	<10	<10	—	<10	<22	<1700	<16	—	<19	<15	<15	<1400	<1500	—
Dibromochloromethane (124–48–1)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,1–Dichloroethane (75–34–3)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,2–Dichloroethane (107–06–2)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,1–Dichloroethene (75–35–4)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,2–Dichloroethene (Total) (540–59–0)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,2–Dichloropropane (78–87–5)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
cis–1,3–Dichloropropene	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
trans–1,3–Dichloropropene	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Ethylbenzene (100–41–4)	<5	<5	<5	—	<5	<11	1400	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
2–Hexanone (591–78–6)	<50	<50	<50	—	<50	<110	<8700	<82	—	<96	<78	<78	<6800	<7600	—
Methylene chloride (75–09–2)	<10	<10	<10	—	<10	<22	<1700	<16	—	<19	<15	<15	<1400	<1500	—
4–Methyl–2–pentanone (108–10–1)	<50	<50	<50	—	<50	<110	<8700	<82	—	<96	<78	<78	<6800	<7600	—
Styrene (100–42–5)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,1,2,2–Tetrachloroethane (79–34–5)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Tetrachloroethene	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Toluene (108–88–3)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	570J	700J	—
1,1,1–Trichloroethane (71–55–6)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
1,1,2–Trichloroethane (79–00–5)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Trichloroethene (79–01–6)	<5	<5	<5	—	<5	<11	<870	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
Vinyl acetate (108–05–4)	<50	<50	<50	—	<50	<110	<8700	<82	—	<96	<78	<78	<6800	<7600	—
Vinyl chloride (75–01–4)	<10	<10	<10	—	<10	<22	<1700	<16	—	<19	<15	<15	<1400	<1500	—
Total xylenes (1330–20–7)	<5	<5	<5	—	<5	<11	1100	<8.2	—	<9.6	<7.8	<7.8	<680	<760	—
SEMI–VOLATILE ORGANICS															
Acenaphthene (83–32–9)	<10	<10	<10	<10	—	<190J	<4600	<880	<10	<1000	2600J	3900J	<1400	<820	<10
Acenaphthylene	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	1500J	630J	<1400	<820	<10
Anthracene (120–12–7)	<10	<10	<10	<10	—	550J	2100J	510J	<10	<1000	6900	12000	<1400	300J	<10
Benzo(a)anthracene	<10	<10	<10	<10	—	2200	7100	1600	<10	<1000	23000	30000	<1400	1200	<10

ANALYTICAL RESULTS - AUBURN/CLARK STREET
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	SURFACE WATER					SEDIMENT				SURFACE SOIL					
	CGAC-SW1	CGAC-SW2	CGAC-SW3	FIELD BLANK	TRIP BLANK	CGAC-SE1	CGAC-SE2	CGAC-SE3	FIELD BLANK	CGAC-SS1	CGAC-SS2	CGAC-SS3	CGAC-SS4	CGAC-SS5	FIELD BLANK
Benzo(b)fluoranthene (205-99-2)	<10	<10	<10	<10	—	2900	830J	1700	<10	450J	3500J	29000	2500	1700	<10
Benzo(k)fluoranthene (207-08-9)	<10	<10	<10	<10	—	1200	<4600	660J	<10	190J	46000	13000	<1400	<600J	<10
Benzo(ghi)perylene	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Benzo(a)pyrene (50-32-8)	<10	<10	<10	<10	—	2100	4200J	840J	<10	250J	20000	4100	1800	1100J	<10
Benzyl alcohol (100-51-6)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Bis(2-chloroethoxy)methane	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Bis(2-chloroethyl)ether (111-44-4)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Bis(2-chloroisopropyl)ether	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Bis(2-ethylhexyl)phthalate (117-81-7)	<10	<10	<10	<10	—	790J	2100J	290J	2J	<1000	<4100	<4100	<1400	230J	<10
4-Bromophenyl phenyl ether	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Butyl benzyl phthalate (85-68-7)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
4-Chloroaniline (106-47-8)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
2-Chloronaphthalene (91-58-7)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
4-Chlorophenyl phenyl ether	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Chrysene (218-01-9)	<10	<10	<10	<10	—	2400	6900	1600	<10	380J	24000	28000	2400	1300	<10
Dibenzo(a,h)anthracene (53-70-3)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Dibenzofuran	<10	<10	<10	<10	—	160J	<4600	<880	<10	<1000	1500J	2100J	<1400	<820	<10
Di-n-butyl phthalate (84-74-2)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
1,2-Dichlorobenzene (95-50-1)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
1,3-Dichlorobenzene (541-73-1)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
1,4-Dichlorobenzene (106-46-7)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
3,3'-Dichlorobenzidine (91-94-1)	<50	<50	<50	<50	—	<5800	<23000	<4400	<50	<5200	<21000	<21000	<7100	<4100	<50
Diethyl phthalate (84-66-2)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Dimethyl phthalate (131-11-3)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
2,4-Dinitrotoluene	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
2,6-Dinitrotoluene (606-20-2)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Di-n-octyl phthalate (117-84-0)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Fluoranthene (206-44-0)	<10	<10	<10	<10	—	5500	17000	3700	<10	630J	40000	68000	3800	2400	<10
Fluorene (86-73-7)	<10	<10	<10	<10	—	220J	790J	170J	<10	<1000	2500J	4300	160J	<820	<10
Hexachlorobenzene (118-74-1)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Hexachlorobutadiene (87-68-3)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Hexachlorocyclopentadiene (77-47-4)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Hexachloroethane (67-72-1)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
Indeno(1,2,3-cd)pyrene (193-39-5)	<10	<10	<10	<10	—	670J	2200J	450J	<10	150J	8400	6100	910J	500J	<10
Isophorone (78-59-1)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
2-Methylnaphthalene	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	410J	500J	<1400	<820	<10
Naphthalene (91-20-3)	<10	<10	<10	<10	—	170J	4900	<880	<10	<1000	2000J	1500J	<1400	86J	<10
Nitrobenzene (98-95-3)	<10	<10	<10	<10	—	<1200	<4600	<880	<10	<1000	<4100	<4100	<1400	<820	<10
2-Nitroaniline (88-74-4)	<50	<50	<50	<50	—	<5800	<23000	<4400	<50	<5200	<21000	<21000	<7100	<4100	<50
3-Nitroaniline (99-09-2)	<50	<50	<50	<50	—	<5800	<23000	<4400	<50	<5200	<21000	<21000	<7100	<4100	<50

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	SURFACE WATER					SEDIMENT				SURFACE SOIL					
	CGAC–SW1	CGAC–SW2	CGAC–SW3	FIELD BLANK	TRIP BLANK	CGAC–SE1	CGAC–SE2	CGAC–SE3	FIELD BLANK	CGAC–SS1	CGAC–SS2	CGAC–SS3	CGAC–SS4	CGAC–SS5	FIELD BLANK
Antimony (7440-36-0)	<60	<60	<60	—	—	<10	<8.3	9.7	—	<9.3	<7.5	<7.5	<13	<7.3	—
Selenium (7782-49-2)	<5	<5	<5	—	—	<4.2	<3.5	<3.1	—	<3.8	<3.1	<3	<2.6	<3	—
Thallium (7440-28-0)	<10	<10	<10	—	—	<1.7	<1.4	<1.2	—	<1.5	<1.3	<1.2	<1.1	<1.2	—
Vanadium (7440-62-2)	<50	<50	<50	—	—	16	11	16	—	15	13	14	12	11	—
Zinc (7440-66-6)	94	<20	<20	—	—	120	190	200	—	100	250	140	58	130	—
CYANIDE	<0.01	<0.01	<0.01	—	—	<0.84	6.8	<0.65	—	<0.76	9.7	3.2	<0.52	<0.6	—
PCBs															
1016	—	—	—	—	—	—	—	—	—	<260	<210	<210	<180	<210	—
1221	—	—	—	—	—	—	—	—	—	<260	<210	<210	<180	<210	—
1232	—	—	—	—	—	—	—	—	—	<260	<210	<210	<180	<210	—
1242	—	—	—	—	—	—	—	—	—	<260	<210	<210	<180	<210	—
1248	—	—	—	—	—	—	—	—	—	<260	<210	<210	<180	<210	—
1254	—	—	—	—	—	—	—	—	—	<510	<410	<410	<360	<400	—
1260	—	—	—	—	—	—	—	—	—	<510	<410	<410	<360	<400	—

All concentrations in ppb. Metals and cyanide concentrations in ppm, except surface water metals in ppb.
< None detected, lower detectable limit.
— Not analyzed.
J – Detected, but below quantification limit; estimated value.
Shaded region indicates detected concentration.
Laboratory: Wadsworth/Alert Laboratories, Inc.
Sample locations shown on Figure 5.

PLATE 1