PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
187 FALL STREET
SENECA FALLS, NEW YORK

by

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for

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1. INTRODUCTION

1.1 General

New York State Electric & Gas Corporation (NYSEG) retained Haley & Aldrich of New York (Haley & Aldrich) to prepare this Preliminary Site Assessment (PSA) Work Plan (Work Plan) for conducting field investigations at the former manufactured gas plant (MGP) located 187 Fall Street, Seneca Falls, New York. The former MGP was operated by the Seneca Falls & Waterloo Gas Light Co., which was a predecessor company to NYSEG. The former MGP Site is currently referred to as the Seneca Falls Former MGP Site (Site). The 187 Fall Street parcel is currently owned by NYSEG and leased to Pick-A-Flick Video. The parcel has had various property owners and uses since the MGP ceased operation in the early 1900's. The Work Plan was prepared in accordance with the requirements of a Multi-Site Consent Order (Index # D0-0002-9309, 1994 March 30) between NYSEG and the New York State Department of Environmental Conservation (NYSDEC).

1.2 Objectives, Scope, and Rationale

The investigation activities outlined in the Work Plan will provide data to address the following objectives:

- Determine if MGP-related and/or non-MGP-related chemical constituents are present in soil and/or groundwater at the Site;
- Identify the potential presence of MGP-related residuals (e.g., coal tar, non-aqueous phase liquid [NAPL], purifier wastes) and/or non-MGP-related residuals, (e.g., petroleum, solvents) in soil and/or groundwater at the Site;
- Evaluate, to the extent practicable, whether groundwater flow may be a pathway for offsite migration of identified chemical constituents (if present);
- Determine compliance with applicable NYSDEC standards, criteria, and guidance values (SCGs); and
- Provide sufficient data to develop an initial conceptual site model and evaluate the necessity for further action.

The scope of the Work Plan includes sampling surface soil, subsurface soil and groundwater media for the purpose of characterizing current Site conditions and determining the presence and general extent of potential MGP-derived waste. The rationales for the soil and groundwater sampling locations are summarized on Tables I through IV. The possible need for investigation of other media (e.g., surface water, sediment, and soil gas/indoor air) will be made by NYSEG after evaluation of the soil and groundwater results and in consultation with the NYSDEC.

1.3 Work Plan Organization

Following this introductory section, the Work Plan is organized as follows:

- Section 2 provides a summary of the Site setting, land-use history, geology, and hydrogeology;
- Section 3 describes the field activities to be conducted;
- Section 4 presents a Contingency Plan that describes detailed procedures to be followed during drilling to limit the potential for remobilization and downward migration of dense, non-aqueous phase liquid (DNAPL), if encountered;
- Section 5 presents a conceptual target duration schedule for completing the field investigation activities and submitting the PSA Report (Report);
- Section 6 provides an outline of the Report that will be prepared to summarize the investigation activities and results;
- Section 7 presents references that were used to develop the Work Plan;
- Appendix A – Aerial photographs that show the Site and the adjacent area;

- Appendix B – Historical documentation used to develop the Work Plan;
- Appendix C – Historic Site Analytical Data presents the results of analytical testing conducted for previous investigations at the Site.
- Appendix D – Field Sampling Plan (FSP) presents detailed field procedures and protocols that will be followed during the field activities;
- Appendix E – Quality Assurance Project Plan (QAPP) presents the analytical methods and procedures that will be used to analyze soil and groundwater samples collected during the field activities;
- Appendix F – Community Air Monitoring Plan (CAMP) presents air monitoring and response efforts to detect and mitigate potential airborne releases of constituents of concern during the field activities;
- Appendix G – Health and Safety Plan (HASP) presents health and safety measures to be implemented during site work.

2. SITE DESCRIPTION AND HISTORY

2.1 General

This section presents a description of the Site setting, land-use history, current Site conditions, and the geology and hydrogeology in the vicinity of the Site based on existing information. This includes the observations made during a Site reconnaissance performed on 15 June 2007 and a regulatory database search. These findings were factored into the development of the scope for the Work Plan investigation provided in Section 3.

2.2 Site Setting

The footprint of the Seneca Falls former MGP Site is located at 187 Fall Street, Seneca Falls, Seneca County, New York. As shown on Figure 1, the Site is located adjacent to the Seneca River and Canal, which flows east towards Cayuga Lake. The Site consists of an approximately 1.2 acre parcel currently owned by NYSEG and located in a mixed residential/commercial area. The Site is bordered by Fall Street to the north, residential properties to the east, a Sunoco gasoline filling station to the west, and the Seneca River and Canal to the south. The layout of the Site and surrounding properties is shown in Figure 2. 1990, 1985, and 1959 aerial photographs of the Site and surrounding areas are presented in Appendix A. The parcel located at 187 Fall Street is physically defined by upland and lowland areas separated by a steep slope running east-west, located in the approximate center of the parcel. The upland area of the parcel is consists of building currently occupied by Pick-a-Flick Video, a movie rental and cosmetic tanning business, and a paved parking lot located immediately west of the building. The upland area is generally flat with an elevation of approximately 456 ft above sea level, steeply sloping south to the lowland area of the Site. The steep slope and lowland portions of the parcel are heavily vegetated. The lowland area of the Site gently slopes south to the Seneca River and Canal, with elevations from approximately 430 ft to 433 ft above sea level. Surface drainage (at a macro scale) is believed to be to the south toward the Seneca River and Canal. There is a catch basin present on the upland portion of the Site that appears to drain to a storm line along Fall Street.

2.3 Site History

This section discusses the historical use of the Site and adjacent properties, with emphasis on the former MGP operations. The information reviewed to produce this summary included:

- Atlantic Environmental Services, Inc. "Manufactured Gas Plant Site Screening Report, Seneca Falls" (September 1991);
- Sanborn fire insurance maps (dated 1886, 1892, 1897, 1899, 1904, 1911, 1916, 1925, 1944, and 1951);
- Historical topographic maps (dated 1902, 1953, and 1978); and
- Aerial photographs (dated 1959, 1985, and 1990).

Historical information was also collected from the Seneca County Clerk, Planning Department, and Tax Collector, Seneca Falls Historical Society, and Seneca Falls Library.

2.3.1 Historical Overview

The Seneca Falls MGP is believed to have begun operations in 1856, producing manufactured gas using coal carbonization processes until plant closure circa 1903. A narrative history of Seneca County indicates in 1871 the gas plant included twenty (20) retorts, four (4) purifiers and a large condenser (Atlantic Environmental Services, 1991). The gas holder at the Site had a capacity of 25,000 cubic feet (cf). Annual gas production was 8,000,000 cf in 1889 and 7,000,000 cf in 1899 (Atlantic Environmental Services, 1991). The 1904 Sanborn Map indicates that the plant is no longer in operation, suggesting that the Seneca Falls MGP ceased operations between 1899 and 1904. Based on review of the Sanborn fire insurance maps, demolition of the retorts and gas fitter occurred between 1911 and 1916. The remainder of the gas plant was demolished between 1925 and 1944. Historical operation features of the

Seneca Falls MGP are shown on Figure 2. The former MGP operational features include: one gas holder, two coal sheds, retorts, purifier house and lime house, engine room, meter room, and gas fitter, as shown on the 1899 and 1904 Sanborn maps.

Key non-MGP features include: the Seneca River and Canal; lumberyards located east and south of the Site (1886 Sanborn) and west of the Site (1892 Sanborn); a currently operating gas station west of the Site; and various manufacturing facilities in the area, including north of the Site.

2.3.2 Historical Timeline

The Sanborn Maps, aerial photographs, and historical information collected from the Seneca County Clerk and Tax Collector, provide information on changes to the former MGP property and adjacent properties over time.

- 1856, Seneca Falls & Waterloo Gas Light Company was organized. Seneca Falls MGP plant built and began operation.
- 1886 – 1899, Scallard Lumber Company yard operations east of the Site and on the lowland area of the Site.
- 1886 – 1944, F. Maier's Lumber and Coal Yard operations west of the Site.
- 1886 – 1892, Seneca Falls & Waterloo Gas Light Company operates a large coal shed (approximately the size of both coal sheds onsite) on the southeast portion of the F. Maier property.
- 1899 – 1904, Residential properties built adjacent to and east of the Site.
- 1904, Seneca Falls MGP plant no longer in operation. Lumber yard operations west of the Site.
- 1911, Seneca Falls & Waterloo Gas Light Company acquired by Inter-Urban Gas Company.
- 1911, Inter-Urban Gas Company acquired by Empire Gas & Electric Company.
- 1911 – 1916, Demolition of the retorts.
- 1925 – 1944, Remainder of the Seneca Falls MGP plant demolished.
- 1936, Empire Gas & Electric Company acquired by New York State Gas and Electric Company.
- 1944 – 1959, Building constructed on the upland area of former MGP Site (existing onsite building).
- 1936 – 1953, Between this time, Site property ownership transferred to Howard Conkey.
- 1953, Site property ownership transferred to Jarvee Corporation.
- 1965, Site property ownership transferred to Eber Reality.
- 1974, Site property ownership transferred to Rochester Gas & Electric Corporation (a subsidiary of Energy East Corporation).

2.3.3 Previous Investigations

The Site was initially screened in 1991 by Atlantic Environmental Services, Inc. (AES). The 1991 "Site Screening Report" consisted of a Site reconnaissance, collection of three (3) surface soil samples from the lowland area of the Site, three (3) sediment samples from the Seneca River and Canal adjacent to the Site, and three (3) surface water samples from the Seneca River and Canal adjacent to the Site. Figure 2 shows the approximate locations of surface soil, sediment, and surface water samples collected by AES. Samples were analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), metals, and cyanide. Tables summarizing historic analytical data are summarized in Appendix C. The intent of the screening was to determine if there was any imminent threat to human health or the environment at the Site.

Surface soil samples were collected from intervals of 0 ft to 0.5 ft below ground surface. VOCs were not detected in any of the surface soil samples. SVOCs were detected in all three samples, with SVOC totals ranging from 186 ppm to 274.4 ppm. Arsenic, calcium, mercury, nickel, and selenium were detected at generally low levels, some exceeding New York State Department of Environmental Conservation (NYSDEC) Recommended Soil Cleanup Objectives (NYSDEC, 1994). Cyanide was detected at sample locations SS-2 and SS-3 at concentrations 3.80 ppm and 6.60 ppm, respectively.

Sediment samples were collected from the Seneca River and Canal at three locations: approximately 250 ft upstream of the Site, adjacent to the west portion of the Site, and adjacent to the east portion of the Site, as shown on Figure 2. VOCs were not detected in sediment samples collected by AES. Total SVOCs of 34.18 ppm were detected at the upgradient sampling location. Total SVOCs at the west location adjacent to the Site were 63.33 ppm, and 260.2 ppm at the east location adjacent to the Site. Antimony, arsenic, calcium, copper, lean, manganese, mercury, and nickel were detected at similar levels at the sediment sampling locations.

Three (3) surface water samples were collected from the Seneca River and Canal at locations corresponding to sediment sample locations. VOCs and SVOCs were not detected in surface water samples. Cyanide was detected at 0.27 ppm in a surface water sample collected adjacent to the Site (New York State Ambient Water Quality Standard for cyanide in Class C surface waters is 0.0052 ppm). Calcium, magnesium, and sodium were detected in surface water samples below water quality standards.

On 26 November 2002, NYSEG conducted limited surface soil analytical sampling on the residential property, 185 Fall Street, adjacent to the Site. Samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), Target Analyte List (TAL) Metals, total cyanide and cyanide amenable to chlorination, and total recoverable phenolics. Analytical results are presented in Appendix C. BTEX constituents were not detected at any location. PAH compounds were detected all three locations at total PAH concentrations ranging from 0.389 ppm to 145.88 ppm. Metals were also detected, with arsenic, beryllium, chromium, copper, and iron exceeding NYSDEC Recommended Soil Cleanup Objectives at all three sample locations. In response, NYSEG completed an Interim Remedial Measure (IRM) consisting of the application of clean backfill across the backyard portion of the 185 Fall Street property.

2.4 Current Conditions

2.4.1 2007 Site Reconnaissance

At NYSEG’s request, Haley & Aldrich conducted a Site reconnaissance on 15 June 2007.

The Site’s current use is commercial, and the upland area of the parcel is occupied by a 1-story building currently leased by NYSEG to Pick-A-Flick Video, a movie rental and cosmetic tanning business. The interior of the building was accessed to observe general conditions, with particular focus on floor slab conditions and presence of floor drains. One (1) floor drain was observed in the center rear (south) of the building and the drain was plugged with concrete to grade. Cracks (up to ¼-in. wide) in the concrete floor slab were observed in areas of the rear portion of the building where flooring material was not present. The floor in the front half of the building is carpeted. MGP-type odors were not observed in the building. Based on exterior observations of the building foundation, it appears that the building foundation construction is concrete slab-on-grade.

An asphalt parking area occupies the northwestern portion of the property, accessed from Fall Street via a wide entry way. Overhead utility lines run from south side of Fall Street to a utility pole in the southwest corner of the parking area, then connecting to the onsite building. A catch basin is located in the north center of the parking lot with the sub-grade drain line exiting the northern side of the catch basin, presumably draining towards Fall Street. No settling was observed in the vicinity of the former MGP structures, and the asphalt generally appeared to be in good condition. The south end of the parking area is bounded by a steel guard rail. The sloped area between the upland and lowland portions of the Site is steep, heavily vegetated, and loose fill and debris was observed. The lowland area of the Site is relatively flat and also heavily vegetated.

The Site is bounded on the south by the Seneca River and Canal. On 15 June 2007, the canal was observed to be stagnant; the water was green-brown in color and significant algae growth appeared to be present. A sewage odor was noted.

Ash- and clinker-like materials were observed at the ground surface in the backyard of the 185 Fall Street property. Ash- and clinker-like materials were also observed in surface soils at the base of two (2) trees in the west portion of the backyard of the 181 Fall Street property. Both of these properties backyards have maintained grass lawns with some trees. The grass in the backyard of 185 Fall Street was observed to be thin in some areas. At the time of the Site visit, it did not appear that vegetable gardening occurs in either backyard, nor were bare spots present that typically result from heavy use by the residents.

2.4.2 Environmental Database Research

Haley & Aldrich requested a regulatory database search from Environmental Data Resources, Inc. (EDR). Based on the database query, one environmentally impacted site was identified within ¼ mile or less from the Site. The Goulds Pumps Facility, located at 240 Fall Street, is believed to be hydraulically upgradient relative to the Site. Several areas within the Goulds Pumps Facility have been investigated; in some areas investigation is ongoing, and some areas have achieved closure. VOCs, SVOCs, and PCBs are the constituents of concern.

The ERD report also identified one (1) water well listed in the Federal Public Water Supply (PWS) Information Database, one water well listed in the state well information database, and two (2) water wells listed in the Federal USGS Well Information database. Well NY0022633 is located ½ mile east (presumed cross-gradient) of the Site and has been deactivated (the deactivation date and construction data is not reported). Well USGS2202804 is located approximately ¾ mile west (presumed cross-gradient) of the Site, and a 1 January 1947 depth to groundwater was reported 50 ft below surface (well depth and construction data not reported). Well USGS2202792 is located approximately 1 mile west (presumed cross-gradient) of the Site, and depth to groundwater was reported 20 ft below surface on 1 January 1947. Well NYWS0014329 is located 1 mile southwest (presumed down-gradient) of the Site, and no data regarding well depth, construction data, or depth to groundwater are reported. The Village of Seneca Falls is serviced with municipal water from Cayuga Lake. Four (4) oil/gas wells within 1 mile north, north-east, and south-east of the Site are listed in the state Oil/Gas well information database (NYO1031887, NYO1031784, NYO1031718, and NYO1031592). Oil/gas well geologic and construction details are not available.

The Site is bordered on the west by a Sunoco gasoline filling station. Monitoring wells were observed in the gas station parking lot and filling areas. Underground storage tank fill pipes were observed south and southwest of the gas station building. According the NYSDEC Spill Incidents Database, multiple spills have occurred at the gas station west of the Site, including:

- The first spill, consisting of waste oil/used oil occurred 10 August, 1989 and was closed the same day (NYSDEC Spill # 8904698). A contractor removing a 550 gal waste oil underground storage tank (UST) observed contaminated soil around the tank fill port and reported the spill to the NYSDEC.

- A gasoline spill occurred on 24 April 1992 and was closed the following day (NYSDEC Spill # 9200996). The gas station attendant noticed a puddle of gasoline on the ground near the pump from an apparent customer overfill. The spill was cleaned by the Seneca Falls Fire Department.
- On 4 June 1993 a release of gasoline and MBTE occurred. This spill, NYSDEC Spill # 9303031, is still active. No further details regarding the spill are available at this time.
- A diesel spill occurred 11 January 1996 and was closed on 26 April 2001 (NYSDEC Spill # 9512705). An unknown truck pulled into the gas station with a likely leaking line or tank. Diesel was spilled across the asphalt surface of the station. The spill was cleaned by the Seneca Falls Fire Department.
- NYSDEC Spill # 0400452 occurred on 14 April 2004. The gasoline spill was closed the same day it was reported. A customer spilled approximately 12 gal of gasoline on the asphalt at the gas station. The still was contained and cleaned by the Seneca Falls Fire Department.

2.5 Geology/Hydrogeology

Based on review of existing literature and resources (see References), a description of the inferred geologic and hydrogeologic setting at the Site is provided below.

2.5.1 Geologic Setting

Seneca County, bounded on the east and west by Cayuga and Seneca Lakes, straddles two major physiographic provinces, the Ontario Lowlands to the north and the Allegheny Plateau to the south. The boundary between the two provinces lies roughly along the line of the Seneca River and Canal. The Ontario Lowlands is characterized by generally low relief and productive farmlands. The Allegheny Plateau is relatively high and rugged. The bedrock beneath the northern portion of Seneca Falls and in the vicinity of the Site is the Late Silurian Salina Group consisting of the Akron, Bertie, and Syracuse Dolostones and the Camillus, Syracuse, and Vernon Shales. The Salina Group is replaced southwardly in the Allegheny Plateau by the Middle Devonian Onondaga Formation consisting of the Onondaga Limestone (Fisher, D.W., et al., 1970). The contact between the Salina Group and Onondaga Formation is mapped in the approximate center of Seneca Falls along the Seneca River and Canal.

The Seneca River and Canal flows through the Clyde/Seneca River and Canal Trough, a belt of lowlands running west-to-east. The trough was carved from soft shales of the Salina Group during and after the Wisconsin ice sheet, ending approximately 14,000 years ago. The Clyde and Seneca Rivers Trough is bounded by the Onondaga limestone ridge. The trough was subsequently filled with unconsolidated material during glacial retreat. (USGS, 2002)

The soil at the Site consists of lacustrine clay and silt with little to no gravel, from the Schoharie Association (USDA, 1988). These soils are moderately well drained and are pinkish to reddish-brown in color. Overburden thickness is variable.

2.5.2 Hydrogeologic Setting

Seneca Falls and the Seneca River and Canal are located within the Oswego River Basin. Water flows from upland streams to the Finger Lakes, to low-gradient rivers including the Seneca River and Canal, and ultimately to Lake Ontario (USGS, 2002). The average depth to groundwater in the area is approximately three feet or greater (USDA Soil Conservation Service, 1988). Based on Site topography, shallow groundwater likely flows south beneath the Site towards the Seneca River and Canal.

3. FIELD ACTIVITIES

This section describes the field activities to be conducted during the PSA. The following activities will be conducted to evaluate environmental conditions at the Site and the surrounding area:

- Mobilize to the Site and conduct a utility markout to verify existing Site conditions and label and/or stake the proposed sample locations;
- Conduct a soil investigation, including the completion of test pits and soil borings, and the collection of surface and subsurface soil samples for chemical analyses; and,
- Conduct a groundwater investigation, including the installation of groundwater monitoring wells, the collection of groundwater samples for chemical analyses, characterization of groundwater flow, and monitoring for the potential presence (and characterization) of NAPL.

A detailed description of the work plan field activities is presented below.

3.1 Mobilization and Utility Markout

Field personnel will mobilize to the Site to stake (with flagging and paint) the proposed sample locations. Once the sample locations are marked, Dig Safely New York will be contacted to mark underground utilities. If necessary, the Site property owners, adjacent property owners, and/or private vendors will be contacted for assistance with markout of utilities. Once the utilities are marked, field equipment and personnel will be mobilized to the Site.

3.2 Soil Investigation

The objectives for the soil investigation and the general procedures for obtaining and analyzing soil samples are detailed below. The actual number and location of soil samples collected may vary based on consideration of conditions encountered in the field and consultation with NYSEG and NYSDEC.

3.2.1 Soil Investigation Objectives

The objectives of the soil investigation are to:

- Determine if MGP-related and/or non-MGP-related by-product residuals are present in the soil at the Site and some proximate offsite properties.
- Determine the potential presence of NAPL in subsurface materials, and, if present, quantify relevant physical properties of the NAPL.
- Determine compliance with applicable NYSDEC standards, criteria, and guidance values.
- Obtain sufficient information to develop an initial conceptual site model in order to evaluate the necessity for further action.

3.2.2 Surface Soil Sampling

Surface soil samples will be collected for chemical analysis from six (6) locations, as shown on Figure 2. It is expected that one surface soil sample will be collected from residential properties 181 and 185 Fall Street, and four (4) surface soil samples will be collected from the lowland area of the Site. Surface soil samples will be analyzed for Target Compound List (TCL) SVOCs and TAL Metals (including cyanide). The proposed surface soil sample locations and the soil sampling rationales are summarized on Table I.

Surface soil samples will be collected with a stainless steel trowel or sampling spoon. The sod layer will be neatly removed and soil will be collected from an interval of 0 in. to 2 in. Soil will be visually characterized for color, texture, and moisture content. The presence of staining, odors, and photoionization detector (PID) headspace will be noted. Surface soil sampling methods are described in the FSP (Appendix D).

Air emissions in the worker breathing zone during implementation of the field work activities will be monitored using a photoionization detector (PID) and a Real-Time Aerosol Monitor (mini-RAM).

3.2.3 Test Pits

Approximately ten (10) test pits will be excavated at the target locations, as shown on Figure 2. It is expected that a minimum of two (2) subsurface soil samples may be collected from each test pit. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, and TAL Metals (including cyanide). The proposed test pit locations and the soil sampling rationales are summarized on Table II.

Test pits will be excavated with either a rubber-tire or track excavator. Excavated soil will be temporarily staged on plastic sheeting next to the test pit locations. Soil will be visually characterized for color, texture and moisture content. The presence of visible staining, NAPL (if encountered), odors, and PID headspace will be noted. In general, each test pit will be excavated to the top of bedrock, to the water table surface, or to the base foundation of historic structures.

Generally, soil samples will be selected for chemical analysis based on visual observations (e.g., staining) and/or the sample interval with the highest PID reading. If no staining or elevated PID readings are encountered, the sample interval immediately above the groundwater table will be selected for chemical analysis. Samples may also be collected from intervals below potential impacted soil to aid in vertical delineation. Soil sampling methods are described in the FSP.

Soils removed from the test pits will be returned to the test pits in generally the reverse order from which it was removed (i.e. the last soil removed will be the first soil replaced such that the soil stratigraphy remains generally unchanged). Tarry or grossly contaminated soil will be separated from other soils and containerized for offsite disposal with other investigation derived waste.

Air emissions in the worker breathing zone during implementation of the field work activities will be monitored using a PID and a mini-RAM. The need for additional perimeter monitoring of air emissions at the boundary of the work area during the investigation is detailed in the CAMP presented as Appendix F.

3.2.4 Soil Borings

3.2.4.1 Direct Push Borings

Shallow-subsurface soil borings will be completed with a direct push unit in several target areas, as shown on Figure 2. It is expected that a maximum of twelve (12) subsurface soil samples may be collected for chemical analysis from the two residential properties 181 and 185 Fall Street. Soil samples will be analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, and TAL Metals (including cyanide). The proposed shallow soil sample locations and the soil sampling rationales are summarized on Table III.

Shallow-subsurface soil borings will be completed with a tractor mounted direct push unit and 4-foot long macrocores. Soil recovered from each sample interval will be visually characterized for color, texture, and moisture content. The presence of visible staining, NAPL (if encountered), odors, and PID headspace will be noted. It is expected that each direct push boring will be completed to a depth of 2 ft below grade. If indications of impacts are observed, these borings may be drilled deeper to aid in evaluating the vertical extent of possible MGP materials and additional samples may be collected. Soil sampling methods are described in the FSP (Appendix D).

3.2.4.2 Hollow Stem Auger Borings

Approximately nine (9) subsurface soil borings will be completed at the target locations, as shown on Figure 2. It is expected that a minimum of two (2) subsurface soil samples may be collected from each soil boring. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, and TAL Metals (including cyanide). The proposed soil boring locations and the soil sampling rationales are summarized on Table III.

Soil borings will be completed using 3¼-in. inside diameter hollow stem augers (HSA) or 4-ft long direct push macrocores. Continuous soil sampling will be conducted at the boring locations by advancing a 2-ft 2-in. long outer diameter (OD) splitspoon ahead of the augers, or 4-ft long macrocore sampling device. Each boring will be completed to a depth of refusal (if encountered) or to the top of bedrock or other confining unit, or to a depth of approximately 30 ft below ground surface if soil impacts are not observed. Soil recovered from each sample interval will be visually characterized for color, texture, and moisture content. The presence of visible staining, NAPL (if encountered), odors, and PID headspace will be noted.

Generally, soil samples will be selected for chemical analysis based on visual observations (e.g., staining) and/or the sample interval with the highest PID reading. If no staining or elevated PID readings are encountered, the sample interval immediately above the groundwater table will be selected for chemical analysis. Samples may also be collected from intervals below potential impacted soil to aid in vertical delineation. Soil sampling methods are described in the FSP. If NAPL is encountered in any of the soil borings, the DNAPL Contingency Plan presented in Section 4 will be implemented to limit the potential for remobilization and downward migration of DNAPL. Soil cuttings generated during the drilling operations will be placed in properly labeled DOT-approved steel drums for transportation and disposal coordination by NYSEG.

Air emissions in the worker breathing zone will be monitored using a PID and mini-RAM. The need for additional perimeter monitoring of air emissions at the boundary of the work area during the investigation is detailed in the CAMP presented as Appendix F.

3.3 Groundwater Investigation

The PSA groundwater investigation objectives and the general procedures for obtaining and analyzing groundwater samples are described below. Detailed procedures are presented in the FSP (Appendix D).

3.3.1 Groundwater Investigation Objectives

The objectives of the groundwater investigation are to:

- Determine groundwater flow and hydraulic characteristics beneath the Site
- Evaluate, to the extent practicable, whether groundwater flow may be a pathway for offsite migration of identified chemical constituents (if present)
- Determine if MGP-related and/or non-MGP-related chemical constituents are present in groundwater beneath the Site by collecting and analyzing groundwater samples
- Obtain sufficient information to develop an initial conceptual site model in order to evaluate the necessity for further action

The approach that will be implemented to address these objectives is discussed below

3.3.2 Groundwater Monitoring Well Installation and Development

It is anticipated that the groundwater investigation will consist of installing a minimum of six (6) overburden monitoring wells at the (general) locations shown on Figure 2. The final locations of the monitoring wells may be modified in the field based on Site reconnaissance and utility locations. Based on subsurface conditions encountered during the implementation of field activities at the Site (including the depth of groundwater, the depth of bedrock, and the presence/extent of NAPL), one (1) or more of the monitoring wells may be installed as shallow bedrock wells. The proposed monitoring well locations and rationales are summarized on Table IV.

At each monitoring well location, a soil boring will be completed to the top of bedrock or other confining unit or to a depth of approximately 30 ft below ground surface if soil impacts are not observed. Soil borings will be drilling using 4¼-in. inside diameter (ID) hollow stem augers (HSAs). Procedures for the soil boring activities are outlined in the FSP. Soil samples will be collected continuously from each soil boring using 2-ft 2-in. long OD, split-spoon sampling devices. Soil recovered from each sampling interval will be visually characterized for color, texture, and moisture content. Each sampling interval will be screened with a PID to measure the relative concentration of VOCs in the soil (if any), and the presence of staining and odors will be noted. A minimum of two (2) soil samples from each groundwater monitoring well boring will be submitted for laboratory analysis for TCL VOCs, TCL SVOCs, and TAL Metals (including cyanide) based on the sample selection criteria described above in Section 3.3.3. If NAPL is encountered in any of the soil borings completed at the monitoring well locations, the DNAPL Contingency Plan presented in Section 4 will be implemented to limit the potential for remobilization and downward migration of DNAPL. Soil cuttings generated during the drilling operations will be placed in properly labeled DOT-approved steel drums for transportation and disposal coordination by NYSEG.

Following completion of the borings, stickup or surface mount monitoring wells will be installed at each location. The monitoring wells will be constructed using 2-in. diameter Schedule 40 polyvinyl chloride (PVC) pipe and will be screened over a 10-ft interval with 0.020"slotted PVC screen. Each well will be fitted with a PVC sump, 2 ft in length and tremie-grouted in with cement, attached to the bottom of the screen for potential collection of DNAPL. The screen interval will be determined in the field based on observed subsurface conditions. If the water table is observed approximately 5 ft above bedrock, the screen will be set from approximately 5 ft above the water table to the depth of completion. If the water table is within 2 ft of the surface, an alternate monitoring well installation protocol will be used to ensure that an adequate surface seal is maintained. If the water table is encountered less than 5 ft from bedrock, the well screen will be set approximately 1 ft to 2 ft into the bedrock (by augering into bedrock to the extent practicable) with an equal length of screen above the water table. Based on subsurface conditions encountered, one or more of the monitoring wells may be completed as an overburden/bedrock interface installation or a bedrock installation.

Each monitoring well will be checked for the presence of NAPL and then developed by bailing or pumping until the turbidity is reduced to 50 nephelometric turbidity units (NTUs) or less, or until pH and conductivity measurements have stabilized. Water generated by monitoring well development and equipment decontamination will be placed in steel 55-gal drums or an onsite polyethylene storage tank for storage prior to being transported for offsite disposal by NYSEG.

3.3.3 Groundwater Sampling

To assess the potential presence of dissolved MGP-related and/or non-MGP-related chemical constituents in groundwater, one (1) complete round of groundwater sampling will be conducted at a minimum of two (2) weeks after completion of the monitoring well installation and development activities. A second round of groundwater sampling may be performed to supplement the initial groundwater sampling data based on consultation with NYSEG and the NYSDEC. If needed, the second round of groundwater sampling will be completed approximately three (3) to six (6) months subsequent to the initial sampling event to coincide with, or to assess seasonable variability of the groundwater elevation. A comprehensive round of fluid-level measurements will be collected from Site monitoring wells prior to each sampling event.

Each well will be checked for the presence of NAPL prior to and during purging. If light non-aqueous phase liquid (LNAPL) and/or DNAPL is observed to be present in sufficient volume at any monitoring well, the NAPL will be sampled and analyzed for density, viscosity, and interfacial tension (all parameters will be evaluated at 12^{o} C).

Following the purging, one (1) groundwater sample will be collected from each monitoring well using low-flow sampling techniques for laboratory analysis for TCL SVOCs and TAL Metals (including cyanide). After the low-flow samples are collected, one (1) sample will be collected from each monitoring well using a disposable bailer for analysis for TCL VOCs. Field parameters collected during groundwater sampling will consist of pH, oxidation/reduction potential (ORP), turbidity, temperature, conductivity and dissolved oxygen.

Groundwater samples will not be collected from wells that contain NAPL unless such data are needed to aid in characterization of Site conditions.

3.3.4 Groundwater Flow Pattern Characteristics

Following the collection of groundwater samples from each monitoring well, falling or rising head tests will be conducted, where feasible, to evaluate the hydraulic conductivity of the formation surrounding the screened interval of each monitoring well. Water level drawdown will be monitored using an electronic water level indicator or data logging pressure transducer.

The groundwater flow patterns and hydraulic characteristics beneath the Site will be evaluated by conducting a comprehensive fluid-level measurement round from all of the new groundwater monitoring wells to determine general groundwater flow direction at the Site. Groundwater levels will be measured to the nearest one-hundredth of a foot, from a reference point at the top of the inner casing. The measurements will be converted to elevations based on survey of the monitoring well locations. The groundwater elevation information will be used in conjunction with the hydraulic conductivity test results to evaluate horizontal groundwater flow beneath the Site.

3.4 Chemical Analyses

As noted above, soil and groundwater samples will be analyzed for Target Compound List TCL VOCs, TCL SVOCs, and TAL Metals (including cyanide). The samples will be submitted to a New York State Department of Health (NYSDOH) accredited laboratory certified for the selected analysis on a standard turnaround basis for reporting of analytical results. Analytical methods, sample handling, and laboratory protocols are outlined in the QAPP (Appendix E). Sample analyses will follow the NYSDEC Analytical Services Protocol (ASP) (most recent version), and will include quality assurance/quality control (QA/QC) samples at a frequency indicated in the QAPP. Analytical results for analysis of the soil samples will be reported using NYSDEC ASP Category B data deliverables.

3.5 Surveying

Subsequent to the field activities, a surveyor will locate surface soil sampling locations, test pits, soil borings, monitoring wells, stream elevation reference points, and any other pertinent locations. For each surveyed location, the surveyor will determine its horizontal location relative to the NAD 83 (CONUS) datum with the projection for the New York State Plane

Central Coordinate System, and its vertical elevation relative to the NAVD 88 or NGVD 29 datum. Additionally, for each monitoring well, the surveyor will determine the measuring-point elevation (defined as the top of the inner casing).

3.6 Decontamination

Equipment decontamination will follow the procedures outlined in the FSP. In general, non disposable equipment, including drilling tools and equipment, will be decontaminated prior to first use onsite, between each investigation location, and prior to demobilization (if dedicated equipment is not used).

3.7 Management of IDW

Investigation-derived waste (IDW) will be containerized in appropriate waste containers and staged in an onsite area prior to offsite disposal. Soil cuttings, personal protective equipment (PPE), and spent disposable sampling materials will be segregated by waste type and placed in DOT-approved 55-gal steel drums. Decontamination water and drilling water will be stored in polyethylene tanks or DOT-approved 55-gallon steel drums. Waste storage containers will be appropriately labeled with the contents, generator, location, and date for offsite transportation and disposal coordination by NYSEG.

IDW will be sampled per the requirements of the permitted disposal facility and the pre-existing waste profiles NYSEG has established with various facilities.

4. DNAPL CONTINGENCY PLAN

This section specifies procedures to be followed during drilling at the Site to limit the potential for remobilization and downward migration of DNAPL. These procedures apply to all soil borings and monitoring wells to be completed for the Work Plan.

Split-spoon and/or macrocore samples will be taken continuously during drilling. Sampling procedures and soil-characterization requirements are outlined in the FSP. These procedures include geologic descriptions and field screening PID measurements to gauge the relative concentrations of organic vapors in soil samples. In addition, the field geologist will carefully examine each sample for the presence of sheens, staining, and NAPL. Indications that soil may be MGP-impacted will be documented in the field notes.

If NAPL is observed, the field staff will first judge if the NAPL is lighter or denser than water (i.e., LNAPL or DNAPL). If an easy determination cannot be made, one representative sample will be selected for a shake test. To perform a shake test, the field staff will place one small sample of NAPL-containing soil in a clear jar. The jar will then be filled ¾ full with water, closed, and manually shaken for several seconds. The jar will be allowed to sit for up to five (5) minutes, if needed, to allow any potential emulsions to settle. NAPLs associated with MGP sites can have specific densities similar to water and form emulsions which are slow to separate. Determination of light or dense NAPL can be made by observing whether the NAPL floats or sinks. The field staff will exercise caution when using the shake test to determine NAPL density relative to water.

If the NAPL is judged to be denser than water, the field staff will make a qualitative judgment whether the apparent quantity of DNAPL represents a mobilizable pool, or is immobile (residual) DNAPL. The presence of a DNAPL pool would be suggested by an apparent DNAPL volume of greater than 5% to 10% of the total soil sample volume.

If a DNAPL pool is interpreted, drilling may continue through the DNAPL-impacted interval to determine the approximate vertical extent, except where continued drilling would risk breaching a confining unit or MGP-related structure (confining with respect to DNAPL). If DNAPL is encountered immediately above a potential confining unit or MGP structure, one of the following five possible actions will be taken upon consultation with NYSEG and the NYSDEC:

1. If deeper drilling and characterization are desired at locations where a confining unit such as bedrock is identified, the borehole may be properly abandoned and an alternate nearby location will be selected. Drilling will proceed at the alternate location by casing off the interval from the bottom of the probable DNAPL pool to the land surface by grouting a casing in place. Should the borehole diameter of the original boring be adequate for installing casing and grout, an alternate drilling location would not be required. Drilling will resume inside the casing once the grout has set. If a DNAPL pool is identified below the potential confining unit, and no deeper confining unit has been identified in which an outer casing may be set, the borehole will be abandoned and grouted.
2. If deeper drilling and characterization are desired at locations where a former MGP-related structure is identified (e.g., gas holder floor) with significant accumulations of NAPL above the structure, the borehole will be properly abandoned and additional attempts will be tried within the structure and completed if feasible. If significant NAPL is present in the initial borings within the structure, then an alternate nearby location will be selected immediately outside of the footprint of the former structure.
3. If a confining unit or former MGP-related structure is not observed, drilling should be discontinued when approximately 6 ft of clean soil has been observed below the DNAPL-impacted interval. If deeper drilling and characterization are desired, drilling will proceed by casing off the interval from the bottom of the approximately 6 ft of clean soil to the land surface by grouting a casing in place. Should the borehole diameter of the original boring be adequate for installing casing and grout, an alternate drilling location would not be required. Drilling will resume inside the casing once

the grout has set.

4. If deeper drilling and characterization are not desired, the borehole should be properly abandoned by tremie-grouting from the bottom of the borehole to land surface.
5. If NAPL characterization data or NAPL recovery are desired, a monitoring well may be installed inside the borehole with a grouted-in, 2-ft sump (at a minimum).

4.1 NAPL Monitoring

If intervals containing potentially free-phase NAPL are encountered while drilling, NAPL monitoring wells may be installed at these locations, based on the boring location and the nature of the NAPL-impacted interval. The determination of potentially free-phase NAPL at boring locations will be made by visual and olfactory observations, as well as by completing a shake test on selected soil samples (as specified above).

The length and slot size of NAPL monitoring-well screens will depend on the nature of the stratigraphic interval containing NAPL. If NAPL accumulates in a NAPL monitoring well, then NAPL recovery tests will be performed to assess the recoverability of the NAPL. The schedule and protocol for NAPL recovery (if required) will be agreed upon with NYSEG and the NYSDEC prior to completing the field activities. Groundwater samples will not be collected from wells that contain NAPL unless such data are needed to aid in characterization of Site conditions.

5. SCHEDULE

This section presents a conceptual duration schedule for implementing the field investigation activities presented in this Work Plan. Following receipt of any comments on the draft Work Plan from the NYSDEC, NYSEG will revise the draft Work Plan and submit the final document to the NYSDEC. Once written approval is received from the NYSDEC to implement the field activities, a revised schedule with target dates will be submitted. The project duration may depend on whether additional investigation efforts are required to meet project objectives due to unforeseen field conditions and findings. Changes in the schedule will be made in consultation with the NYSDEC.

Work Activity	Duration
Work Plan Approval	—
Implement Field Activities	4 weeks
Laboratory Analysis of Samples	4 weeks
Data Validation	4 weeks
Conduct Additional Groundwater Sampling (if needed) [1.]	1 week; 3 to 6 months following initial groundwater sampling event (if needed)
Laboratory Analysis of Groundwater Samples (if needed)	4 weeks
Data Validation (if needed for additional groundwater samples)	4 weeks
Prepare PSA Report [2.]	4 – 8 weeks
NYSDEC Review of PSA Report	4 – 8 weeks
Revise PSA Report	2 – 4 weeks
Submit Final PSA Report	Complete

Note:

1. Refer to Section 3.4.4 for the need and timing of the 2nd round of groundwater sampling.
2. It is NYSEG's intent to make all reasonable efforts to determine the extent of contamination in one mobilization to the Site. At the conclusion of and based upon the observations and finding of the field work, NYSEG and the NYSDEC will agree whether a PSA Report or Remedial Investigation Report is required.

REFERENCES

1. Atlantic Environmental Services. 1991. “Manufactured Gas Plant Site Screening Report, Seneca Falls, New York,” dated September 1991.

2. Environmental Data Resources (EDR). 2007. EDR Radius Map with GeoCheck for Seneca Falls Former MGP Site, 13 June 2007.

3. Fisher, D.W., Isachsen, Y.W., and Rickard, L.V. 1970. Geologic Map of New York State. New York State Museum and Science Service, Finger Lakes sheet, Map and Chart Series 15.

4. Isachsen, Y.W., Landing, E., Lauber, J.M., Rickard, L.V., and Rogers, W.B. 2000. *Geology of New York*. Second Edition. (New York State Museum)

5. T. Blazicek (NYSEG). Letter to R. Schicke (NYSDEC), “Seneca Falls Former MGP Site, Surface Soil Analytical Results,” 25 March 2003.

6. United States Department of Agriculture (USDA) Soil Conservation Service. 1988. “Soil Survey of Seneca County, New York.”

7. United States Geological Survey (USGS). 2002. “Managing the Water Resources of the Oswego River Basin in Central New York,” USGS Fact Sheet FS 180-99.

8. Van Diver, B. 1985. Roadside Geology of New York. New York: Mountain Press Publishing Company.

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APPENDIX A

Aerial Photograph

APPENDIX B

Historical Documentation

APPENDIX C

Historic Site Analytical Data

APPENDIX D

Field Sampling Plan

APPENDIX E

Quality Assurance Project Plan

APPENDIX F

Community Air Quality Assurance Project Plan
Monitoring Plan

APPENDIX G

Health and Safety Plan

TABLE I
SURFACE SOIL EXPLORATION AND SAMPLING SUMMARY
PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Exploration Description	Location	Rational	Sampling Program	Target Exploration Depth	Laboratory Analyses [1.]		
					TCL VOCs	TCL SVOCs	TAL Metals & Cyanide
Surface Soil	SS-07-01 185 Fall Street backyard area	Screen for the presence of MGP residuals, obtain soil samples.	6 soil samples to be submitted for chemical laboratory analysis of TCL VOCs, TCL SVOCs, and TAL Metals (including total Cyanide).	0 - 1 inches below sod	1	1	1
	SS-07-02 181 Fall Street backyard area				1	1	1
	SS-07-03 Center-east portion of site				1	1	1
	SS-07-04 South-east portion of site				1	1	1
	SS-07-05 South-central portion of site				1	1	1
	SS-07-06 South-west portion of site				1	1	1

Notes:
1. Analytical methods likely to include:
   TCL VOC soil samples will be analyzed using Method 8260B; TCL SVOC soil samples will be analyzed using Method 8270C;
   TAL Metals (including total Cyanide) soil samples will be analyzed using Method 6010B and 9012A.
2. All exploration locations are approximate. Adjustments to exploration locations and depth may be made
   based on analysis of real-time field observations.

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TABLE II
TEST PIT EXPLORATION AND SAMPLING SUMMARY
PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Exploration Description	Location	Rational	Sampling Program	Target Exploration Depth	Laboratory Analyses [1.]		
					TCL VOCs	TCL SVOCs	TAL Metals & Cyanide
Approximately 10 test pit excavations (Additional test pits may be excavated based on real-time analysis of field observations.)	TP-07-01 Straddling west rim of former gas holder	Screen for the presence of MGP residuals, confirm construction of former gas holder (slab or sub-grade) and characterize condition of structure, obtain soil samples, delineate overburden thickness, supplemental geological information.	(1) Soil sample descriptions based on Energy East/H&A description protocol. (2) The presence of volatile organic compounds in soil samples to be screened using a photoionizing detector (PID). (3) A minimum of 20 soil samples (2 from each test pit location) to be submitted for chemical laboratory analysis of TCL VOCs, TCL SVOCs, and TAL Metals (including total Cyanide). Samples will be collected from the two foot interval registering the highest PID reading, or if not applicable, the two foot interval above the water table.	Top of bedrock, saturated zone, or former foundation, which ever is encountered first	2	2	2
	TP-07-02 Spanning former purifier and lime house structures	Screen for the presence of MGP residuals, characterize purifier and lime structures associated with former MGP operations, obtain soil samples, supplemental geological information.		Top of bedrock, saturated zone, or former foundation, which ever is encountered first	2	2	2
	TP-07-03 Straddling north former coal shed	Screen for the presence of MGP residuals, characterize condition and contents of former coal shed, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock, saturated zone, or former foundation, which ever is encountered first	2	2	2
	TP-07-04 Toe of slope, upgradient site boundary, vicinity of SS-1	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2
	TP-07-05 Toe of slope, east of SS-2	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2
	TP-07-06 Eastern portion of lowland area	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2
	TP-07-07 Eastern portion of lowland area	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2
	TP-07-08 Southwestern portion of lowland area adjacent to SS-3 and Canal	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2
	TP-07-09 South central portion of lowland area adjacent to Canal	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2
	TP-07-10 Southeastern portion of lowland area adjacent to Canal	Screen for the presence of MGP residuals, obtain soil samples, delineate overburden thickness, supplemental geological information.		Top of bedrock	2	2	2

Notes:
1. Analytical methods likely to include:
   TCL VOC soil samples will be analyzed using Method 8260B; TCL SVOC soil samples will be analyzed using Method 8270C;
   TAL Metals (including total Cyanide) soil samples will be analyzed using Method 6010B and 9012A.
2. All exploration locations and depths are approximate. Adjustments to exploration locations and depth may be made based on analysis of real-time field observations.
3. Soil sampling locations SS-1 through SS-3 reported by Atlantic Environmental Services, Inc., 1991.

TABLE III
SUBSURFACE SOIL EXPLORATION AND SAMPLING SUMMARY
PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Exploration Description	Location	Rational	Sampling Program	Target Exploration Depth	Laboratory Analyses [1.]		
					TCL VOCs	TCL SVOCs	TAL Metals & Cyanide
Approximately 12 direct-push shallow soil borings	Sampling Grid 181 Fall Street	Screen for the presence of MGP residuals, obtain soil samples, supplemental geological information.	Up to 12 soil samples to be submitted for chemical laboratory analysis of TCL VOCs, TCL SVOCs, and TAL Metals (including total Cyanide).	Two feet bgs	6	6	6
	Sampling Grid 185 Fall Street	Screen for the presence of MGP residuals, obtain soil samples, supplemental geological information.		Two feet bgs	6	6	6
Approximately 6 soil borings with monitoring wells and 3 soil borings (Additional soil borings and monitoring wells may be drilled based on real-time analysis of field observations. Modifications to monitoring well installation may be made based on real-time field observations.)	SB-07-01 (MW-07-01) North of site, adjacent to Fall Street	Background (upgradient) soil characterization, supplemental geological information.	(1) Soil sample descriptions based on Synergy Energy East/H&A description protocol. (2) The presence of volatile organic compounds in soil samples to be screened using a PID. (3) A minimum of 22 soil samples (2 from each boring location, 2 duplicate, 2 MS/MSD) to be submitted for chemical laboratory analysis of TCL VOCs, TCL SVOCs and TAL Metals (including total Cyanide). Samples will be collected for the 2 foot interval registering the highest PID reading, or if not applicable, the two foot interval above the water table.	Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-02 (MW-07-02) Western site boundary, downgradient of adjacent gas station, 160' south of Fall Street	Screen for the presence of MGP residuals, obtain soil samples for Site characterization, assess presence of potential upgradient impact sources, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-03 (MW-07-03) Approximately 10 feet southeast of the on-site building	Screen for the presence of MGP residuals, obtain soil samples for Site characterization downgradient of former MGP structures, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-04 (MW-07-04) Between existing on-site building and private residence, approximately 80 feet south of Fall Street	Screen for the presence of MGP residuals and obtain soil samples at possible downgradient location of former MGP structures, upgradient and downgradient of potential receptors, provide data to evaluate potential vapor intrusion pathway, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-05 (MW-07-05) Approximately 30 feet west of SS-3	Screen for the presence of MGP residuals and obtain soil samples at possible downgradient location of former MGP structures and upgradient of potential receptor, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2

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TABLE III
SUBSURFACE SOIL EXPLORATION AND SAMPLING SUMMARY
PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Exploration Description	Location	Rational	Sampling Program	Target Exploration Depth	Laboratory Analyses [1.]		
					TCL VOCs	TCL SVOCs	TAL Metals & Cyanide
Approximately 6 soil borings with monitoring wells and 3 soil borings (Additional soil borings and monitoring wells may be drilled based on real-time analysis of field observations. Modifications to monitoring well installation may be made based on real-time field observations.)	SB-07-06 (MW-07-06) Southern portion of site approximately 50 feet west of east site boundary	Screen for the presence of MGP residuals and obtain soil samples at possible downgradient location of former MGP structures and upgradient of potential receptor, supplemental geological information.	(1) Soil sample descriptions based on Synergy Energy East/H&A description protocol. (2) The presence of volatile organic compounds in soil samples to be screened using a PID. (3) A minimum of 22 soil samples (2 from each boring location, 2 duplicate, 2 MS/MSD) to be submitted for chemical laboratory analysis of TCL VOCs, TCL SVOCs and TAL Metals (including total Cyanide). Samples will be collected for the 2 foot interval registering the highest PID reading, or if not applicable, the two foot interval above the water table.	Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-07 Central area of asphalt parking lot	Screen for the presence of MGP residuals, obtain soil samples, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-08 South-central area of asphalt parking lot	Screen for the presence of MGP residuals, obtain soil samples, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2
	SB-07-09 South-central portion of site	Screen for the presence of MGP residuals, obtain soil samples in vicinity of canal, supplemental geological information.		Top of bedrock, confining unit, or 30 feet bgs	2	2	2

Notes:
1. Analytical methods likely to include:
   TCL VOC soil samples will be analyzed using Method 8260B; TCL SVOC soil samples will be analyzed using Method 8270C;
   TAL Metals (including total Cyanide) soil samples will be analyzed using Method 6010B and 9012A.
2. All exploration locations and depths are approximate. Adjustments to exploration locations and depth may be made based on analysis of real-time field observations.
3. bgs = below ground surface

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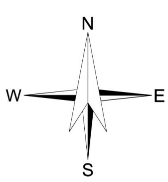
TABLE IV
GROUNDWATER CHARACTERIZATION SUMMARY
PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

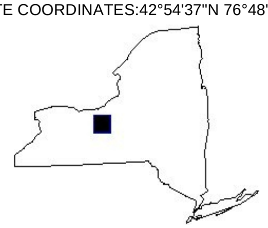
Exploration Description	Location	Rational	Sampling Program	Target Screen Interval	Laboratory Analyses [1.]		
					TCL VOCs	TCL SVOCs	TAL Metals & Cyanide
Approximately 6 monitoring wells (Additional monitoring wells may installed based on real-time analysis of field observations. Modifications to monitoring well installation may be made based on real-time field observations.)	MW-07-01 North of site, adjacent to Fall Street	Obtain groundwater samples, background (upgradient) groundwater characterization, determine depth to groundwater and flow direction.	(1) Measure depth to groundwater and depth to separate phase product (if present) in each well. (2) Collect natural attenuation parameters (dissolved oxygen, pH, oxidation-reduction potential, conductivity) during low-flow sampling. (2) Collect one round of groundwater samples using low-flow sampling techniques to be submitted for chemical laboratory analysis of TCL VOCs, TCL SVOCs, and TAL Metals (including total cyanide).	Five feet above water table to bottom of borehole	1	1	1
	MW-07-02 Western site boundary, downgradient of adjacent gas station, 160' south of Fall Street	Obtain groundwater samples, groundwater characterization, assess presence of potential upgradient impact sources, determine depth to groundwater and flow direction.		Five feet above water table to bottom of borehole	1	1	1
	MW-07-03 Approximately 10 feet southeast of the on-site building	Obtain groundwater samples, groundwater characterization downgradient of former MGP structures, determine depth to groundwater and flow direction, supplemental geological information.		Five feet above water table to bottom of borehole	1	1	1
	MW-07-04 Between existing on-site building and private residence, approximately 80 feet south of Fall Street	Obtain groundwater samples at possible downgradient location of former MGP structures, upgradient and downgradient of potential receptors, provide data to evaluate potential vapor intrusion pathway, determine depth to groundwater and flow direction.		Five feet above water table to bottom of borehole	1	1	1
	MW-07-05 Approximately 30 feet west of SS-3	Obtain groundwater samples at possible downgradient location of former MGP structures and upgradient of potential receptor, determine depth to groundwater and flow direction, assess hydraulic connection between overburden groundwater and river.		Five feet above water table to bottom of borehole, or shallow water bearing zone	1	1	1
	MW-07-06 Southern portion of site approximately 50 feet west of east site boundary	Obtain groundwater samples at possible downgradient location of former MGP structures and upgradient of potential receptor, determine depth to groundwater and flow direction, assess hydraulic connection between overburden groundwater and river.		Five feet above water table to bottom of borehole, or shallow water bearing zone	1	1	1

Notes:
1. Analytical methods likely to include:
   TCL VOC groundwater samples will be analyzed using Method 8260B; TCL SVOC groundwater samples will be analyzed using Method 8270C;
   TAL Metals (including total Cyanide) groundwater samples will be analyzed using Method 6010B and 9012A.
2. All exploration locations and screen intervals are approximate. Adjustments to exploration locations and screen interval may be made based on analysis of real-time field observations.

G:\34507_Seneca Falls\001\Final Report\Tables\Table IV

SITE COORDINATES:42°54'37"N 76°48'15"W





U.S.G.S. QUADRANGLE: SENECA FALLS, NY

HALEY & ALDRICH

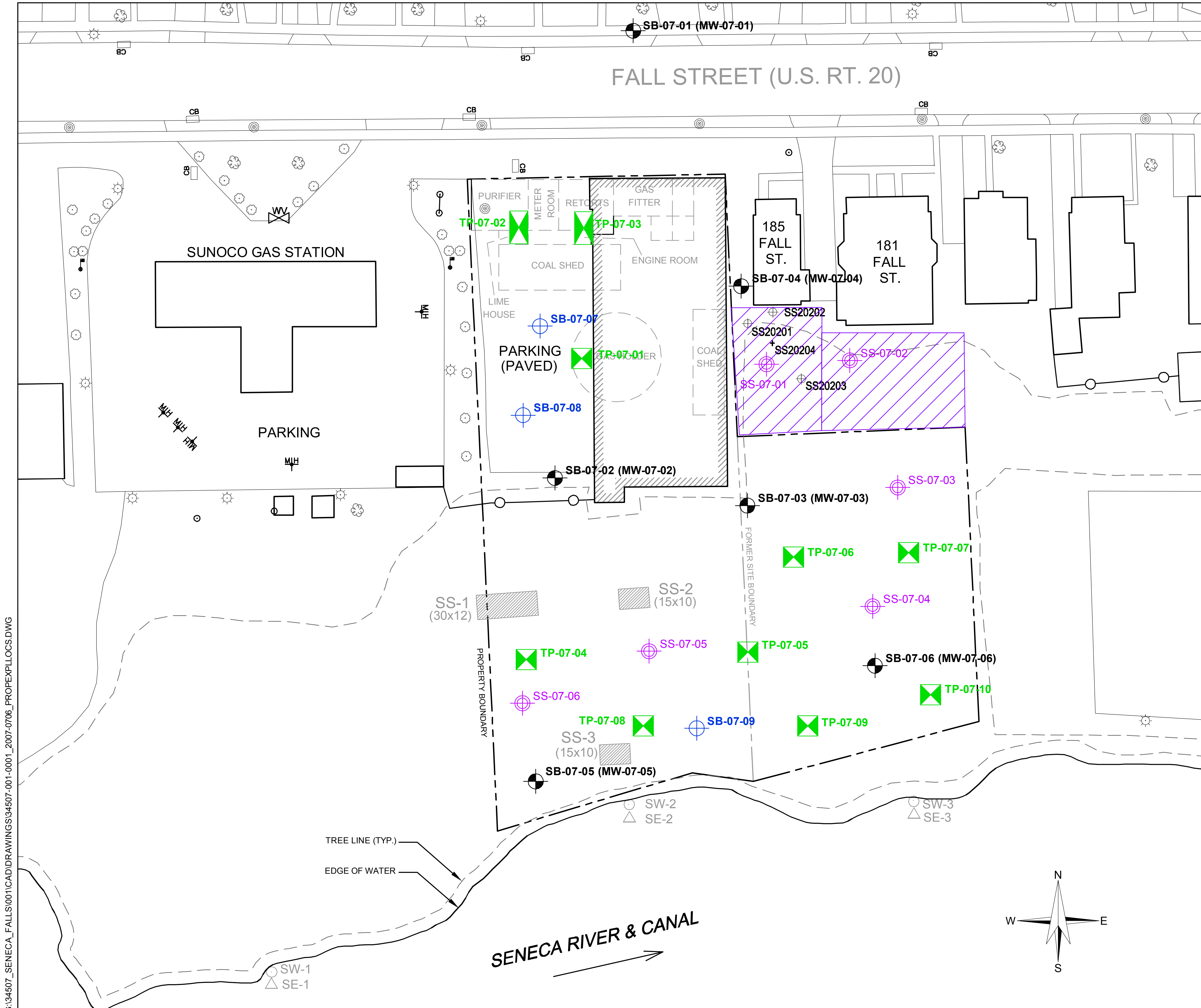
PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

PROJECT LOCUS

SCALE: 1:24,000
JULY 2007

FIGURE 1

34507-001 1.PDF



LEGEND:

TP-07-01	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED TEST PIT
SB-07-09	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED SOIL BORING
SB-07-06 (MW-07-06)	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED SOIL BORING WITH MONITORING WELL
SS-07-03	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED SURFACE SOIL SAMPLE LOCATION
	APPROXIMATE LOCATION OF PROPOSED DIRECT PUSH EXPLORATION AREA
	SURFACE SOIL SAMPLE (11/90)
	SURFACE WATER SAMPLE (11/90)
	SEDIMENT SAMPLE (11/90)
	SURFACE SOIL SAMPLE (03/03)
	POWER POLE
	LIGHT POLE
	POST
CB	CATCH BASIN
MH	MANHOLE
WV	WATER VALVE

NOTE:

1. BASE PLAN CREATED FROM ELECTRONIC FILE SENFMGP.DWG TITLED "SENECA FALLS FORMER MGP SITE VILLAGE OF SENECA FALLS SENECA COUNTY, NEW YORK" RECEIVED FROM TRACY BLAZICEK ON 18 MAY 2007.

0 50 100

SCALE IN FEET

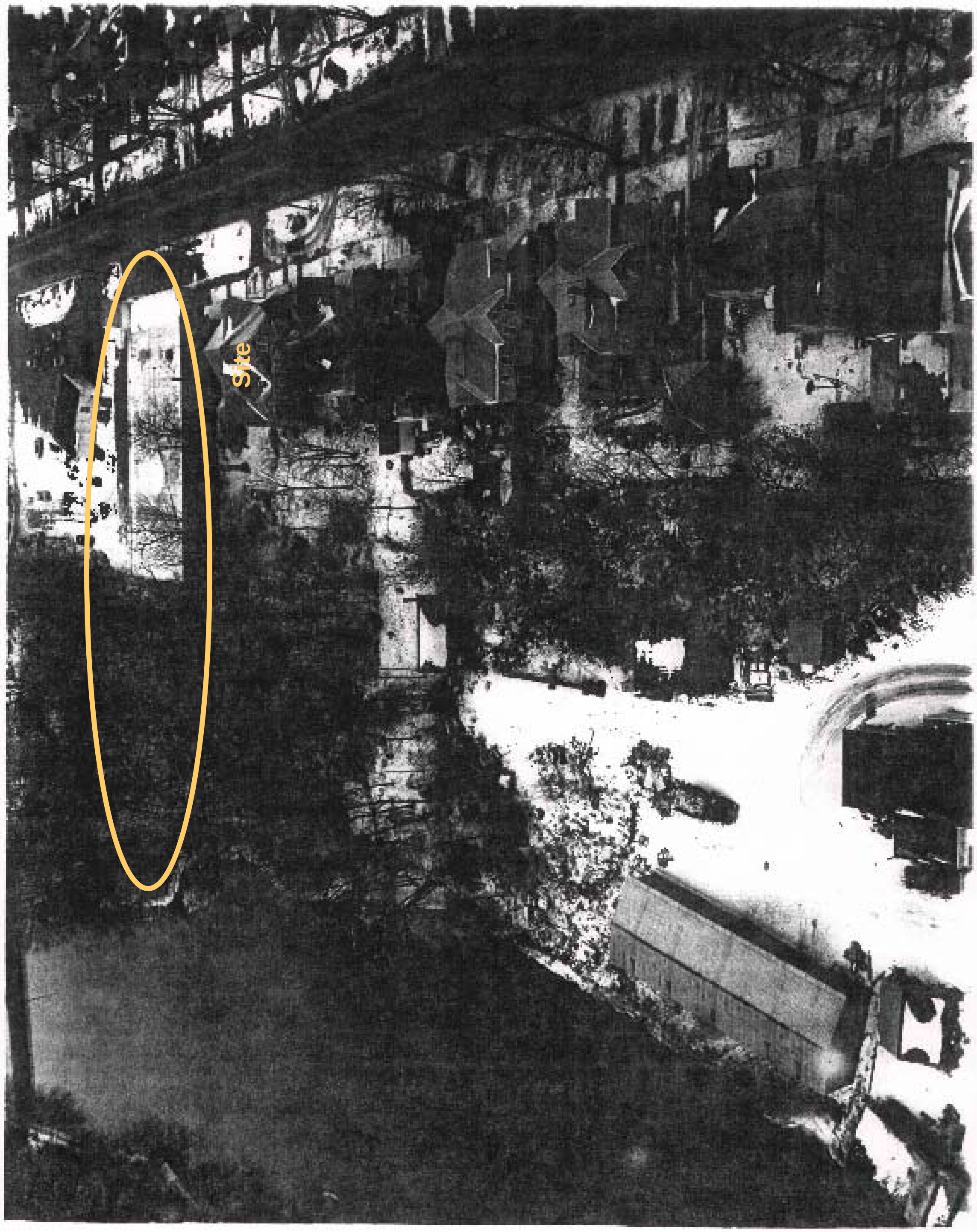
HALEY & ALDRICH

PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

PROPOSED EXPLORATION LOCATIONS

SCALE: AS SHOWN
JULY 2007

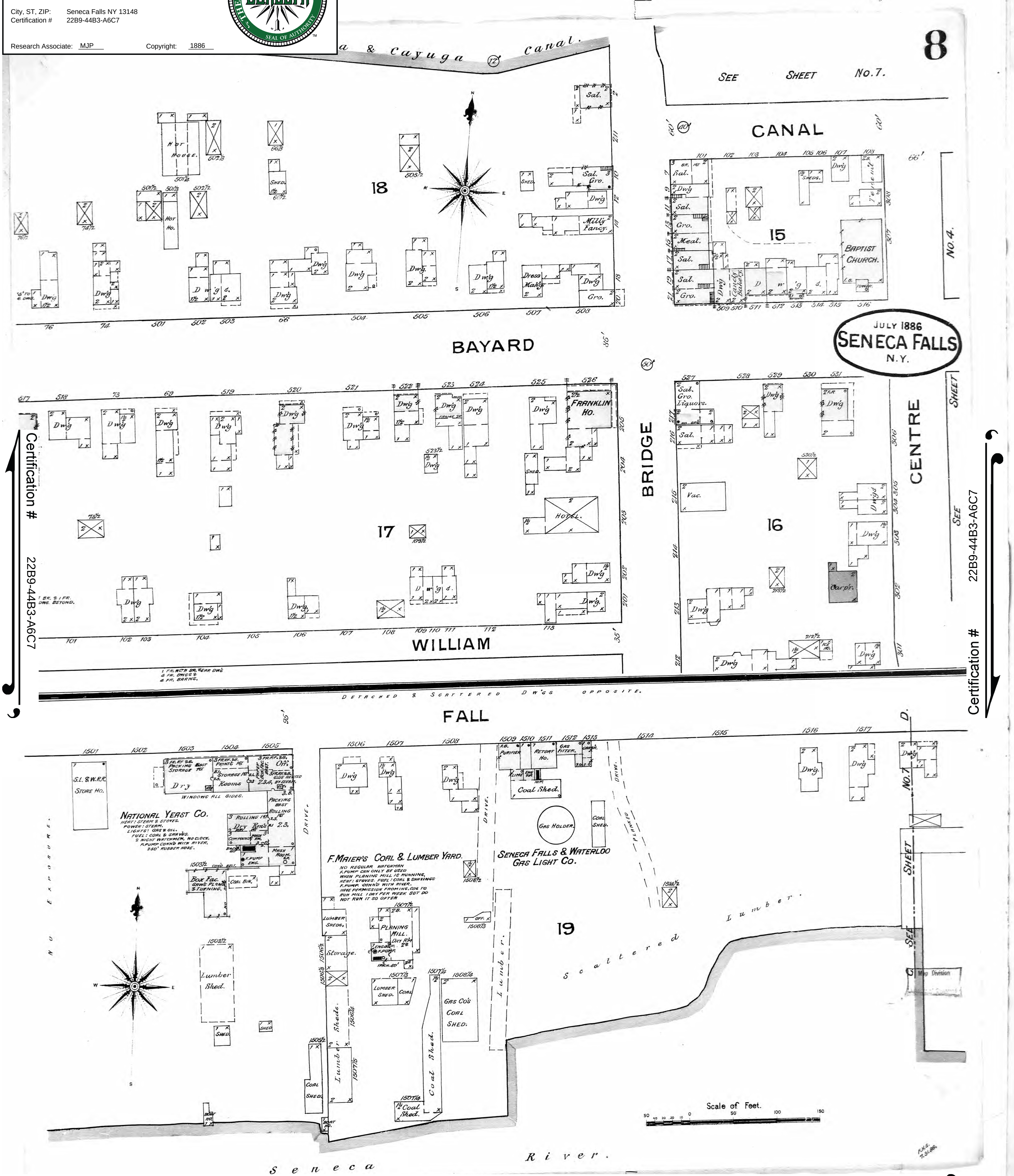
FIGURE 2



Aerial photograph of Seneca Falls, New York
Photo circa 1990

Aerial photograph of Seneca Falls, New York
Photo circa 21 October 1959

Aerial photograph of Seneca Falls, New York
Photo circa 29 April 1985


8
a & Cayuga Canal.
SEE SHEET No.7.
CANAL
BAYARD
BRIDGE
CENTRE
WILLIAM
FALL
JULY 1886
SENECA FALLS
N.Y.
18
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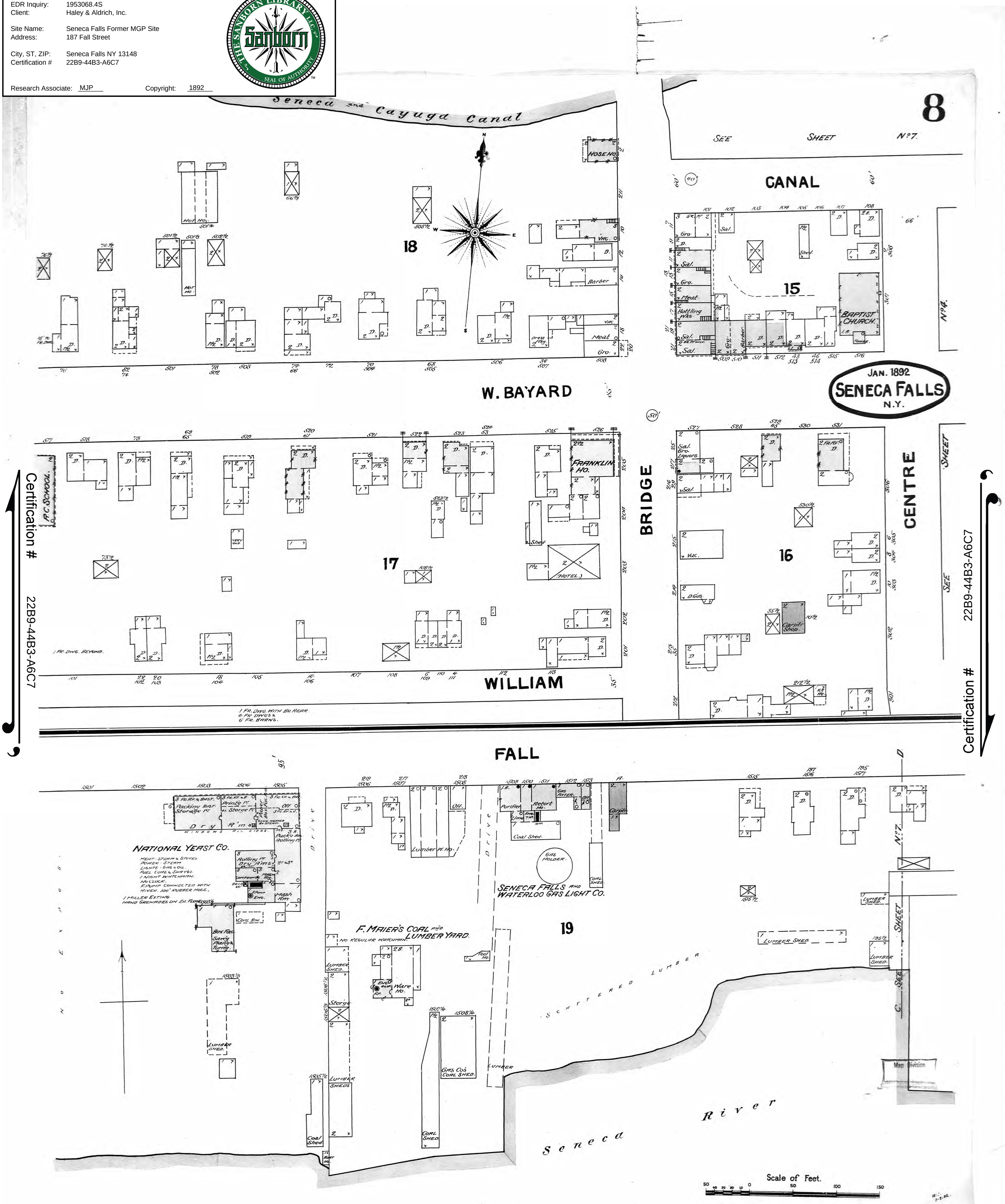
17
16
19
BAPTIST CHURCH.
FRANKLIN HO.
HOTEL.
NATIONAL YEAST CO.
F. MAIER'S COAL & LUMBER YARD.
SENECA FALLS & WATERLOO GAS LIGHT CO.
GAS HOLDER.
S.L. & W.R.R. STORE HO.
PLANING MILL.
Coal Shed.
Lumber Shed.
Scattered Lumber.
DETACHED & SCATTERED DWGS OPPOSITE.
NO EXPOSURE.
SEE SHEET No.4.
SEE SHEET No.7.
Scale of Feet.
Seneca River.
Certification # 22B9-44B3-A6C7

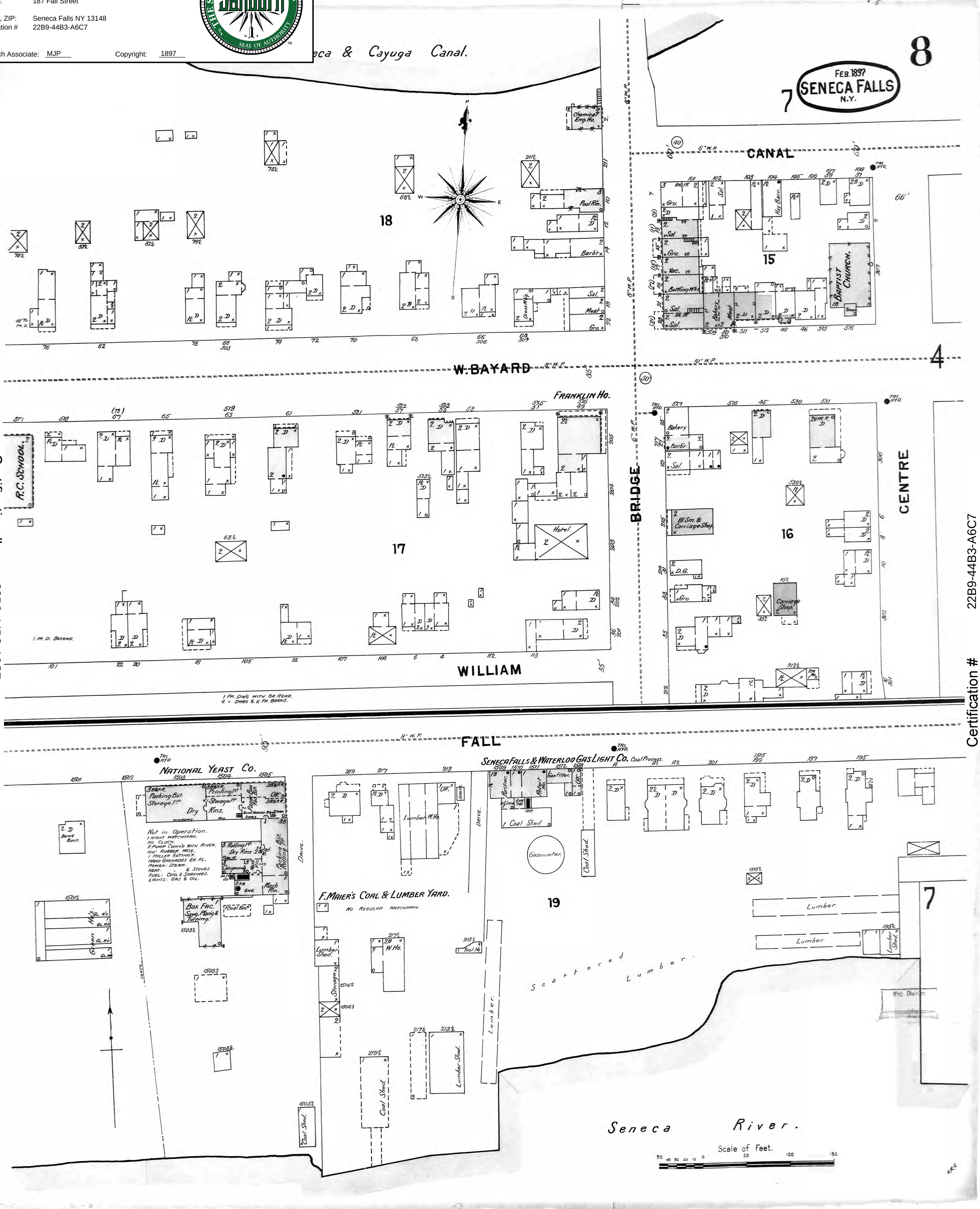

8
Seneca and Cayuga Canal
SEE SHEET No.7
CANAL
18
15
BAPTIST CHURCH
JAN. 1892
SENECA FALLS
N.Y.
W. BAYARD
BRIDGE
CENTRE
17
16
FRANKLIN HO.
(HOTEL)
WILLIAM
FALL
NATIONAL YEAST CO.
SENECA FALLS AND WATERLOO GAS LIGHT CO.
19
F. MAIER'S COAL AND LUMBER YARD.
SCATTERED LUMBER
Seneca River
Scale of Feet.

Date: 6/14/2007 9:56:12 AM
EDR Inquiry: 1953068.4S
Client: Haley & Aldrich, Inc.

Site Name: Seneca Falls Former MGP Site
Address: 187 Fall Street

City, ST, ZIP: Seneca Falls NY 13148
Certification # 22B9-44B3-A6C7

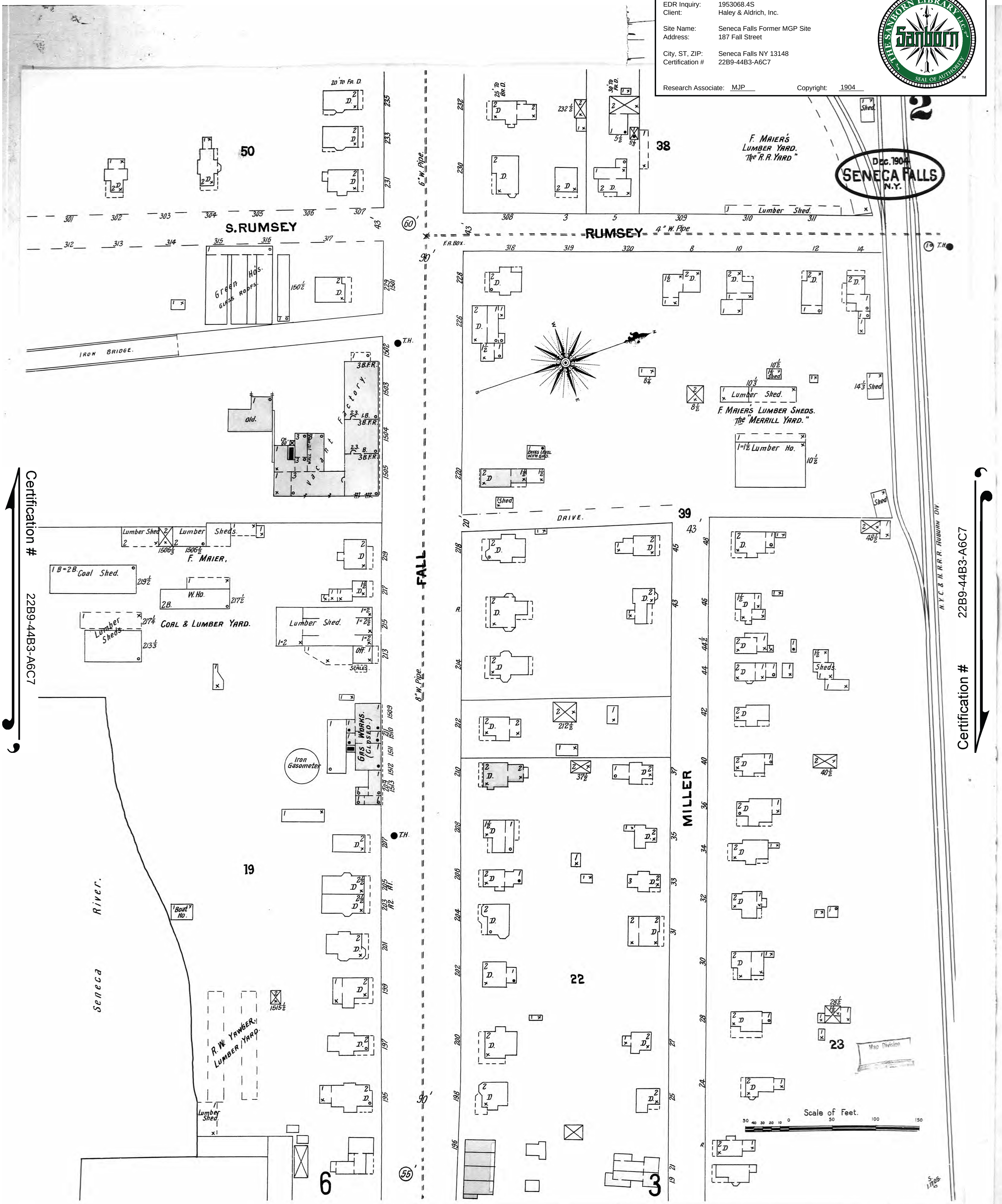
Research Associate: MJP Copyright: 1897



Certification # 22B9-44B3-A6C7

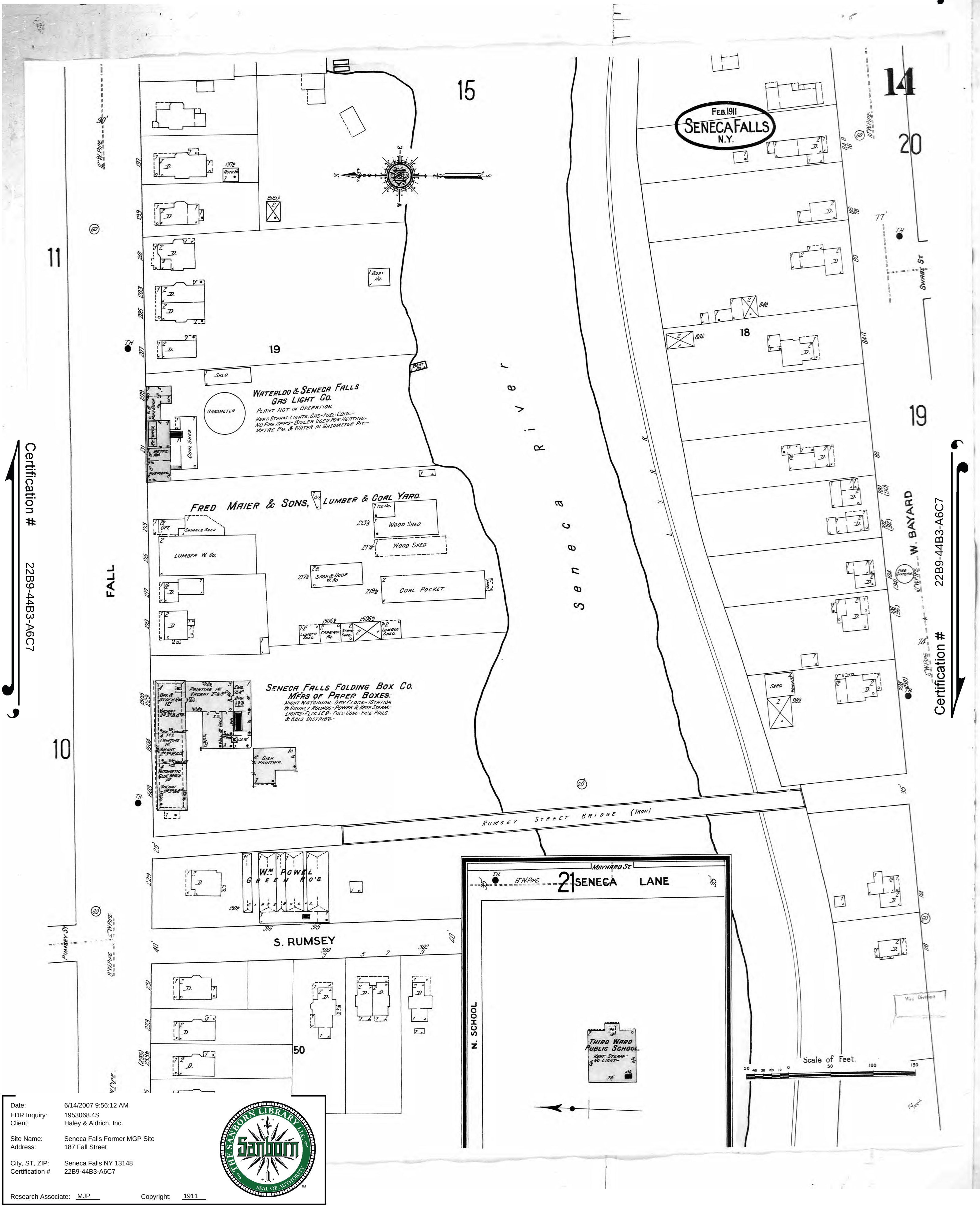
Date:	6/14/2007 9:56:12 AM
EDR Inquiry:	1953068.4S
Client:	Haley & Aldrich, Inc.
Site Name:	Seneca Falls Former MGP Site
Address:	187 Fall Street
City, ST, ZIP:	Seneca Falls NY 13148
Certification #	22B9-44B3-A6C7

Research Associate: MJP Copyright: 1904



Certification # 22B9-44B3-A6C7

Certification # 22B9-44B3-A6C7



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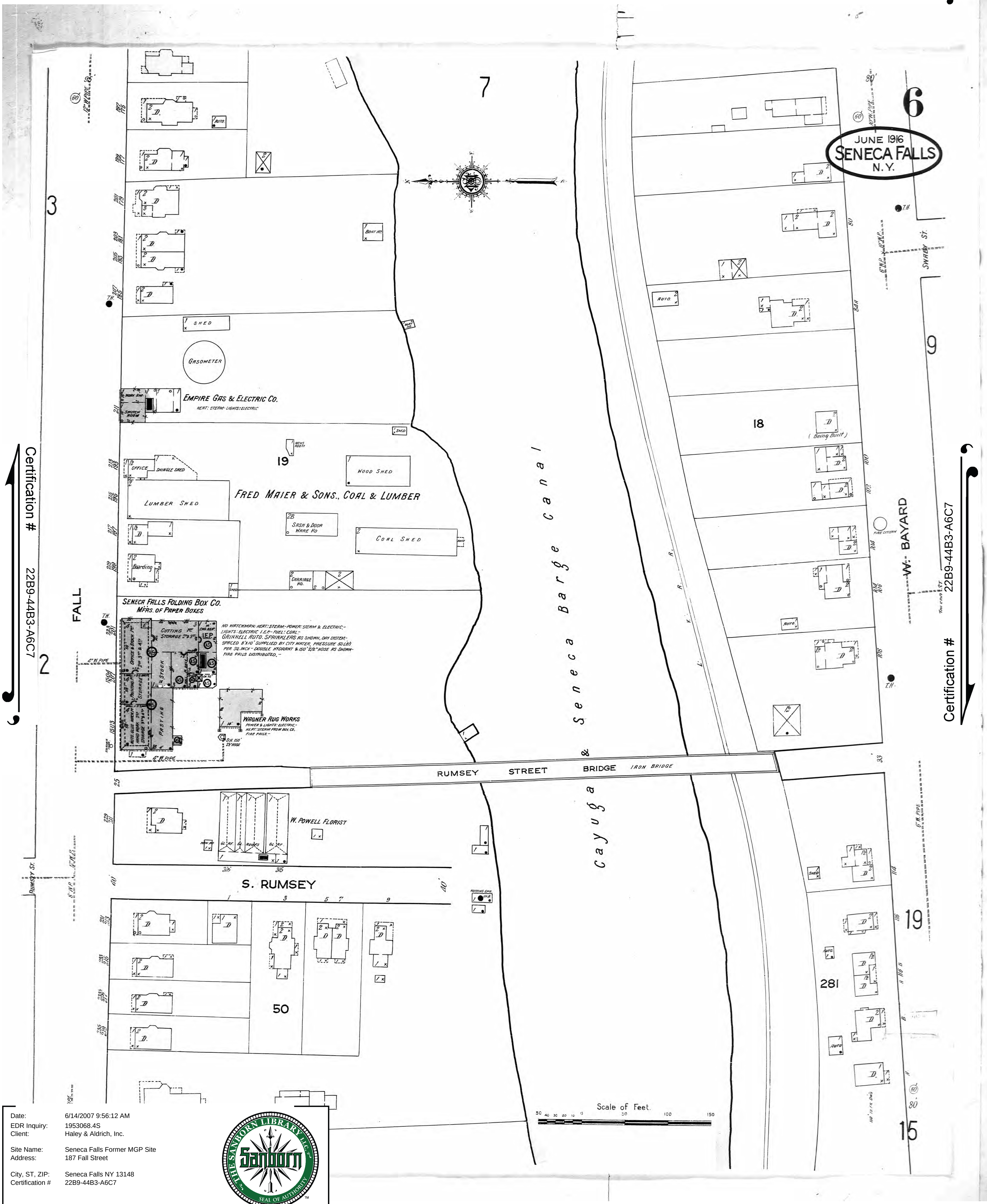
Client: Haley & Aldrich, Inc.

Site Name: Seneca Falls Former MGP Site
Address: 187 Fall Street

City, ST, ZIP: Seneca Falls NY 13148
Certification # 22B9-44B3-A6C7

Research Associate: MJP
Copyright: 1911

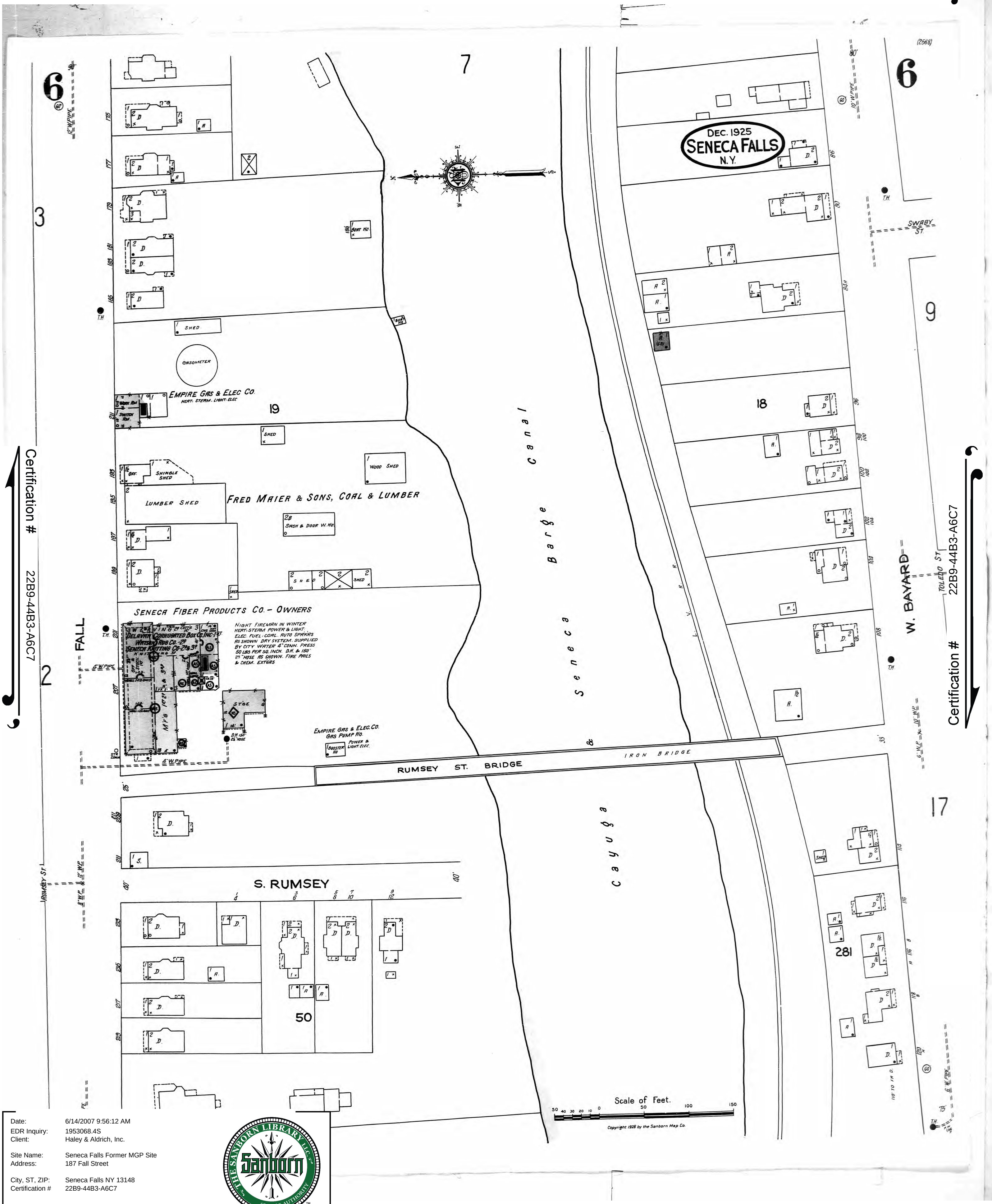


Date: 6/14/2007 9:56:12 AM
EDR Inquiry: 1953068.4S
Client: Haley & Aldrich, Inc.

Site Name: Seneca Falls Former MGP Site
Address: 187 Fall Street

City, ST, ZIP: Seneca Falls NY 13148
Certification # 22B9-44B3-A6C7

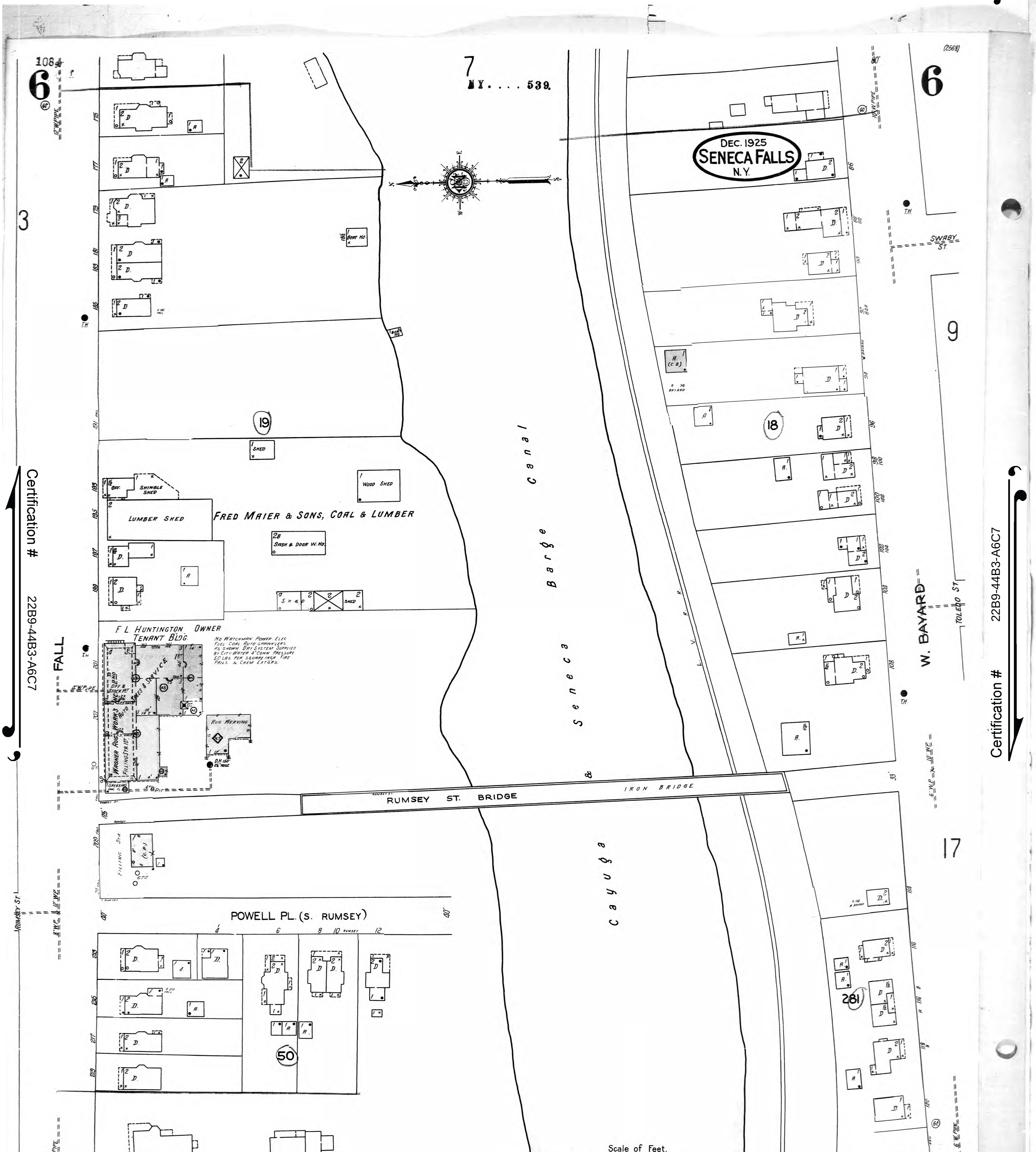
Research Associate: MJP
Copyright: 1916



Certification # 22B9-44B3-A6C7

Date:	6/14/2007 9:56:12 AM
EDR Inquiry:	1953068.4S
Client:	Haley & Aldrich, Inc.
Site Name:	Seneca Falls Former MGP Site
Address:	187 Fall Street
City, ST, ZIP:	Seneca Falls NY 13148
Certification #	22B9-44B3-A6C7

Research Associate: MJP Copyright: 1925



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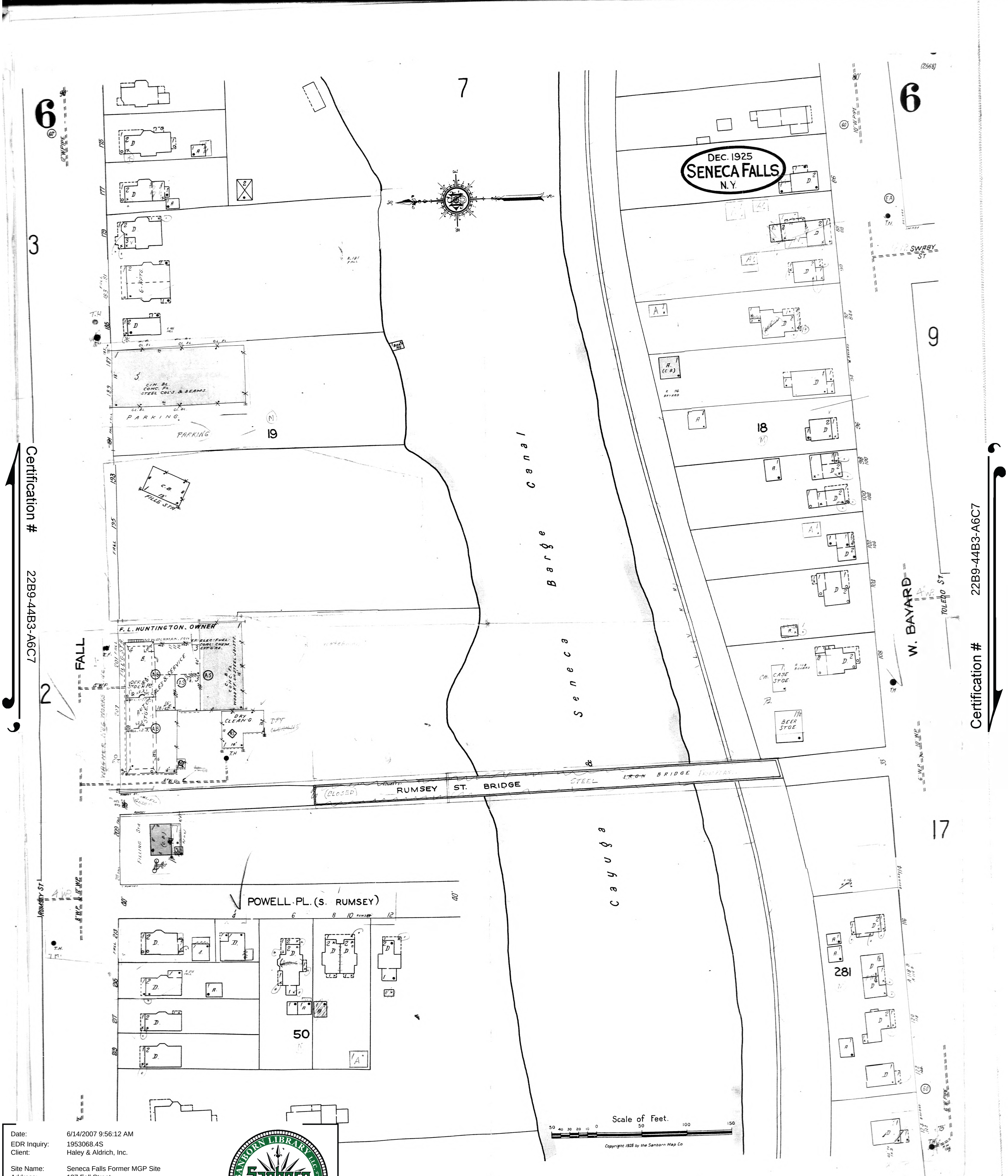
EDR Inquiry:	1953068.4S
Client:	Haley & Aldrich, Inc.
Site Name:	Seneca Falls Former MGP Site
Address:	187 Fall Street
City, ST, ZIP:	Seneca Falls NY 13148
Certification #	22B9-44B3-A6C7

Research Associate: MJP Copyright: 1944


DEC. 1925
SENECA FALLS
N.Y.
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50
281
F. L. HUNTINGTON, OWNER
FALL
PARKING
RUMSEY ST. BRIDGE
POWELL PL. (S. RUMSEY)
W. BAYARD
SWABY ST
TOLEDO ST
Seneca
Barge Canal
Cayuga
DRY CLEAN'G
BEER STGE
CASE STGE
Scale of Feet.
Copyright 1925 by the Sanborn Map Co.
Certification #
22B9-44B3-A6C7

Analytical data from "Manufactured Gas Plant Site Screening Report, Seneca Falls, New York," Atlantic Environmental Services (September 1991)

ANALYTICAL RESULTS – SENECA FALLS
NOVEMBER 30, 1990

	SURFACE WATER					SEDIMENT				SURFACE SOIL			
	CGSF–SW1	CGSF–SW2	CGSF–SW3	FIELD BLANK	TRIP BLANK	CGSF–SE1	CGSF–SE2	CGSF–SE3	FIELD BLANK	CGSF–SS1	CGSF–SS2	CGSF–SS3	FIELD BLANK
VOLATILE ORGANICS (CAS NO.) (ppb)													
Acetone (67–64–1)	<50	<50	<50	--	<50	<83	<140	<96	--	<88	<89	<110	--
Benzene (71–43–2)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Bromodichloromethane (75–27–4)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Bromoform (75–25–2)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Bromomethane (74–95–3)	<10	<10	<10	--	<10	<17	<28	<19	--	<18	<18	<21	--
2–Butanone (78–93–3)	<50	<50	<50	--	<50	<83	<140	<96	--	<88	<110	<110	--
Carbon disulfide (75–15–0)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Carbon tetrachloride (56–23–5)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Chlorobenzene (108–90–7)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Chloroethane (75–00–3)	<10	<10	<10	--	<10	<17	<28	<19	--	<18	<18	<21	--
Chloroform (67–66–3)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Chloromethane (74–87–3)	<10	<10	<10	--	<10	<17	<28	<19	--	<18	<18	<21	--
Dibromochloromethane (124–48–1)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,1–Dichloroethane (75–34–3)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,2–Dichloroethane (107–06–2)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,1–Dichloroethene (75–35–4)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,2–Dichloroethene (Total) (540–59–0)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,2–Dichloropropane (78–87–5)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
cis–1,3–Dichloropropene	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
trans–1,3–Dichloropropene	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Ethylbenzene (100–41–4)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
2–Hexanone (591–78–6)	<50	<50	<50	--	<50	<83	<140	<96	--	<88	<89	<110	--
Methylene chloride (75–09–2)	<10	<10	<10	--	<10	<17	<28	<19	--	<18	<18	<21	--
4–Methyl–2–pentanone (108–10–1)	<50	<50	<50	--	<50	<83	<140	<96	--	<88	<89	<110	--
Styrene (100–42–5)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,1,2,2–Tetrachloroethane (79–34–5)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Tetrachloroethene	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Toluene (108–88–3)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,1,1–Trichloroethane (71–55–6)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
1,1,2–Trichloroethane (79–00–5)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Trichloroethene (79–01–6)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
Vinyl acetate (108–05–4)	<50	<50	<50	--	<50	<83	<140	<96	--	<88	<89	<110	--
Vinyl chloride (75–01–4)	<10	<10	<10	--	<10	<17	<28	<19	--	<18	<18	21	--
Total xylenes (1330–20–7)	<5	<5	<5	--	<5	<8.3	<14	<9.6	--	<8.8	<8.9	<11	--
SEMI–VOLATILE ORGANICS (ppb)													
Acenaphthene (83–32–9)	<10	<10	<10	<10	--	<890	780J	7100	<10	<9300	<9400	<11000	<10
Acenaphthylene	<10	<10	<10	<10	--	150J	620J	1800J	<10	1700J	4000J	2500J	<10
Anthracene (120–12–7)	<10	<10	<10	<10	--	450J	3300	14000	<10	4600J	6100J	7500J	<10
Benzo(a)anthracene	<10	<10	<10	<10	--	4300	11000	22000	<10	20000	27000	39000	<10
Benzo(b)fluoranthene (205–99–2)	<10	<10	<10	<10	--	4100	10000	13000	<10	18000	19000	37000	<10
Benzo(k)fluoranthene (207–08–9)	<10	<10	<10	<10	--	950J	1000J	1400J	<10	8000J	3700J	4600J	<10
Benzo(ghi)perylene	<10	<10	<10	<10	--	2100	2700	8000	<10	11000	2900J	12000	<10
Benzo(a)pyrene (50–32–8)	<10	<10	<10	<10	--	3300	6200	14000	<10	16000	20000	25000	<10
Benzyl alcohol (100–51–6)	<10	<10	<10	<10	--	<890	<2900	<5100	<10	<9300	<9400	<11000	<10

ANALYTICAL RESULTS – SENECA FALLS
NOVEMBER 30, 1990

	SURFACE WATER					SEDIMENT				SURFACE SOIL			
	CGSF–SW1	CGSF–SW2	CGSF–SW3	FIELD BLANK	TRIP BLANK	CGSF–SE1	CGSF–SE2	CGSF–SE3	FIELD BLANK	CGSF–SS1	CGSF–SS2	CGSF–SS3	FIELD BLANK
Bis(2–chloroethoxy)methane	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Bis(2–chloroethyl)ether (111–44–4)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Bis(2–chloroisopropyl)ether	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Bis(2–ethylhexyl)phthalate (117–81–7)	<10	<10	<10	<10	––	<890	530J	<5100	<10	<9300	<9400	<11000	<10
4–Bromophenyl phenyl ether	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Butyl benzyl phthalate (85–68–7)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
4–Chloroaniline (106–47–8)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2–Chloronaphthalene (91–58–7)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
4–Chlorophenyl phenyl ether	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Chrysene (218–01–9)	<10	<10	<10	<10	––	2900	8000	15000	<10	21000	21000	25000	<10
Dibenzo(a,h)anthracene (53–70–3)	<10	<10	<10	<10	––	430J	730J	1400J	<10	2700J	2600J	3900J	<10
Dibenzofuran	<10	<10	<10	<10	––	<890	380J	5100	<10	<9300	<9400	<11000	<10
Di–n–butyl phthalate (84–74–2)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
1,2–Dichlorobenzene (95–50–1)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
1,3–Dichlorobenzene (541–73–1)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
1,4–Dichlorobenzene (106–46–7)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
3,3'–Dichlorobenzidine (91–94–1)	<50	<50	<50	<50	––	<4500	<14000	<25000	<50	<46000	<47000	<58000	<50
Diethyl phthalate (84–66–2)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Dimethyl phthalate (131–11–3)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2,4–Dinitrotoluene	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2,6–Dinitrotoluene (606–20–2)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Di–n–octyl phthalate (117–84–0)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Fluoranthene (206–44–0)	<10	<10	<10	<10	––	7900	1600J	52000	<10	54000	51000	66000	<10
Fluorene (86–73–7)	<10	<10	<10	<10	––	<890	600J	6600	<10	<9300	1600J	1900J	<10
Hexachlorobenzene (118–74–1)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Hexachlorobutadiene (87–68–3)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Hexachlorocyclopentadiene (77–47–4)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Hexachloroethane (67–72–1)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Indeno(1,2,3–cd)pyrene (193–39–5)	<10	<10	<10	<10	––	3100	3600	12000	<10	15000	13000	17000	<10
Isophorone (78–59–1)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2–Methylnaphthalene	<10	<10	<10	<10	––	<890	<2900	2500J	<10	<9300	<9400	<11000	<10
Naphthalene (91–20–3)	<10	<10	<10	<10	––	<890	<2900	6900	<10	<9300	960J	<11000	<10
Nitrobenzene (98–95–3)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2–Nitroaniline (88–74–4)	<50	<50	<50	<50	––	<4500	<14000	<25000	<50	<46000	<47000	<58000	<50
3–Nitroaniline (99–09–2)	<50	<50	<50	<50	––	<4500	<14000	<25000	<50	<46000	<47000	<58000	<50
4–Nitroaniline (100–01–6)	<50	<50	<50	<50	––	<4500	<14000	<25000	<1,0	<46000	<47000	<58000	<50
N–Nitrosodiphenylamine (86–30–6)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
N–Nitrosodi–n–propylamine	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Phenanthrene (85–01–8)	<10	<10	<10	<10	––	1200	7600	60000	<10	12000	12000	16000	<10
Pyrene (129–00–0)	<10	<10	<10	<10	––	9300	9600	25000	<10	20000	24000	27000	<10
1,2,4–Trichlorobenzene (120–82–1)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
Benzoic Acid (65–85–0)	<50	<50	<50	<50	––	<4500	<14000	<25000	<50	<46000	<47000	<58000	<50
4–Chloro–3–methylphenol (59–50–7)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2–Chlorophenol (95–57–8)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2,4–Dichlorophenol (120–83–2)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10

ANALYTICAL RESULTS – SENECA FALLS
NOVEMBER 30, 1990

	SURFACE WATER					SEDIMENT				SURFACE SOIL			
	CGSF–SW1	CGSF–SW2	CGSF–SW3	FIELD BLANK	TRIP BLANK	CGSF–SE1	CGSF–SE2	CGSF–SE3	FIELD BLANK	CGSF–SS1	CGSF–SS2	CGSF–SS3	FIELD BLANK
2,4–Dimethylphenol	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<46000	<47000	<58000	<10
2,4–Dinitrophenol (51–28–5)	<50	<50	<50	<50	––	<4800	<14000	<25000	<50	<46000	<47000	<58000	<50
2–Methyl–4,6–dinitrophenol (534–52–1)	<50	<50	<50	<50	––	<4800	<14000	<25000	<50	<9300	<9400	<11000	<50
2–Methylphenol (95–48–7)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<50
4–Methylphenol (106–44–5)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2–Nitrophenol (88–75–5)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
4–Nitrophenol (100–02–7)	<50	<50	<50	<50	––	<4800	<14000	<25000	<50	<46000	<47000	<58000	<10
Pentachlorophenol (87–86–5)	<50	<50	<50	<50	––	<4800	<14000	<25000	<50	<46000	<47000	<58000	<50
Phenol (108–95–2)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<50
2,4,5–Trichlorophenol (95–95–4)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
2,4,6–Trichlorophenol (88–06–2)	<10	<10	<10	<10	––	<890	<2900	<5100	<10	<9300	<9400	<11000	<10
METALS (ppm)													
Silver (7440–22–4)	<10	<10	<10	––	––	<1.3	<2.2	<1.5	––	<1.4	<1.4	<1.7	––
Aluminum (7429–90–5)	<200	<200	<200	––	––	5000	6700	6500	––	8100	3700	6400	––
Arsenic (7440–38–2)	<10	<10	<10	––	––	14	7.5	13	––	6.5	3.3	7.9	––
Barium (7440–39–3)	<200	<200	<200	––	––	40	69	110	––	89	33	77	––
Beryllium (7440–41–7)	<5	<5	<5	––	––	0.85	<1.1	<0.76	––	<0.7	<0.72	<0.85	––
Calcium (7440–70–2)	46000	48000	48000	––	––	20000	23000	74000	––	43000	29000	18000	––
Cadmium (7440–43–9)	<5	<5	<5	––	––	<0.67	<1.1	<0.76	––	1	<0.72	1	––
Cobalt (7440–48–4)	<50	<50	<50	––	––	<6.7	<11	<7.6	––	<7	<7.2	<8.5	––
Chromium (7440–47–3)	<5	<5	<5	––	––	5.2	9.2	7.9	––	9.5	5.8	12	––
Copper (7440–50–8)	<25	<25	<25	––	––	1400	86	140	––	38	31	49	––
Iron (7439–89–6)	<100	<100	<100	––	––	29000	24000	22000	––	14000	11000	17000	––
Mercury (7439–97–6)	<0.2	<0.2	<0.2	––	––	<0.13	0.63	9.1	––	<0.17	0.14	0.97	––
Potassium (7440–09–7)	<5000	<5000	<5000	––	––	<670	<1100	360	––	1400	<720	1000	––
Magnesium (7439–95–4)	11000	11000	11000	––	––	8700	11000	29000	––	15000	9200	4000	––
Manganese (7439–96–5)	<15	<15	<15	––	––	220	200	780	––	420	250	480	––
Sodium	89000	90000	90000	––	––	<670	<1100	<760	––	<500	<720	<850	––
Nickel (7440–02–0)	<40	<40	<40	––	––	9	25	12	––	16	10	13	––
Lead (7439–92–1)	<3	<3	<3	––	––	1900	120	780	––	490	42	190	––
Antimony (7440–36–0)	<60	<60	<60	––	––	180	<13	<9.2	––	<8.4	<8.6	<10	––
Selenium (7782–49–2)	<25	<25	<25	––	––	<0.64	<1.1	<3.8	––	<0.7	0.84	<0.84	––
Thallium (7440–28–0)	<10	<10	<10	––	––	<1.3	<2.1	<1.5	––	<1.4	<1.4	<1.7	––
Vanadium (7440–62–2)	<50	<50	<50	––	––	13	23	18	––	19	7.8	16	––
Zinc (7440–66–6)	<20	<20	<20	––	––	190	1000	430	––	180	130	240	––
CYANIDE (ppm)	<0.01	0.27	<0.01	––	––	<0.65	<0.94	<0.7	––	<0.66	3.8	6.6	––

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 regions indicate detected concentrations.
Laboratory: Wadsworth/Alert Laboratories, Inc.
Sample locations shown on Figure 5.

Analytical data from T. Blazicek (NYSEG), Letter to R. Schicke (NYSDEC), “Seneca Falls Former MGP Site, Surface Soil Analytical Results,” (25 March 2003)

TABLE 1
SOIL ANALYTICAL RESULTS
NYSEG - SENECA FALLS

Parameter	Units	Criteria*				
Location ID			SFSS00020201	SFSS00020201	SFSS00020202	SFSS00020203
Sample ID			SFSS00020201	SFSS00020204DUP	SFSS00020202	SFSS00020203
Matrix			Soil	Soil	Soil	Soil
Depth Interval (ft)			0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled			11/26/02	11/26/02	11/26/02	11/26/02
				Field Duplicate (1-1)		
Volatile Organic Compounds						
Benzene	UG/KG	60	6 U	6 U	7 U	7 U
Ethylbenzene	UG/KG	5500	6 U	6 U	7 U	7 U
Toluene	UG/KG	1500	6 U	6 U	7 U	7 U
Xylene (total)	UG/KG	1200	6 U	6 U	7 U	7 U
Semivolatile Organic Compounds						
2-Methylnaphthalene	UG/KG	36400	4,200 U	550 J	180 U	540 U
Acenaphthene	UG/KG	50000	240 J	650 J	2,100 U	540 U
Acenaphthylene	UG/KG	41000	1,300 J	2,500 J	550 J	540 U
Anthracene	UG/KG	50000	2,800 J	5,900	950 J	540 U
Benzo(a)anthracene	UG/KG	224 or MDL	9,000	13,000	5,600	49 J
Benzo(a)pyrene	UG/KG	61 or MDL	8,200	11,000	5,100	49 J
Benzo(b)fluoranthene	UG/KG	1100	5,800	8,200	4,600	540 U
Benzo(g,h,i)perylene	UG/KG	50000	4,600	4,900	2,700	540 U
Benzo(k)fluoranthene	UG/KG	1100	9,600	12,000	5,100	540 U
Chrysene	UG/KG	400	8,300	12,000	5,100	56 J
Dibenz(a,h)anthracene	UG/KG	14 or MDL	1,900 J	2,400 J	1,200 J	540 U
Fluoranthene	UG/KG	50000	15,000	24,000	8,400	95 J
Fluorene	UG/KG	50000	610 J	2,000 J	2,100 U	540 U
Indeno(1,2,3-cd)pyrene	UG/KG	3200	5,000	6,100	3,000	540 U
Naphthalene	UG/KG	13000	410 U	680 J	2,100 U	540 U
Phenanthrene	UG/KG	50000	7,300	18,000	2,000 J	51 J
Pyrene	UG/KG	50000	14,000	22,000	9,400	89 J
Total PAH's	UG/KG	-	94,060	145,880	53,880	389

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised) - Recommended Soil Cleanup Objective.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria.

SB - Site Background MDL - Method Detection Limit

J - The reported concentration is an estimated value.

B (metals only) - The reported concentration is above the method detection limit but below the quantitation limit.

U - Not detected above the reported quantitation limit. UJ - Not detected. The reported quantitation limit is an estimated value.

Detection Limits shown are PQL

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TABLE 1
SOIL ANALYTICAL RESULTS
NYSEG - SENECA FALLS

Location ID			SFSS00020201	SFSS00020201	SFSS00020202	SFSS00020203
Sample ID			SFSS00020201	SFSS00020204DUP	SFSS00020202	SFSS00020203
Matrix			Soil	Soil	Soil	Soil
Depth Interval (ft)			0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled			11/26/02	11/26/02	11/26/02	11/26/02
Parameter	Units	Criteria*		Field Duplicate (1-1)		
Polychlorinated Biphenyls						
Aroclor 1016	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1221	UG/KG	1000	42 U	41 U	43 U	54 U
Aroclor 1232	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1242	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1248	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1254	UG/KG	1000	120	120	88 J	15 J
Aroclor 1260	UG/KG	1000	22 U	21 U	22 U	28 U
Metals						
Aluminum	MG/KG	SB	7,550	7,850	7,700	13,500
Antimony	MG/KG	SB	13.4 UJ	11.3 UJ	1.8 BJ	15 UJ
Arsenic	MG/KG	7.5 or SB	8.7 B	7.6 B	15.4	8 B
Barium	MG/KG	300 or SB	120	94.9	1,070	114
Beryllium	MG/KG	0.16 or SB	2.3 U	0.52 B	0.6 B	2 B
Cadmium	MG/KG	1 or SB	3.4 U	2.9 U	2.4 B	3.9 U
Calcium	MG/KG	SB	32,200 J	51,800 J	17,500 J	2,930 J
Chromium	MG/KG	10 or SB	15.4	13.1	17.9	13.8
Cobalt	MG/KG	30 or SB	7.0	6.4	8.2	16.1
Copper	MG/KG	25 or SB	93.5	96.6	67.9	74.1
Iron	MG/KG	2000 or SB	21,700	17,300	13,000	3,800
Lead	MG/KG	SB	221	182	2,150	41.1
Magnesium	MG/KG	SB	11,100	11,300	5,420	317
Manganese	MG/KG	SB	437	406	287	34.9
Mercury	MG/KG	0.1	0.73 B	0.49 B	0.45 B	0.1 B

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised) - Recommended Soil Cleanup Objective.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria.

SB - Site Background MDL - Method Detection Limit
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Detection Limits shown are PQL

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[MATRIX] = 'SO'

TABLE 1
SOIL ANALYTICAL RESULTS
NYSEG - SENECA FALLS

Location ID			SFSS00020201	SFSS00020201	SFSS00020202	SFSS00020203
Sample ID			SFSS00020201	SFSS00020204DUP	SFSS00020202	SFSS00020203
Matrix			Soil	Soil	Soil	Soil
Depth Interval (ft)			0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled			11/26/02	11/26/02	11/26/02	11/26/02
Parameter	Units	Criteria*		Field Duplicate (1-1)		
Metals						
Nickel	MG/KG	13 or SB	17.2	16.2	18.9	26.5
Potassium	MG/KG	SB	2,420 J	2,630 J	1,710 J	1,490 J
Selenium	MG/KG	2 or SB	18.4 UJ	15.5 UJ	2.3 BJ	20.5 UJ
Silver	MG/KG	SB	3.4 U	2.9 U	0.42 B	3.9 U
Sodium	MG/KG	SB	140	186	157	234
Thallium	MG/KG	SB	25.2 U	21.3 U	24.6 U	28.2 U
Vanadium	MG/KG	150 or SB	23.5	19.1	25.1	31.2
Zinc	MG/KG	20 or SB	183	167	1,650	53.9
Miscellaneous Parameters						
Cyanide	UG/KG	-	631 U	599 U	203 B	788 U
Cyanide, Amenable To Chlorination	UG/KG	-	631 U	599 U	203 B	788 U
Phenolics, Total Recoverable	MG/KG	-	1.7	2.9	1.4	0.74

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised) - Recommended Soil Cleanup Objective.

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Concentration Exceeds Criteria.

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Detection Limits shown are PQL

FIELD SAMPLING PLAN
SENECA FALLS FORMER MGP SITE
187 FALL STREET
SENECA FALLS, NEW YORK

by

Haley & Aldrich of New York
Rochester, New York

for

New York State Electric & Gas Corporation
Binghamton, New York

File No. 34507-001
10 July 2007
Revised 11 September 2007

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(continued)

1. INTRODUCTION

1.1 General

This Field Sampling Plan (FSP) supports the Preliminary Site Assessment (PSA) Work Plan prepared by Haley & Aldrich of New York (Haley & Aldrich) for the Seneca Falls Former Manufactured Gas Plant (MGP) site (Site) located in Seneca Falls, New York. The investigation locations described in the PSA Work Plan are shown on Figure 2 of the Work Plan. The PSA Work Plan and this FSP were prepared on behalf of New York State Electric & Gas Corporation (NYSEG).

This FSP addresses the field procedures and sample collection methods to be used during implementation of the investigation field activities. The FSP should be used in conjunction with the PSA Work Plan, the Quality Assurance Project Plan (QAPP), the Health and Safety Plan (HASP), and the Community Air Monitoring Plan (CAMP). The PSA Work Plan presents the Site background and defines the field sampling program. The QAPP presents the quality assurance/quality control (QA/QC) procedures to be used during implementation of the PSA Work Plan, as well as a description of the general field and laboratory procedures. The QAPP and CAMP are provided in Appendix E and Appendix F of the PSA Work Plan and the HASP is a separate project-specific document.

1.2 Project Objectives

The purpose of the field investigation activities outlined in the PSA Work Plan is to provide data to address the following objectives:

- Determine if MGP-related and/or non-MGP-related chemical constituents are present in soil and/or groundwater at the Site;

- Identify the potential presence of MGP-related and/or non-MGP-related by-product residuals (such as coal tar, non-aqueous phase liquid (NAPL), purifier wastes, petroleum, solvents, etc.) in soil and/or groundwater at the Site;

- Evaluate, to the extent practicable, whether groundwater flow may be a pathway for offsite migration of identified chemical constituents (if present);

- Determine compliance with applicable NYSDEC standards, criteria, and guidance values (SCGs); and

- Provide sufficient data to evaluate the necessity for further action.

1.3 Overview of Investigation Field Activities

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

- Surface soil sampling;
- Test pitting and sampling;
- Soil boring and sampling;
- Monitoring well installation;
- Comprehensive measurement round(s) of groundwater levels; and

- Groundwater sampling of monitoring wells.

The sampling locations and quantities for each field sampling activity are described in detail in the PSA Work Plan Table 1, and therefore, are not further described in this FSP. Soil and groundwater samples will be analyzed for volatile organic compounds (VOCs), semi-VOCs, metals, and cyanide, and waste characterization parameters, as discussed in the PSA Work Plan. Table 1 of the QAPP presents the anticipated number of samples for specific laboratory analyses from each matrix type.

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

2. FIELD ACTIVITIES

2.1 General Field Guidelines

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

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

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

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

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

- Name of author, date of entry, and physical/environmental conditions during field activity;
- Purpose of sampling activity;
- Location of sampling activity;
- Name of field crew members;
- Name of any site visitors;
- Sample media (soil, groundwater, etc.);
- Sample collection method;

- Number and volume of sample(s) taken;
- Description of sampling point(s);
- Volume of groundwater removed before sampling (where appropriate);
- Preservatives used;
- Date and time of collection;
- Sample identification number(s);
- Field observations; and
- Any field measurements made, such as pH, temperature, conductivity, water-level, etc.

Original data recorded in field log books, task-appropriate forms, and Chain of Custody Records will be written with indelible ink. If an error is made on a document, corrections will be made by crossing a single line through the error and entering the correct information. The erroneous information will not be erased. Any subsequent error discovered on a document will be corrected by the person who made the entry. Subsequent corrections will be initialed and dated.

2.2 Sample Labeling, Packing, and Shipping

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

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

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

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

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

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

- A drain plug (if present) that has been sealed with duct tape;
- Water ice packaged in re-sealable plastic bags;
- Appropriate packaging material to help ensure sample integrity while being transported; and
- The completed chain-of-custody in a re-sealable plastic bag, taped in place on the inside cover of the cooler.

The cooler will then be sealed with tape. Samples will be hand delivered or delivered by an express carrier within 48 hours of sample collection. The express carrier will not be required to sign the chain-of-custody form; however, the shipping receipt should be retained by the sampler, and forwarded to the project files. See OP3001 – Preservation and Shipment of Environmental Samples, included in Appendix D-5, for a detailed description of sample handling procedures.

2.3 Equipment Decontamination

2.3.1 Drill Rig Decontamination

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

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

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

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

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

2.3.2 Sampling Equipment Decontamination

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

2.4 Surface Soil Sampling

Surface soil samples will be collected using a stainless steel spoons or trowels. Devices plated with chrome or other exterior coatings that may chemically alter the sample should not be used. Soils will be visually characterized for color, texture, density, layering, and moisture content and described in accordance with OP2001 – Identification and Description of Soils in the Field Using Visual-Manual Methods. The presence of MGP-related fill materials, NAPL, and obvious odors will be recorded. Surface soil samples will be collected from 0- to 2-inch below sod/topsoil.

Samples will be collected with pre-cleaned cleaned stainless steel spoons or trowels. Non-dedicated stainless steel spoons or trowels and bowels used in sample homogenization will be decontaminated, as specified in Section 2.3.2, after each sample is collected. The top layer of sod should be neatly removed to access undisturbed soils from 0- to 2-inch below sod. Soil for volatile organic analysis should be transfer directly into an appropriate, labeled sample container with a stainless steel lab spoon. The remainder of the sample should be placed in a stainless steel homogenization container (i.e. stainless steel mixing bowel), and mixed thoroughly to obtain a homogenous sample representative of the entire sampling interval, than paced into appropriate, labeled containers. Sample descriptions, PID readings, and location will be recorded in the field book or on the task-appropriate form. Calibration, operation, and maintenance procedures are included as Appendix D-2 for one type of PID commonly used in the field. Surface soil sampling procedures are outlined in OP3003 – Surficial Soil Sampling, included in Appendix D-5.

2.5 Subsurface Soil Sampling

2.5.1 Direct Push/Macrocore Sampling Method

Shallow-subsurface soil borings will be collected using a tractor mounted direct push unit and 4-foot macrocores. Soils will be visually characterized for color, texture, density, layering, and moisture content and described in accordance with OP2001 – Identification and Description of Soils in the Field Using Visual-Manual Methods. The presence of MGP-related fill materials, NAPL, and obvious odors will be recorded. Borings will be completed to a depth of 2 feet below grade, or to the vertical extent of impacts, if observed.

Samples will be collected with disposable macrocore liners. Non-dedicated stainless steel spoons or trowels used in sample homogenization will be decontaminated, as specified in Section 2.3.2, after each sample is collected. Sample descriptions, PID readings, and location will be recorded in the field book or on the task-appropriate form. Calibration, operation, and maintenance procedures are included as Appendix D-2 for one type of PID commonly used in the field. A detailed description of soil boring and subsurface soil sampling procedures is listed OP2005 – Test Borings, Sampling, Standard Penetration Testing (SPT) and Borehole Abandonment, included in Appendix D-5.

2.5.2 Split-Spoon/Macrocore Sampling Method

Soils will be visually characterized for color, texture, density, layering, and moisture content and described in accordance with OP2001 – Identification and Description of Soils in the Field Using Visual-Manual Methods. The presence of MGP-related fill materials, NAPL, and obvious odors will be recorded. Soil borings will be completed to a depth of refusal (if encountered) or to a confining unit, or when visual signs of impact are not observed in the last 6 feet of sample using 3¼-inch inside diameter (ID) hollow stem augers or 4-foot long direct push macrocores. Continuous soil sampling will be conducted at the boring locations by advancing a 2-foot long, 2-inch outer diameter (OD) split-spoon. Samples will be selected for laboratory analysis based on:

- their position in relation to potential source areas;

- the visual presence of source materials;
- the relative levels of volatile organics based on PID field screening measurements; and/or
- the discretion of the onsite geologist.

Split-spoon samplers will be decontaminated, as specified in Section 2.3.2, before use and after each sample is collected. Sample descriptions, PID readings, and location will be recorded in the field book or on the task-appropriate form. Calibration, operation, and maintenance procedures are included as Appendix D-2 for one type of PID commonly used in the field. The procedures to be followed will be dependent on the PID acquired for this project, as described in the equipment manual. A detailed description of soil boring and subsurface soil sampling procedures is listed OP2005 – Test Borings, Sampling, Standard Penetration Testing (SPT) and Borehole Abandonment, included in Appendix D-5.

2.5.3 Test Pits

Test pits will be excavated using a rubber-tire or track excavator and will be excavated to the top of bedrock, saturated zone, of former foundation. Excavated soils will be placed on plastic sheets. Soils will be characterized for color, texture, and moisture content and described in accordance with OP2001 – Identification and Description of Soils in the Field Using Visual-Manual Methods. The presence of visible staining, NAPL, and obvious odors will be recorded. The actual number, size, and placement of test pits will be based on field conditions and observations of soil conditions obtained from each test pit and will be determined in consultation with NYSDEC. Proposed test pit locations and depth may be modified thought the execution of the excavation as the accumulated geologic data and any test results are interpreted.

For samples that may be submitted for chemical analysis, stainless steel spoons, trowels, or other non-dedicated sampling devices will be decontaminated, as specified in Section 2.3.2, after each sample is collected. Sample descriptions, PID readings, and location will be recorded in the field book or on the task-appropriate form. Calibration, operation, and maintenance procedures are included as Appendix D-2 for one type of PID commonly used in the field. Test pitting procedures are described in OP2026 – Exploratory Test Pits, included in Appendix D-5.

2.6 Surface/Subsurface Soil Sample Collection

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

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

- Site;

- boring number;
- interval sampled;
- date; and
- initials of sampling personnel.

These soil samples will be screened for organic vapors using a PID. In addition, a geologist will be on site during the drilling operations to describe each sample in accordance with the Unified Soil Classification System (USCS), and will include:

- soil type and sorting;
- color;
- feet of recovery;
- moisture content;
- texture;
- grain size and shape;
- relative density;
- consistency;
- visible evidence of residues; and
- miscellaneous observation.

2.7 Monitoring Well Installation and Development

Monitoring wells will be installed to the depths and at the locations defined in the PSA Work Plan. NYSEG anticipates that the PSA groundwater investigation will consist of installing up to six overburden monitoring wells at the (general) locations shown on Figure 2 of the PSA Work Plan. Based on subsurface conditions encountered (including the depth of groundwater, the depth of bedrock, and the presence/extent of NAPL), one of more of the monitoring wells (or additional wells, if needed) may be installed as overburden/bedrock interface wells or bedrock monitoring wells. Should the need for bedrock wells be discovered during the implementation of the PSA work plan, the Department will be notified and the placement and need of such wells discussed. After completion of drilling and well installation, the wells will be developed to establish hydraulic connection between the well and the formation. The following procedures will be used to drill, install, and develop monitoring wells.

2.7.1 Overburden Drilling

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

- Boreholes in the overburden will be drilled with hollow stem augers or 4-foot long direct push macrocores. Soil borings will be completed to the depth of refusal (if encountered).

- Continuous soil sampling will be conducted at the monitoring well borings using a 2-foot long, 2-inch OD split-spoon ahead of the augers or a 4-foot long macrocore sampling device as described in Section 2.4 of the FSP.

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

- A plywood sheet or tub will be placed around the auger or casing when drilling to contain cuttings at all boring locations.

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

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

2.7.2 Bedrock Coring

Should bedrock wells be needed, bedrock cores (if necessary) will be completed using an Hx-size core barrel, in accordance with ASTM D 2113 Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation. Rock cores will be obtained in the bedrock up to 10 foot lengths. Rock coring will be completed using water for cooling of apparatus (steel casing, core barrel, and the diamond bit) and to remove any cuttings that may clog the core barrel prior to its introduction into the core hole. Drill water will be re-circulated through a large container (recirculation tub) to minimize water use at each location. Core samples will be placed in wood boxes and wood blocks will be labeled and placed at the end of each core run to indicate the run number. Missing sections of core will be shown by wood spacer blocks indicating the run number and footage of the missing core. The wooden core box will be labeled on the outside top and inside lid with the following information: site, date, job number, wooden box number (i.e., box 1 of 2), boring number, run number(s), and run interval(s). Additional information, such as actual recovery, rock quality degree (RQD), PID readings, and any comments, will also re recorded on the inside lid.

The geologist will be responsible for recording mechanical and geological characteristics of the rock core. The mechanical characteristics will include: penetration rates, RQD, percent recovery, water loss, and bit type and size. The retrieved rock cores will be characterized for color, rock type, grain size, bedding planes or foliation, mineralogy, fractures, nature of voids, vugs or cavities, hardness, and degree of weathering.

2.7.3 Monitoring Well Specifications

Appendix D-3 shows typical monitoring well construction details for shallow overburden wells and bedrock monitoring wells. Monitoring well specifications for overburden, overburden/bedrock interface wells, and bedrock monitoring wells are presented below.

2.7.3.1 Overburden Monitoring Wells

The overburden monitoring wells will be installed according to the following specifications:

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

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

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

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

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

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

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

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

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

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

- The measuring point on wells will be on the innermost PVC casing, at the north side of the casing.

Exact well construction details, including the following characteristics of each newly installed well, will be recorded in the field log book/task-appropriate form:

- Date/time of construction;
- Drilling method and drilling fluid used;
- Approximate well location;
- Borehole diameter and well casing diameter;
- Well depth;
- Drilling and lithologic logs;
- Casing materials;
- Screen materials and design;
- Sump depth, if installed;
- Casing and screen joint type;
- Screen slot size/length;
- Filter pack material/size;
- Filter pack placement method;
- Sealant materials;

- Sealant placement method;
- Surface seal design/construction;
- Well development procedure;
- Type of protective well cap; and
- Detailed drawing of well (including dimensions).

2.7.3.2 Overburden/Bedrock Interface Monitoring Wells

If saturated conditions are encountered just above bedrock, then a monitoring well will be installed at the overburden/bedrock interface and the screen will be placed to straddle the ground-water table. If the bedrock is sufficiently weathered or soft enough to be sampled with a split-spoon sampler, then the sampling/advancement of the borehole with HSA can continue. If not, the boring can be advanced into the upper portion of the bedrock with a 4-inch nominal diameter tri-cone bit. Water used during advancement of the tri-cone bit will be containerized for subsequent disposal by NYSEG. The borehole should be advanced approximately 4 to 5 feet into bedrock so that the 10-foot long monitoring well screen will be placed across the water table surface.

Monitoring wells will be installed by placing the screen and casing assembly with DNAPL sump into the auger-string after the screen interval has been selected. Well screen will consist of a ten foot length of 2-inch diameter 0.020-inch slot Schedule 40 PVC screen. A two foot length Schedule 40 PVC DNAPL sump will be tremie-grouted in place with cement, and the cement grout will be allowed to cure for a minimum of 24 hours. At that time, a washed silica sand pack will be placed in the annular space opposite the screen to one to two feet above the top of the screen as the auger string is removed from the hole. A hydrated bentonite pellet seal or slurry will then be added to the annulus for 1 to 2 feet above the sand pack as the augers are extracted. A cement-bentonite grout will be added above the bentonite seal during the extraction of the augers to ground surface. During placement of sand and bentonite, frequent measurements will be made to check the height of the sand pack and thickness of bentonite using a weighted tape measure.

A stick-up protective standpipe shall be located over the well casing. A 12-inch thick surface seal shall extend laterally at least one foot in all directions from the protective casing. A lockable cap will be placed on the protective casing and secured with a pad lock. A weep hole will be installed through the protective standpipe casing at all overburden/bedrock interface stick-up monitoring wells. If a flush-mount curb box is installed, the cover will be secured in a neat portland cement or concrete surface seal. A lockable non-vented cover will be placed on the well and the flush-mount curb box secured with a bolt-down cover.

The onsite geologist shall specify the monitoring well design to the drilling contractor before installation. An alternate monitoring well construction method can be used if the water table is within approximately 4.0 feet of the surface. If these conditions are encountered, the thickness of the sand and bentonite would be reduced as necessary and the depth of the protective casing would be modified as necessary. If required, a protective reinforced concrete collar, approximately six inches thick and 30 inches in diameter, will be installed at grade which will hold a locking steel protective casing. For added protection of the monitoring wells guard posts may be added. Monitoring wells will be labeled with the appropriate designation on the outer well casings.

2.7.3.3 Bedrock Monitoring Wells

A bedrock monitoring well will be installed at locations where ground water is not encountered in the overburden.

Once the top of bedrock is determined by auger refusal, a permanent surface casing will be installed to minimize the possible introduction of constituents from the overburden into the bedrock during bedrock coring. The surface casing will be installed using one of two methods depending on site conditions.

If the depth to bedrock is minimal and the overburden materials not susceptible to significant collapse, the permanent casing can be installed as follows:

- Using 4 1/4-inch ID HSA, advance the augers to approximately 0.5 feet into the surface of the bedrock.

- Fill the augers with cement/bentonite grout and then withdraw the augers from the borehole, adding sufficient grout to the borehole to minimize collapse of the borehole wall.

- Install 4-inch diameter permanent casing to the total depth of the borehole (approximately 0.5 to 1.0 foot into the top of the bedrock).

- Top the grout off in the borehole. The grout in the casing can be diluted with water if desired, however, the grout at the base of the casing should not be disturbed.

- Wait a minimum of 24 hours for the grout to set prior to drilling out the grout within the casing and initiating coring of the bedrock.

If the depth to bedrock is large and/or the overburden materials are likely to collapse into the borehole following auger removal, the permanent casing will be installed as follows:

- Using 8¼-inch ID HSA advance the augers to approximately 0.5 feet into the surface of the bedrock.

- Install the 4-inch diameter permanent casing into the auger string to the total depth of the borehole.

- Using a tremie pipe, tremie cement/bentonite grout into the annulus between the HSA and the 4-inch casing.

- Remove the HSA and maintain the level of grout in the borehole at grade. If desired dilute the grout in the casing with water, being careful not to disturb the grout at the base of the casing.

- As above, wait a minimum of 24 hours prior to initiating coring through the permanent casing.

Coring of the bedrock through the casing will be completed as described in Section 2.5.2.

Once the desired depth is reached, the drilling rods and core barrel will be removed, and a 2-inch diameter PVC casing and 10-foot long, 0.020-inch slot PVC screen will be placed into the core-hole. A 2-foot length PVC DNAPL sump will be installed on the bottom of the well screen and tremie-grouted in place with cement. The cement-grout seal around the DNAPL sump will be allowed to cure for a minimum of 24 hours before the installation of the sand pack. A silica sand pack will be placed in the annular space opposite the PVC well screen between 1 and 2 feet above the screen. Bentonite will then be added to the annulus between the casing and the core-hole wall for at least 2 feet. A cement-bentonite grout will then be added above the bentonite seal to approximately 0.5 feet below the ground surface. A locking well cap will be installed on all monitoring wells. A stickup protective casing or flush-mount curb box will be placed over the well, depending on the location. A weep hole will be installed through the protective standpipe casing at all bedrock stick-up monitoring well locations.

The onsite geologist shall specify the monitoring well design to the drilling contractor before installation. The onsite geologist is responsible for recording the exact well details, as relayed by the drilling contractor, and measuring the actual details. Both the onsite geologist and drilling contractor are responsible for tabulating all well materials used, such as footage of casing and bags of grout or cement.

2.7.4 Monitoring Well Development

A minimum of 24 hours after installation, the monitoring wells will be developed by surging/bailing, using a submersible pump and dedicated polyethylene tubing, or by Waterra inertial displacement pump (or equivalent) and dedicated polyethylene tubing, or other methods at the discretion of the field geologist. Bailing and pumping will continue until the turbidity is reduced to 50 nephelometric turbidity units (NTUs) or less, or until pH and conductivity measurements stabilize, assuming a minimum of 10 well volumes of water have been removed from the monitoring well during development. The development water will be placed in steel 55-gallon drums or an onsite polyethylene storage tank for storage prior to being transported for offsite disposal by NYSEG. Following development, wells will be allowed to recover for a minimum of two weeks before groundwater is purged and sampled. Monitoring well development will be overseen by a qualified person and the duration, method of development, and approximate volume of water removed will be recorded in the field book or task-appropriate form. Monitoring well development procedures are described in detail in OP3009 – Monitoring Well Development Procedure, included in Appendix D-5.

2.8 Fluid-Level Measurements

A round of fluid-level elevations will be collected in conjunction with each groundwater sampling event, as discussed in the PSA Work Plan. The measurements will be made in as short a timeframe as practical to minimize temporal fluctuations in hydraulic conditions. The following procedure will be used to measure fluid-level depths at monitoring wells:

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

2.9 Low-Flow Groundwater Sampling Procedures for Monitoring Wells

This protocol describes the procedures to be used to collect groundwater samples. OP3012 – Low Stress/Low Flow Groundwater Sample Collection Procedure is included in Appendix D-5. Wells will not be sampled until well development has been performed. During heavy precipitation events, groundwater sampling will be discontinued until precipitation ceases. When one round of water levels is taken to generate water-elevation data, the water levels will be taken consecutively at one time prior to sampling or other activities.

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

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

The following 21 steps detail the monitoring well sampling procedures:

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

2. Identify site and well sampled on sampling log sheets, along with date, arrival time, and weather conditions. Identify the personnel and equipment used and other pertinent data requested on the logs. A groundwater sampling log is provided as Appendix D-4.

3. Label sample containers using an appropriate label.

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

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

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

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

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

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

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

11. After groundwater elevations are measured and NAPLs are determined not to be present, groundwater will be purged from the wells. If NAPLs are determined present, then a groundwater sample will not be collected (except where specified in the Work Plan), rather a representative NAPL sample may be collected (if required) using a peristaltic pump or other suitable method.

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

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

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

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

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

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

16. After the groundwater quality parameters have stabilized as discussed above, obtain the groundwater sample needed for analysis (except for VOCs) directly from the sampling device in the appropriate container and tightly screw on the caps. Remove the pump and collect a groundwater sample for VOC analysis using a clean disposable bailer.

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

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

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

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

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

2.10 Air Monitoring

Air monitoring will be conducted with a photoionization detector (PID) and a Real-Time Aerosol Monitor (mini-RAM) during intrusive activities and only a PID during sampling activities. The PID will be used to monitor organic vapors in the breathing zone and borehole, and to screen samples for analysis and the aerosol monitor will be used to monitor particulate concentration in the breathing zone for particulates less than 10 microns in diameter.

The PID and dust monitor readings will be recorded in the field book during drilling activities. The instruments will be calibrated at least once each day and more frequently if needed. A detailed procedure for the PID calibration is included as Appendix D-2.

3. FIELD INSTRUMENTS

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

3.1 Portable Photoionization Analyzer

The photoionization analyzer will be a MiniRAE 2000 (or equivalent), equipped with a 10.6 eV lamp. The MiniRAE 2000 is capable of ionizing and detecting compounds with an ionization potential of 10.6 eV or less. . This accounts for up to 73 percent of the VOCs on the Target Compound List. Calibration will be performed according to the procedures outlined in Appendix D-2.

3.2 Aerosol Monitor

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

3.3 pH Meter

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

3.4 Specific Conductivity Meter

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

3.5 Water-level Meter

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

3.6 Turbidity Meter

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

APPENDIX D-1

Sample Chain-of-Custody Form

Haley & Aldrich, Inc.
465 Medford St.,
Suite 2200,
Boston, MA 02129-1400

CHAIN OF CUSTODY RECORD

Phone (617) 886-7400
Fax (617) 886-7600

Page of

H&A FILE NO.		LABORATORY		DELIVERY DATE	
PROJECT NAME		ADDRESS		TURNAROUND TIME	
H&A CONTACT		CONTACT		PROJECT MANAGER	

Sample No.	Date	Time	Depth	Type	Analysis Requested: VOA	ABNs PAH only	MCP Metals	Pesticides PCBs	VPH Full Suite C-ranges only	EPH Full Suite C-ranges only	TPH (specify)	TCLP (specify)	Reactivity Ignitability Corrosivity				Number of Containers	Comments (special instructions, precautions, additional method numbers, etc.)
																		Laboratory to use applicable DEP CAM methods, unless otherwise directed.

Sampled and Relinquished by	Received by
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time

LIQUID

												VOA Vial
												Amber Glass
												Plastic Bottle
												Preservative
												Volume

SOLID

												VOA Vial
												Amber Glass
												Clear Glass
												Preservative
												Volume

PRESERVATION KEY

A Sample chilled	C NaOH	E H_2SO_4	G Methanol
B Sample filtered	D HNO_3	F HCL	H Sodium Bisulfate

Sampling Comments

Evidence samples were tampered with? YES NO

If YES, please explain in section below.

Presumptive Certainty Data Package (Laboratory to use applicable DEP CAM methods)

If Presumptive Certainty Data Package is needed, initial all sections:

__________ The required minimum field QC samples, as designated in BWSC CAM-VII have been or will be collected, as appropriate, to meet the requirements of Presumptive Certainty.

__________ Matrix Spike (MS) samples for MCP Metals and/or Cyanide are included and identified herein.

__________ This Chain of Custody Record (specify)__________includes _________does not include samples defined as Drinking Water Samples.

__________ If this Chain of Custody Record identifies samples defined as Drinking Water Samples, Trip Blanks and Field Duplicates are included and identified and analysis of TICs are required, as appropriate. Laboratory should (specify if applicable)_________analyze _________hold for contingency testing the Drinking Water Field Duplicate and Drinking Water Trip Blank samples.

Required Reporting Limits and Data Quality Objectives

- ☐ RC-S1 ☐ S1 ☐ GW1
- ☐ RC-S2 ☐ S2 ☐ GW2
- ☐ RC-GW1 ☐ S3 ☐ GW3
- ☐ RC-GW2

WHITE - Laboratory **CANARY** - Project Manager **PINK** - Haley & Aldrich Laboratory **GOLDENROD** - Haley & Aldrich Contact **AUGUST 2003**

Form 3003

APPENDIX D-2

MiniRAE 2000 Photoionization Detector Calibration, Operation, and Maintenance Procedures

OPERATING PROCEDURE: OP1004

OPERATION/CALIBRATION OF PID PHOTOIONIZATION DETECTOR

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	JWL / Dec. 02	CLM / Oct. 02	GJM / June 03		JAK / Aug. 03

Total Pages: 6

HALEY & ALDRICH

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OPERATING PROCEDURE: OP1004

OPERATION/CALIBRATION OF PID PHOTOIONIZATION DETECTOR

1. PURPOSE

This procedure describes the operation and calibration techniques for the Model PI 101 Photoionization Detector, manufactured by HNU Systems, Inc. The instrument will measure organic vapor levels. There are three direct reading ranges: 0-20 ppm, 0-200 ppm and 0-2,000 ppm at a minimum gain (all specifications are benzene referred). The detection limit is 0.1 ppm. The linear range is 0.1-600 ppm. The response time is less than 3 seconds to 90% of full scale. The instrument will have an 11.7 eV UV lamp.

2. EQUIPMENT & SUPPLIES

2.1 Supporting Materials

- HNU PI 101 instrument with 10.2 or 11.7 eV UV lamp
- Span gas cylinders: 100 ppm isobutylene in air
- Calibration "Tee" with rotometer

3. PROCEDURE

3.1 Responsibilities

The Site Technician will be responsible for the calibration, operation and maintenance of the photoionization detector (PID).

The Safety Officer will be responsible for insuring that the work is performed and that the required data is collected.

3.2 Operation

The location and extent of use of the PID will be determined by the Safety Officer.

The following procedures will be performed daily, prior to initiation of air monitoring activities and after an instrument warm-up period. The following are general operating instructions for the instrument; more detailed instructions are provided in the manufacturer's operation manual.

1. Instrument zero: Turn the function switch to the stand-by position. If the meter does not read zero, rotate the zero potentiometer until a zero reading is obtained. Wait 15-20 seconds to ensure that the reading is stable. If not, readjust andre-check.

2. Calibration: Turn the function switch to the measurement range to be used for sampling. Attach the 8" probe extension to the calibration "Tee", then attach the calibration gas cylinder and rotometer to the remaining connections on the "Tee". Open the cylinder until a slight flow is detected on the rotometer. The HNU unit draws the volume of sample for detection and the excess is indicated on the rotometer. Adjust the span potentiometer so that the instrument reading is the exact value of the calibration gas. Close and remove the span gas. If the instrument span setting is changed, the instrument zero step will be repeated.

3. All calibration checks will be documented in the Site Log Book.

4. Operation: Verify that the function switch is at the measurement range in use during normal sampling. Note the instrument readings during the site visit.

3.3 Repair and Maintenance

If the instrument fails to function as per manufacturer's specifications, it will be replaced with a spare. The defective unit should be sent to the manufacturer for diagnostic treatment and correction.

APPENDIX A
RELATED HALEY & ALDRICH PROCEDURES

- OP1005 Operation/Calibration of FID Flame Ionization Detector
- OP1006 Operation of Draeger Gas Detector Pump
- OP1007 Field Monitoring for Volatile Organics (breathing space-work zone)
- OP1009 Medical Surveillance Program
- OP1010 Health and Safety Plans

APPENDIX B
GLOSSARY

APPENDIX D-3

Monitoring Well Construction Diagrams (Overburden and Bedrock Monitoring Wells)

HALEY & ALDRICH

OBSERVATION WELL INSTALLATION REPORT

Well No.

Boring No.

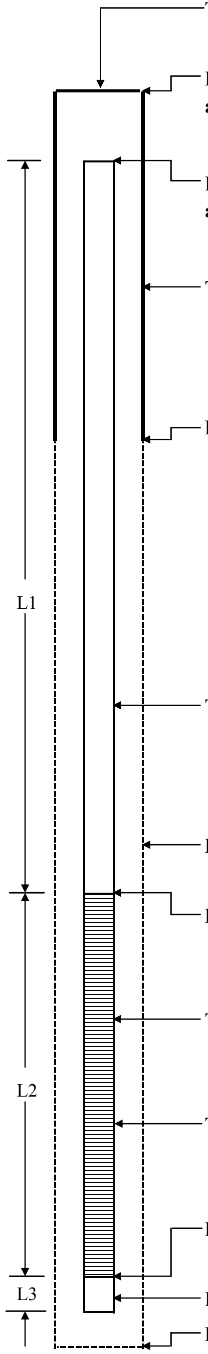
PROJECT ______ H&A FILE NO. ______
LOCATION ______ PROJECT MGR. ______
CLIENT ______ FIELD REP. ______
CONTRACTOR ______ DATE INSTALLED ______
DRILLER ______ WATER LEVEL ______

Ground El. ______ ft
El. Datum ______
Location ______

☐ Guard Pipe
☐ Roadway Box

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock ______

Height/Depth of top of guard pipe/roadway box above/below ground surface ______ ft

Height/Depth of top of riser pipe above/below ground surface ______ ft

Type of protective casing: ______
Length ______ ft
Inside Diameter ______ in

Depth of bottom of guard pipe/roadway box ______ ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete		
Bentonite Seal		

Type of riser pipe: ______
Inside diameter of riser pipe ______ in
Type of backfill around riser ______

Diameter of borehole ______ in

Depth to top of well screen ______ ft

Type of screen ______
Screen gauge or size of openings ______ in
Diameter of screen ______ in
Type of backfill around screen ______

Depth of bottom of well screen ______ ft

Bottom of Silt trap ______ ft

Depth of bottom of borehole ______ ft

(Not to Scale)

______ ft + ______ ft + ______ ft = ______ ft
Riser Pay Length (L1) + Length of screen (L2) + Length of silt trap (L3) = Pay length

COMMENTS: ______

HALEY & ALDRICH

TEST BORING REPORT

BORING NO. B 7 (OW)

Page 1 of 2

PROJECT	Greenspace Development	**H&A FILE NO.**	27921-000
LOCATION	18 Riverside Road, Boston Massachusetts	**PROJECT MGR.**	S.R. Kraemer
CLIENT	Ecologic Investments	**FIELD REP.**	C.S. Osgood
CONTRACTOR	Guild Drilling Co., Inc.	**DATE STARTED**	13-Feb-01
DRILLER	Charlie O'Donnel	**DATE FINISHED**	14-Feb-01

Elevation 23.3 ft. **Datum** Boston City **Boring Location** See sketch on reverse of form.

Item	Casing	Sampler	Core Barrel	Rig Make & Model: CME 75			Hammer Type	Drilling Mud	Casing Advance
Type	NW	S	NV2	☑ Truck	☐ Tripod	☑ Cat-Head	☑ Safety	☑ Bentonite	Type Method Depth
Inside Diameter (in.)	3	1.385	2	☐ ATV	☐ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer	NW Driven 29.0 ft.
Hammer Weight (lb.)	300	140		☐ Track	☐ Air Track	☑ Roller Bit	☐ Automatic	☐ None	
Hammer Fall (in.)	24	30		☐ Skid	☐	☐ Cutting Head	Drilling Notes: Flushed slurry prior to coring.		

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																	
	10		0.0			SP-SM	Medium dense brown poorly graded SAND with silt (SP-SM),				20	70	10				
	12	S1					mps 2 mm, distinctly stratified, fines partially organic, no odor, dry.										
	15	21"															
	20		2.0		2.0		-ALLUVIUM-										
	11		2.0			SP	Dense brown poorly graded SAND (SP), mps 25 mm, no odor, dry.	5	5	20	30	35	5				
	15	S2															
	16	10"															
	17		4.0				-ALLUVIUM-										
					4.5												
5																	
	WOR		5.0				Very soft, dark brown ORGANIC SOILS with sand (OL/OH), trace					25	75	S	M	H	VH
	WOR	S3				OL/OH	seashell fragments and particles, soil mps 0.5 mm, strong										
	WOH	24"					organic odor, moist.										
	WOH		7.0				-ORGANIC DEPOSIT-										
					8.0												
							Note: Drilling fluid returning medium to fine sand from 8.0 ft. to										
							10.0 ft. Drilling fluid color change to yellow red at 8.5 ft.										
							-PROBABLE MARINE DEPOSIT-										
					10.0												
10																	
	3		10.0			CH	Stiff yellow brown fat CLAY (CH), trace fine sand, mps 0.5 mm,						100	N	M	H	
	6	S4					apparently laminated with frequent fine sand partings and										
	6	22"					possible organic fibers, no odor, moist.										
	6		12.0				-MARINE DEPOSIT-										
					13.5												
							Note: Drill action indicates gravel below 13.5 ft.										
15																	
	12		15.0			CL	Very stiff yellow brown to gray sandy lean CLAY with gravel (CL),	5	10	10	10	15	50	S	M	M	
	14	S5					mps 35 mm, distinct disrupted laminae in discrete zones, coarse										
	15	17"					fraction consists of well rounded igneous and igneous and										
	19		17.0				metamorphic lithologies, no odor, moist.										
							-GLACIOMARINE DEPOSIT-										
					18.0												
							Note: Drill action and total loss of drilling fluid indicates gravel										
					19.0		and cobbles from 18.0 ft. to 19.0 ft.										
							Very dense gray silty SAND (SM) , mps 15 mm, very well bonded,										
20																	
	21	S6	20.0			SM	coarse fraction consists partly of platy argillite fragments, no odor, moist.		10	15	20	30	25	R			
	25	10"	21.0		21.0		-GLACIAL TILL-										
	33	S6A	21.0			ML	Very dense gray SILT (ML), mps <0.1 mm, no structure, no odor,						100	R		N	
	34	7"	22.0				dry.										
							-RESIDUAL SOIL-										
							Note: Drilling advanced smoothly from 21.0 ft. to 25.0 ft.										
					25.0		PROBABLE TOP OF DECOMPOSED BEDROCK 25.0 FT.										
25																	
	53		25.0				Very dense gray highly to completely weathered ARGILLITE.										
	28	S7					Possible extremely thin relect bedding subparallel to strong										
	39	5"					low angle foliation. Sample is generally well bonded and consists										
	35		27.0				of very soft angular fragments and particles which are easily										
							crushed with finger pressure.										
							-DECOMPOSED BEDROCK-										
							Note: Drill action indicates stratum change at 28.5 ft.										
					28.5		TOP OF "SOUND" BEDROCK 28.5 FT.										
							SEE SHEET 2 FOR CORE BORING REPORT										
30																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water
13-Feb-01	15:30	0	29.0	29.0	2.0
14-Feb-01	7:00	15.5	29.0	29.0	6.2
14-Feb-01	15:00	1.0	39.5	39.5	10.4

Sample ID

O	Open End Rod
T	Thin Wall Tube
U	Undisturbed Sample
S	Split Spoon Sample
G	Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.)	29.5
Rock Cored (Linear ft.)	10.0
Number of Samples	S7 C2
BORING NO.	**B 7 (OW)**

Field Tests Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

CORE BORING REPORT

HALEY & ALDRICH

BORING NO.
B 7 (OW)
Page 2 of 2

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath- ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks
								SEE SHEET 1 TEST BORING REPORT FOR OVERBURDEN DETAILS.
							21.0	TOP OF RESIDUAL SOIL 21.0 FT.
								Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through residual
								soil from 21.0 ft. to 25.0 ft.
					Residual			
					Soil			-RESIDUAL SOIL-
							25.0	TOP OF DECOMPOSED BEDROCK 25.0 FT.
25								
					High			Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through
					to			decomposed bedrock from 25.0 ft. to 28.5 ft.
					Complete			
								-DECOMPOSED BEDROCK-
							28.5	TOP OF "SOUND" BEDROCK 28.5 FT.
								Note: Seated NW casing at 29.0 ft. Advanced borehole with rollerbit to 29.5 ft. without sampling
								prior to coring.
		29.5	56"		Slight			C1: Moderately hard, slightly weathered, gray, aphanitic ARGILLITE. Bedding extremely thin to
30								very thin, generally low angle (30-35 degrees). Foliation low angle, commonly subparallel to
	6							bedding. Cleavage well developed along bedding/foliation planes where coincident.
					Mod.			Cleavage joints very close to close 29.5 -31.0 ft. and close below 32.5 ft. smooth-planar,
	3	C1			High			slightly oxidized, occasionally calcite-infilled, tight. High angle to vertical joints moderately
					Mod.			close, rough-undulatory, pyritized or highly oxidized and decomposed with silt infilling, open.
	5							Soft, moderately to highly weathered zone 31.0-32.5 ft. associated with extremely close,
					Slight			moderately dipping, slickensided-planar shears intersecting bedding plane and high angle features.
	6							Note: Partial water loss below 31.0 ft.
		34.5	24"	40%				Note: Lost core assumed 31.7-32.0 ft.
	6	34.5	60"	100%				C2: Similar to bottom of run C1 except cleavage joints close to moderately close. High angle to
35								vertical joints absent. Occasional thin zone of extremely close, extremely thin, moderately
	7							dipping to high angle (50-60 degrees) calcite stringers. Occasional calcite-healed low angle
								joint.
	6	C2			Slight			-CAMBRIDGE FORMATION-
	6						38.0	
								Lithology change at 38.0 ft. to hard, slightly weathered, dark gray to black, fine grained to
	8							aphanitic DIABASE. Single high angle joint at 38.7 ft. rough-stepped, slightly oxidized, tight.
		39.5	54"	90%				
40	8							BOTTOM OF EXPLORATION 39.5 FT.

APPENDIX D-4

Groundwater Sampling Log

GROUNDWATER SAMPLING RECORD

Page of

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

GROUNDWATER SAMPLING INFORMATION

Well No.							
Water Depth (ft)							
Time							
Product							
Depth Of Well (ft)							
Inside Diameter (in)							
Standing Water Depth (ft) (1)							
Volume Of Water In Well (gal)							
Purging Device							
Volume of Bailer/Pump Capacity							
Cleaning Procedure							
Bails Removed/ Volume Removed							
Time Purging Started							
Time Purging Stopped							
Sampling Device							
Cleaning Procedure							
TIME SAMPLES TAKEN: TCL VOCs							
TCL SVOCs							
TAL Metals (including total Cyanide)							
PARAMETERS: Depth to Water (ft)							
Color							
Odor							
pH							
Conductivity							
Turbidity							
Dissolved Oxygen							
Temp, ^{0} C							
Salinity							

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

1. Standing Water Depth = Depth of Well - Water Depth

APPENDIX D-5

Operating Procedures

OPERATING PROCEDURE: OP2001

IDENTIFICATION AND DESCRIPTION OF SOILS IN THE FIELD USING VISUAL-MANUAL METHODS

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	MPD, SAN, CSO: 5-02	SAN: 5-02	EBK: 5-02	STP/6-1-03	SRK/7-1-03
Ver. 0.1	CSO: 1-13-03				

Total Pages: 53

HALEY & ALDRICH

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OPERATING PROCEDURE: OP2001

IDENTIFICATION AND DESCRIPTION OF SOILS IN THE FIELD USING VISUAL-MANUAL METHODS

1. PURPOSE

This procedure provides methods of identifying soils in a field or office setting using visual examination and simple manual tests. Soil identification produces a Group Symbol and a Group Name for each soil identified. The Group Names and Group Symbols are based on the Unified Soil Classification System (USCS) described in ASTM Standard D2487. It is important to note that this method produces a **SOIL IDENTIFICATION** based on simple observations and does not produce a SOIL CLASSIFICATION. Soil classifications are determined using ASTM D2487 and require laboratory test results which may not be available for every project.

Additional descriptive information is also determined for each soil reviewed. The description includes soil properties such as color, consistency, odor, etc.

Haley & Aldrich (H&A) personnel are to use the techniques in OP2001 to identify and describe all soil samples from any source. The nature of this soil identification procedure makes it adaptable to various types of geologic terrain and provides a high degree of reproducibility and understanding among geoscience professionals everywhere.

IMPORTANT NOTE: It is not necessary to follow all of the methods in this procedure for every sample. Soils which appear similar can be grouped together based on one or two samples completely identified and described. Similar samples can be identified as the same soil based on performing only a few of the identification and descriptive procedures.

2. EQUIPMENT & SUPPLIES

	Required		Optional
1.	Knife, pocket	7.	Penetrometer, pocket
2.	Ruler, engineer's 6 ft. folding	8.	Torvane, pocket
3.	Scale, engineer's	9.	Color chart, Munsell's
4.	Marker, indelible, black	10.	Sieves
5.	Logs & Forms	11.	Test tube
6.	Lens, hand, magnifying	12.	Camera & film
		13.	Jars, sample with labels
		14	HCl (one part 10N HCl to three parts water

3. PROCEDURE

3.1 Introduction to Soil Identification and Description

The Haley & Aldrich soil identification and description procedures follow the visual-manual procedure outlined in ASTM D2488. Two distinct tasks are required. First the soil is identified based on percentage of grain-size constituents. This process produces a Group Name and Group Symbol for the soil. Secondly, the soil is described. The additional descriptive information includes properties such as color, density or consistency, odor, structure, and geologic origin.

The Group Names and Group Symbols used to identify soils are determined using the flow charts shown in Figures 1 and 2. The Group Names and Group Symbols generated by this procedure are based on the Unified Soil Classification System. It is important to point out again that the soil Group names and Group Symbols determined using OP2001 and ASTM D2488 do not constitute a soil classification. When precise classification of soils is required for engineering purposes, the laboratory procedures outlined in ASTM D2487 must be used.

Soil identification is divided into three broad categories: **coarse grained** soils, for which the proportion and gradation of the components are most significant; **fine grained** soils, for which the degree of plasticity and dry strength are the controlling factor; and **organic** soils. Frequently, coarse grained and fine grained soils will occur in combination.

Soil identification is limited to soil particles smaller than 3 inches in size.

At the initiation of project planning, the Project Manager, Project Engineer or Scientist, and field personnel determine any project-specific requirements for soil identification and description. Project requirements may dictate the use of a different identification system. Different identification methods are permitted if our client requires them. Although identification systems vary to some degree, the procedural aspects of making the underlying observations and describing the soils encountered generally remain the same.

3.2 Definition of Soil Components

Soil Component	Size Range and Sieve Size	
OVERSIZED PARTICLES:		
Boulders	> 12 in.	>305 mm
Cobbles	3 in. to 12 in.	75.0 mm to 305 mm
COARSE GRAINED PARTICLES:		
Gravel:		
coarse Gravel	3 in. to 3/4 in.	75.0 mm to 19.0 mm
fine Gravel	3/4 in. to No. 4 (3/16")	19.0 mm to 4.75 mm
Sand:		
coarse Sand	No. 4 (3/16") to No.10 (1/13")	4.75 mm to 2.00 mm
medium Sand	No. 10 (1/13") to No. 40 (1/60")	2.00 mm to 0.42 mm
fine Sand	No. 40 (1/60") to No. 200	0.42 mm to 0.075 mm
FINE GRAINED PARTICLES:		
Silt:	< No. 200	< 0.075 mm
Nonplastic to very slightly plastic		
Little or no dry strength		
Clay:	< No. 200	< 0.075 mm
Plastic		
Considerable dry strength		

Two other terms are frequently used to broadly describe and define soil behavior:

- Cohesive Soil

  A soil that when unconfined has considerable dry strength when air-dried and that has considerable cohesion when submerged.

- Noncohesive or Cohesionless Soil

  A soil that when unconfined has little or no strength when air-dried and that has little or no cohesion when submerged.

3.3 Sampling

The sample used for soil identification should be representative of the stratum from which it was obtained. All samples should be carefully identified by File No., Exploration No., Sample No., recovery, depth, source, etc.

Soil identification procedures are generally based on a very small quantity of the stratum sampled. Larger particle sizes included in a sample may misrepresent the true proportion of such sizes in a given stratum due to their greater individual weight. Furthermore, in test borings where a split-spoon sampler is utilized, size limitations (2 in. O.D. by 1-3/8 in. I.D.) preclude the ability to recover representative samples in soil strata with significant percentages of gravel and larger size components. Care must be exercised in the field when identifying and describing soils. Care is also required when selecting a representative sample for preservation and possible laboratory testing.

ASTM D2488 defines the minimum amount of soil required for identification and description. The minimum amount required is based on the maximum particle size observed in the soil. However, in many cases it is not possible to obtain the required amount of soil. Therefore, the following table should be used as a guide. Wherever possible, an employee should base his or her soil identification and description on an amount of soil equal to or greater than the minimum amount of soil required in the following table. As a general rule it should be assumed that all split-spoon samples of soils containing coarse gravel do not meet the required sample size. In addition, all jar samples of soil containing particles larger than coarse sand may not meet the required sample size.

Maximum Particle Size			Minimum Specimen Size (estimated in dry weight)
No. 4	(5 mm)	coarse sand	100 g (0.25 lb)
3/8 in.	(10 mm)	fine gravel	200 g (0.5 lb)
¾ in.	(19 mm)	fine gravel	1.0 kg (2.2 lb)
1.5 in.	(38 mm)	coarse gravel	8.0 kg (18 lb)
3 in.	(75 mm)	coarse gravel	60.0 kg (132 lb)

3.4 Soil Identification

Detailed methods used to identify soil are presented below.

3.4.1 Preliminary Identification

The first step in the soil identification process is the preliminary identification of the soil. At this step, it will be determined if the soil will be considered a fine grained soil or a coarse grained soil. To do this, the percentage of each soil component must be estimated.

3.4.1.1 Fine Grained Soil:

If it is estimated that the soil consists of 50 percent or more fines (particles that are finer than a No. 200 sieve), the soil will be identified as either a SILT or a CLAY using Figure 1.

3.4.1.2 Coarse Grained Soil:

If it is estimated that the soil contains less than 50 percent fines (particles that are finer than a No. 200 sieve), the soil will be identified as either a GRAVEL or a SAND using Figure 2.

3.4.1.3 Organic Soils:

If it is estimated that the soil consists of enough organic particles to influence the soil properties, see Section 3.4.5 and Figure 1.

3.4.2 Methods for Identifying Soil

The following items must be determined to identify a soil:

3.4.2.1 Percent of Gravel, Sand, and Fines

Estimate and note the percentage of gravel, sand, and fines. Estimate percentages to the nearest 5 percent. The percentages of gravel, sand, and fines should equal 100 percent.

3.4.2.2 Percent of Oversized Particles

Estimate and note the percentage, if any, of boulders and cobbles. Estimate percentages, relative to the total volume observed, to the nearest 5 percent.

Methods of estimating the percentages of various soil components are found in APPENDIXD.

3.4.3 Identification of Coarse Grained Soils

If the soil to be identified contains more than 50 percent coarse grained material it will be identified as a SAND or a GRAVEL. If a coarse grained soil contains no more than 5 percent fines, it is not necessary to determine the characteristics of the fines. Proceed to Section 3.5 and 3.6.

If the sample contains more than 5 percent fines, proceed to Section 3.4.4 below, Identification of Fine Grained Soil Fractions.

3.4.4 Identification of Fine Grained Soil Fractions

The identification of fine grained soil is determined using a combination of four manual tests: dilatancy, toughness, plasticity, and dry strength. It may not be necessary to perform all four tests to determine the identity of a soil. Figure 3a, Sample Identification Procedure Chart, and 3b, Summary of Test Characteristics, are used as guides for identifying fines.

Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dilatancy, toughness, plasticity, and dry strength tests.

To identify the fine grained fraction of a soil, ASTM D2488 requires that particles larger than the No. 40 be removed from the sample. However, with some soils it may be impractical to remove medium and coarse sand from a sample in the field. In such a case, it should be noted on the log and a best estimate made.

Contaminated soils may also pose a problem for fine grained soil identification. Gloves should be worn whenever contaminated fine grained soils are identified in the field. In some cases, contaminants present in the soil (such as coal tar or gasoline) make manual testing impractical, unreliable or unsafe. In such a case, it should be noted on the log and a best estimate made.
Additional comments on contaminated soil are found in Section 3.8.

3.4.4.1 Tests for Fine Grained Soil

A. *Dilatancy* - Dilatancy is the expansion of soil when subjected to a shearing deformation or, more simply, describes the soil's reaction to hand shaking.

From the specimen, select enough material to mold into a ball about 1/2 in. (13 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria listed below. The appearance of water on the surface of the specimen resembles a glossy, "liver-like" consistency. When then squeezed, the water and gloss disappears from the surface. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

B. *Toughness* - Toughness is the consistency of the soil near its plastic limit.

On the basis of observations made during the plasticity test, describe the toughness of the material as low, medium, or high in accordance with the criteria below.

Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll a 1/8 in. (3 mm) thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

C. *Plasticity* - Plasticity is the property of soil which allows it to be deformed beyond the point of recovery without cracking or appreciable volume change. The plasticity of soil is determined manually by observing how it behaves when it is rolled into a thread, the degree of cohesiveness at the plastic limit, and the general range of moisture contents over which the soil remains in a plastic state.

The test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms. Attempt to roll the soil into a thread about 1/8 in. (3 mm) in diameter. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. If the sample is too dry, add water.

Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 in. (3 mm). The thread will crumble at a diameter of 1/8 in. (3 mm) when the water content in the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles.

Note the plasticity of the soil as nonplastic, low, medium, or high in accordance with the criteria listed below.

Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8 in. (3 mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

D. *Dry Strength* - Dry strength describes the crushing characteristics of a dry soil crumb under finger pressure.

Select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary. From the molded material, make at least three test specimens. A test specimen shall be a ball of material about 1/2 in. (13 mm) in diameter. Allow the test specimens to dry in air or sun, or by artificial means as long as the temperature does not exceed 140° F (60°C). If the test specimen contains natural dry lumps, those that are about 1/2 in. (13 mm) in diameter may be used in place of the molded balls. (The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.)

Test the strength of the dry balls or lumps by crushing between the fingers. The dry strength increases with increasing plasticity. Note the strength as none, low, medium, high, or very high in accordance with the criteria listed below.

Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand. The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (HCl) (see Appendix G).

3.4.4.2 Identifying the Fine Grained Fraction

Decide whether the fine grained soil fraction is an *inorganic* or an *organic* fine grained soil (see 3.4.5). If inorganic, follow the steps listed below using Table 1 as a guide.

Identify the fine grained soil fraction as a *silt*, ML, if the soil has slow to rapid dilatancy, low toughness, no to low plasticity, and no to low dry strength.

Identify the fine grained soil fraction as an *elastic silt*, MH, if the soil has no to slow dilatancy, low to medium toughness and plasticity, and low to medium dry strength. These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D 2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

Identify the fine grained soil fraction as a *lean clay*, CL, if the soil has no or slow dilatancy, medium toughness and plasticity, and medium to high dry strength.

Identify the fine-grained soil fraction as a *fat clay*, CH, if the soil has no dilatancy, high toughness and plasticity, and high to very high dry strength.

TABLE 1 - Identification of Inorganic Fine Grained Soils from Manual Tests

Soil Symbol	Dilatancy	Toughness	Plasticity Designation	Dry Strength
ML	Slow to rapid	Low or thread cannot be formed	Non-plastic	None to low
MH	None to slow	Low to medium	Low	Low to medium
CL	None to slow	Medium	Medium	Medium to high
CH	None	High	Highly	High to very high

3.4.5 Organic Soils

Organic soils are those soils that contain sufficient organic matter to significantly affect the engineering properties or usage of the soil. Topsoil, peat and organic silt are typical examples. Peaty diatomaceous earth is a common organic soil found at the lower stratum of peat bogs. Fibrous peats may be found in both fresh-water (bogs) and marine settings. Organic clays are common in some sections of the country. Certain types of anthropogenic fills contain significant percentages of organic matter.

- <u>Identification of Organic Fine Grained Soils</u> - Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties (see Figure 1). Organic soils usually have a gray, dark gray brown to black color and may have an "earthy" or hydrogen sulfide odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air-dried. Organic soils frequently contain carbonate shell fragments, silica tests (diatoms) or woody, fibrous matter, although the presence of these materials is not an exclusive indicator of organic soils. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy or elastic. In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

- <u>Identification of Peat</u> - A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT.

Because organic soils can exhibit some of the characteristics of inorganic clay soils, they may be differentiated by the following criteria:

- Inorganic Clay Soils - Any color may be expected. For more plastic clays, appreciable effort is required to pull the material apart. The broken pieces show the structure standing on end from the pulling. For high plasticities, the smear has a shiny, waxy appearance.

- Organic Soils – Gray, dark gray, black and various shades of brown are characteristic colors. Fresh organic soils, particularly marine peats and silts, commonly have a strong odor of hydrogen sulfide and heating the sample will intensify the odor. Less effort is required to pull fine grained non-fibrous organic soils apart than in the case of inorganic fine grained soil, and a clean break is generally formed. The smear, although smooth, is very dull and appears silty. Fibrous structure is, of course, an obvious identifying property. Organic silts respond positively to the dilatancy test. Organic soils customarily have very low shear strength in their natural state. Organic clays may be very difficult to identify visually without supplemental laboratory testing.

3.4.6 Identifying Soil

Proceed to section 3.5 and 3.6 to determine a Group Symbol and Group Name.

3.5 Determining the Group Symbol

Based on the properties of the soil, determine the Group Symbol using Figure 1 for fine grained soil and for organic soil, or Figure 2 for coarse grained soil.

If a soil has properties that do not distinctly place it into a specific group, Borderline Symbols may be used. A Borderline Symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. **Borderline Symbols** should not be confused with **Dual Symbols** such as GP-GM (well graded GRAVEL with silt) or SW-SC (well graded SAND with clay). A Dual Symbol is two symbols separated by a dash and represents a standard identification group.

3.6 Determining the Group Name

Based on additional observations, determine a Group Name using Figure 1 for fine grained soil and for organic soil, or Figure 2 for coarse grained soil.

3.6.1 Fine Grained Soil

If the fine grained soil is estimated to have 15 to 25 percent sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the Group Name. For example: "lean CLAY with sand, CL" or "SILT with gravel, ML" (see Fig. 1. If the percentage of sand is equal to the percentage of gravel, use "with sand." If the soil is estimated to have 30 percent or more sand or gravel, or both, the adjectives "sandy" or "gravelly" shall be added to the Group Name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean CLAY, CL", "gravelly fat CLAY, CH", or "sandy SILT, ML" (see Fig. 1). If the percentage of sand is equal to the percent of gravel, use "sandy."

3.6.2 Coarse Grained Soil

1. The soil is a *GRAVEL* if the percentage of gravel is estimated to be more than the percentage of sand. The soil is a *SAND* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

2. The soil is a *clean GRAVEL* or *clean SAND* if the percentage of fines is estimated to be 5 percent or less.

3. Identify the soil as a *well graded GRAVEL*, GW, or as a *well graded SAND*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

4. Identify the soil as a *poorly graded GRAVEL*, GP, or as a *poorly graded SAND*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

5. Identify the soil as a *clayey GRAVEL*, GC, or a *clayey SAND*, SC, if the percentage of fines is estimated to be 15 percent or greater, and the fines are clayey as determined by the procedures in Section 3.4.4.

6. Identify the soil as a *silty GRAVEL*, GM, or a *silty SAND*, SM, if the percentage of fines is estimated to be 15 percent or greater, and the fines are silty as determined by the procedures in Section 3.4.4.

7. If the soil is estimated to contain 10 percent fines, give the soil a dual identification using two Group Symbols. The first Group Symbol corresponds to a clean gravel or sand (GW, GP, SW, SP) and the second Group Symbol corresponds to a gravel or sand with fines (GC, GM, SC, SM). The Group Name corresponds to the first Group Symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well graded GRAVEL with clay, GW-GC" or "poorly graded SAND with silt, SP-SM" (see Fig. 2). If the specimen is predominantly sand or gravel but contains an estimated 15 percent or more of the other coarse grained constituent, the words "with gravel" or "with sand" are added to the Group Name. For example: "poorly graded GRAVEL with sand, GP" or "clayey SAND with gravel, SC" (see Fig. 2).

3.7 Soil Description

Appropriate descriptive information is also recorded. The twelve categories of descriptive information are listed below.

3.7.1 Required Descriptive Information

3.7.1.1 Density

The density of cohesionless or granular soils is determined by the Standard Penetration Test. The density of a soil based on the Standard Penetration Test is obtained from the following table:

Standard Penetration Test (SPT) N-Value (Blows per foot)	Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
Over 50	Very dense

3.7.1.2 Consistency

The consistency of cohesive soils is determined in one of two ways. The preferred method of determining consistency in the field is based upon undrained strength as determined by a Torvane, pocket penetrometer or Field Vane shear test. In general, however, consistency is determined by the Standard Penetration Test (SPT), ASTM Designation D 1586, performed in test borings. The SPT consists of counting the number of blows of a 140 pound hammer freely falling 30 inches while driving a 2 inch O.D. split spoon sampler 18 inches into the soil. The number of blows is recorded for each 6 inches of penetration for an 18 inch drive. The first 6 inches of penetration are discounted and the number of hammer blows required to drive the sample over the 6 to 18 inch range of sampler penetration is termed the standard penetration resistance (N). Cable or wire-winch attached weights are unacceptable for determining STP.

The scale used for the consistency of a soil is presented in the following table:

Approximate Undrained Shear Strength (tsf)	Standard Penetration Test N-Value (Blows/foot)	Consistency
Below 0.13	0 - 2	Very soft
0.13 to 0.25	3 - 4	Soft
0.25 to 0.5	5 - 8	Medium stiff
0.5 to 1.0	9 - 15	Stiff
1.0 to 2.0	16 - 30	Very stiff
Over 2	Over 30	Hard

If required, the ASTM procedure for determining consistency can be used, which is based on indentation of the soil with the thumb and is presented in Appendix E. If the ASTM procedure is used, it should be noted on the logs.

3.7.1.3 Color

Color may be useful in identifying materials of similar geologic origin. Color is an important property in identifying organic soils.

Moist soil samples should be used to describe soil color. Color description is generally confined to a few basic terms such as brown, black, gray and yellow. These terms are often combined in pairs. Examples of combined color descriptors are gray green, yellow brown or yellow gray. In listing two colors, the second color listed is the predominant of the two colors. The ending "ish" is never added to a color description. If dictated by specific project requirements, more accurate color descriptions based on hue and chroma may be obtained by use of the "Munsell Soil Color Charts."

If the soil color is not homogeneous due to layering, describe the color of all layers. If the soil is not layered, use the term mottled, if appropriate, to describe the colors. (Example: mottled brown and gray.)

3.7.1.4 Group Name and Group Symbol

The primary constituent is typed in all uppercase in the Group Name and the Group Symbol is uppercase and set in parentheses.

3.7.1.5 Percent Oversized

When the sample contains cobbles or boulders or both, estimate the percent relative to the total volume observed to the nearest 5 percent.

3.7.1.6 Maximum Particle Size

Describe the maximum particle size found in the sample. The maximum particle size is used to determine the sample size required for field identification and various laboratory tests.

3.7.1.7 Structure

Several terms have been found useful in simplifying the description of some special characteristic of a soil or to add additional information. A list of a few of the more common terms is given in Appendix F, Descriptive Terminology for Soil Structure.

3.7.1.8 Odor

Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. Unusual odors may indicate soil contamination and should be avoided. This should be called to the attention of the project manager unless contamination was expected in the soil.

3.7.1.9 Moisture Condition

The moisture condition of a soil should be described as dry, moist or wet according to the criteria listed below.

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

3.7.1.10 Geologic Interpretation

A geologic interpretation of the soil is very helpful and should be added; e.g., Glaciofluvial Deposits. Note however that if you are uncertain about an interpretation, it is your responsibility to review it with a senior H&A geologist.

3.7.2 Additional Descriptive Information

The following additional information should be included as a part of a soil description. Methods for describing these soil properties are listed in Appendix G.

a. Hardness of the Plus No. 10 Fraction
b. Angularity of the Plus No. 10 Fraction
c. Particle Shape of the Plus No. 4 Fraction
d. Reaction with Hydrochloric Acid
e. Cementation of Intact Samples
f. Torvane and Pocket Penetrometer Readings
g. Additional Comments

3.8 Contaminated Soils

Contamination of soil can occur from an extremely wide range of hazardous and non-hazardous anthropogenic pollutants being released into the environment from a variety of disposal methods. Naturally deposited undisturbed soils may be stained from liquids passing through them. “Clean” undisturbed soils can absorb and retain strong odors from adjacent vapor sources. The actual soil constituents may be partially or completely comprised of anthropogenic materials: ash, cinders, clinker, slag, glass, brick, concrete, etc. If so, the sample should be described with respect to these constituents.

Contaminated soil may be any color, may have some odor level, and may retain the actual product. Indicators of potential contamination include, but are not limited to, soil with an unusual color or distinct odor such as gasoline, diesel fuel, solvents, moth balls, etc. However, the soil may not show any of the above indicators and still be contaminated. If unexpected soil contamination is encountered and there is no site-specific Health & Safety plan, or appropriate Health & Safety equipment is not available, immediately cease exploration operations, clear personnel from work area, and contact the H&A Project Manager and Health and Safety Representative for instructions.

3.8.1 Description of Fills

For methods used to describe fills, see Appendix H.

3.9 Presentation of Soil Identification and Descriptive Information

The soil identification should consist of the Group Name, the Group Symbol, and all required descriptive information. **If using this procedure to identify soil, it must be distinctly and clearly stated in all logs, summary tables, and reports that the Group Names and Group Symbols are based on visual-manual procedures.**

As a rule, descriptive information should be listed in the following order:

1. **Percent of Gravel, Sand, and Fines**
2. **Dilatancy**
3. **Toughness**
4. **Plasticity**
5. **Dry Strength**
6. **Density/Consistency***
7. **Color**
8. **Group Name and Group Symbol**
9. **Percent Oversized (boulders and cobbles)**
10. **Maximum Particle Size**
11. **Structure***
12. **Odor**
13. **Moisture**
14. Optional Descriptions
15. **Geologic Interpretation**

Descriptors in **BOLD** should always be included with descriptions. Descriptors followed with an asterisk (*) apply only to intact samples such as split-spoon samples.

Examples:

Several examples of soil identifications and descriptions based on this procedure are presented below. Note not only the order of descriptive terms, but also the use of commas, hyphens, slashes, parentheses, and upper case letters. Abbreviations should not be utilized in writing soil identifications and descriptions.

Example 1

The example below is a standard identification and description of 50 lb. grab sample from a test pit:

10% fine gravel, 30% coarse sand, 30% medium sand, 30% fine sand, no fines

Brown, poorly graded SAND (SP)
10% boulders, 15% cobbles, maximum particle size 18" (450 mm).
Stratified with coarse to medium grained layers 3" to 6" thick (75-150 mm) alternating with fine grained layers 6" to 12" thick (150-300 mm).
No odor, dry.
GLACIOFLUVIAL DEPOSIT

If the soil above was described from an 8 oz. driller's jar, the following statement should be added to the description:

(Note: Sample size smaller than recommended.)

Example 2

The example below is a standard identification and description of a split-spoon sample:

10% fine gravel, 5% coarse sand, 5% medium sand, 10% fine sand,
70% fines: no dilatancy, medium toughness, medium plasticity, medium dry strength

Stiff, gray green, sandy lean CLAY (CL).
Maximum particle size 13 mm. Laminated. Frequent fine sand partings, occasional medium to fine sand seams. Fine gravel and coarse sand present as dropstones.
No odor. Moist.
MARINE DEPOSIT

Example 3

The example below is a standard identification and description of split-spoon sample:

5% coarse gravel, 10% fine gravel, 5% coarse sand, 10% medium sand, 40% fine sand, 30% fines: rapid dilatancy, low toughness, low plasticity, low dry strength.

Very dense, brown, silty SAND with gravel (SM)
Maximum particle size 1 in. (25 mm).
Foliated and well bonded, no odor, moist, uncemented.
Coarse fraction generally hard and rounded igneous and metamorphic lithologies, imbedded.
Minor soft and angular, flat to elongated sedimentary lithologies (argillite).
Weak reaction with HCl on minor white 0.5-0.1 mm grains (possible seashell particles).
Note: Drill action indicates occasional cobbles. Possible sand lenses indicated by wash water return.
GLACIAL TILL DEPOSIT

Example 3 (abbreviated):

5% c GVL, 10% f GVL, 5% c SA, 10% m SA, 40% f SA
30% fines: D=R, T=L, P=L, DS=L

Very dense, brown, silty SAND with gravel (SM)
mps 25 mm. Foliated and well bonded, no odor, moist.
Cobbles indicated by drill action.
GLACIAL TILL DEPOSIT

In general, final identification of soil samples for typed boring logs and reports requires a careful review, taking into consideration the laboratory identification tests that were not available at time of sampling.

3.10 Precision and Bias

This procedure provides qualitative information only; therefore, a precision and bias statement is not applicable.

Figure 1:
Flow Chart for Identifying Fine-Grained Soils (50% or more fines)

Group Symbol				Group Name
ML (SILT)	<30% plus No. 200	<15% plus No. 200		SILT
		15-25% plus No. 200	% sand ≥% of gravel	SILT with sand
			% sand <% of gravel	SILT with gravel
	≥30% plus No. 200	% sand ≥% of gravel	<15% gravel	sandy SILT
			≥15% gravel	sandy SILT with gravel
		% sand <% of gravel	<15% sand	gravelly SILT
			≥15% sand	gravelly SILT with sand
MH (ELASTIC SILT)	<30% plus No. 200	<15% plus No. 200		elastic SILT
		15-25% plus No. 200	% sand ≥% of gravel	elastic SILT with sand
			% sand <% of gravel	elastic SILT with gravel
	≥30% plus No. 200	% sand ≥% of gravel	<15% gravel	sandy elastic SILT
			≥15% gravel	sandy elastic SILT with gravel
		% sand <% of gravel	<15% sand	gravelly elastic SILT
			≥15% sand	gravelly elastic SILT with sand
CL (LEAN CLAY)	<30% plus No. 200	<15% plus No. 200		lean CLAY
		15-25% plus No. 200	% sand ≥% of gravel	lean CLAY with sand
			% sand <% of gravel	lean CLAY with gravel
	≥30% plus No. 200	% sand ≥% of gravel	<15% gravel	sandy lean CLAY
			≥15% gravel	sandy lean CLAY with gravel
		% sand <% of gravel	<15% sand	gravelly lean CLAY
			≥15% sand	gravelly lean CLAY with sand
CH (FAT CLAY)	<30% plus No. 200	<15% plus No. 200		fat CLAY
		15-25% plus No. 200	% sand ≥% of gravel	fat CLAY with sand
			% sand <% of gravel	fat CLAY with gravel
	≥30% plus No. 200	% sand ≥% of gravel	<15% gravel	sandy fat CLAY
			≥15% gravel	sandy fat CLAY with gravel
		% sand <% of gravel	<15% sand	gravelly fat CLAY
			≥15% sand	gravelly fat CLAY with sand
OL/OH (ORGANIC SOILS)	<30% plus No. 200	<15% plus No. 200		ORGANIC SOIL
		15-25% plus No. 200	% sand ≥% of gravel	ORGANIC SOIL with sand
			% sand <% of gravel	ORGANIC SOIL with gravel
	≥30% plus No. 200	% sand ≥% of gravel	<15% gravel	sandy ORGANIC SOIL
			≥15% gravel	sandy ORGANIC SOIL with gravel
		% sand <% of gravel	<15% sand	gravelly ORGANIC SOIL
			≥15% sand	gravelly ORGANIC SOIL with sand

Note: Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%

Figure 2:
Flow Chart for Identifying Coarse-Grained Soils (less than 50% fines)

HALEY & ALDRICH

				Group Symbol		Group Name
GRAVEL % gravel > % sand	≤5% fines	Well-graded		**GW**	<15% sand	well-graded GRAVEL
					≥15% sand	well-graded GRAVEL with sand
		Poorly-graded		**GP**	<15% sand	poorly-graded GRAVEL
					≥15% sand	poorly-graded GRAVEL with sand
	10% fines	Well-graded	fines = ML or MH	**GW-GM**	<15% sand	well-graded GRAVEL with silt
					≥15% sand	well-graded GRAVEL with silt and sand
			fines = CL or CH	**GW-GC**	<15% sand	well-graded GRAVEL with clay
					≥15% sand	well-graded GRAVEL with clay and sand
		Poorly-graded	fines = ML or MH	**GP-GM**	<15% sand	poorly-graded GRAVEL with silt
					≥15% sand	poorly-graded GRAVEL with silt and sand
			fines = CL or CH	**GP-GC**	<15% sand	poorly-graded GRAVEL with clay
					≥15% sand	poorly-graded GRAVEL with clay and sand
	≥15% fines		fines = ML or MH	**GM**	<15% sand	silty GRAVEL
					≥15% sand	silty GRAVEL with sand
			fines = CL or CH	**GC**	<15% sand	clayey GRAVEL
					≥15% sand	clayey GRAVEL with sand
SAND % sand ≥ % gravel	≤5% fines	Well-graded		**SW**	<15% gravel	well-graded SAND
					≥15% gravel	well-graded SAND with gravel
		Poorly-graded		**SP**	<15% gravel	poorly-graded SAND
					≥15% gravel	poorly-graded SAND with gravel
	10% fines	Well-graded	fines = ML or MH	**SW-SM**	<15% gravel	well-graded SAND with silt
					≥15% gravel	well-graded SAND with silt and gravel
			fines = CL or CH	**SW-SC**	<15% gravel	well-graded SAND with clay
					≥15% gravel	well-graded SAND with clay and gravel
		Poorly-graded	fines = ML or MH	**SP-SM**	<15% gravel	poorly-graded SAND with silt
					≥15% gravel	poorly-graded SAND with silt and gravel
			fines = CL or CH	**SP-SC**	<15% gravel	poorly-graded SAND with clay
					≥15% gravel	poorly-graded SAND with clay and gravel
	≥15% fines		fines = ML or MH	**SM**	<15% gravel	silty SAND
					≥15% gravel	silty SAND with gravel
			fines = CL or CH	**SC**	<15% gravel	clayey SAND
					≥15% gravel	clayey SAND with gravel

Note: Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%

FIGURE 3a. SAMPLE IDENTIFICATION PROCEDURE CHART

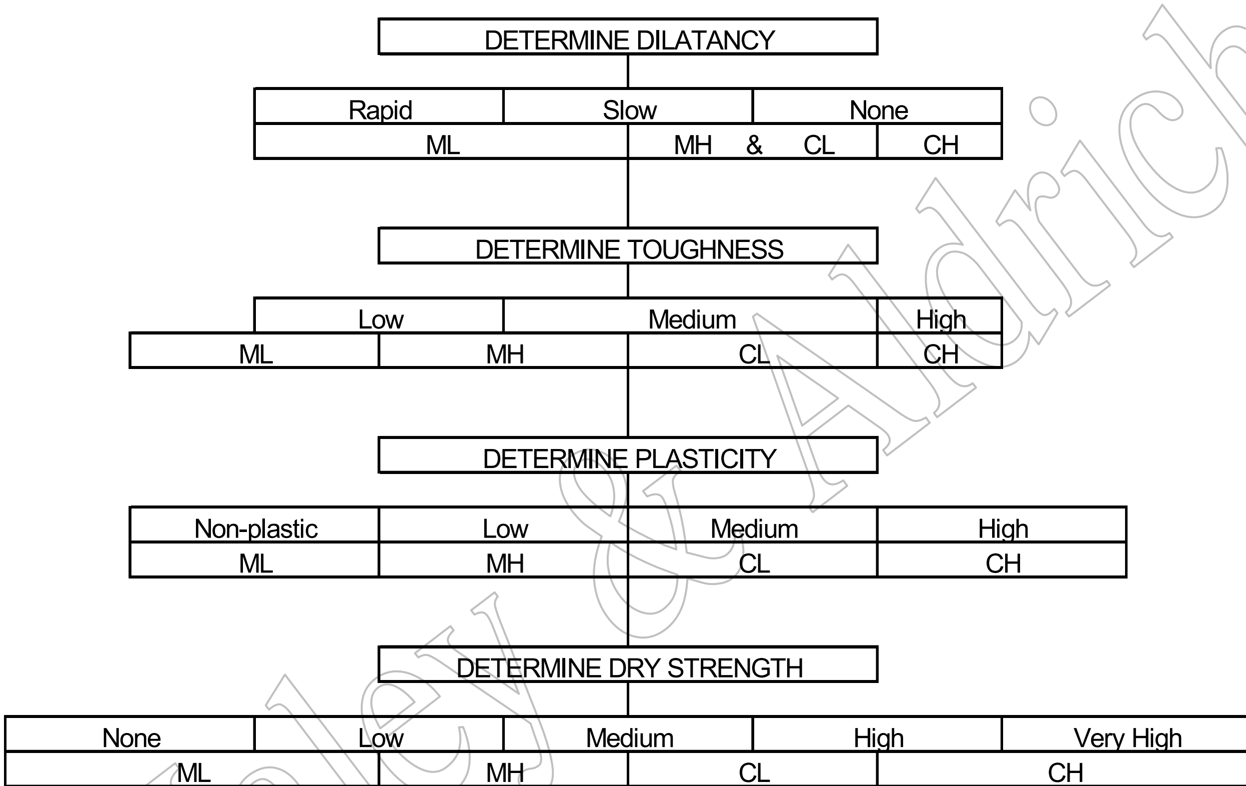

FIGURE 3b. SUMMARY OF TEST CHARACTERISTICS

	Dilatancy	Toughness	Plasticity	Dry Strength
ML	slow - rapid	low	none - low	none - low
MH	none - slow	low - medium	low - medium	low - medium
CL	none - slow	medium	medium	medium - high
CH	none	high	high	high - very high

APPENDIX A
REFERENCES

A.1 Reference Procedure

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D2488-93, “Description and Identification of Soils (Visual-Manual Procedure).”

A.2 Other References

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D2487-98, “Classification of Soils for Engineering Purposes (Unified Soil Classification System).”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D1586-99, “Penetration Test and Split-Barrel Sampling of Soils.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D5434-97, “Field Logging of Subsurface Explorations of Soil and Rock.”

A.3 COMMENTS ON REFERENCE PROCEDURE

The procedures and equipment listed in OP2001 and used by H&A are generally as specified in the Reference Procedure. Deviations of OP2001 from the Reference Procedure are listed below. The procedure described in Section 3 has been developed to assist H&A personnel in identifying and describing soil, and in some cases simplifies the Reference Procedure.

OP2001 deviates from the ASTM Reference Procedure in the following:

- ASTM D2488-93 defines the minimum amount of soil required for identification and description. The minimum amount required is based on the maximum particle size observed in the soil. However, in many cases it is not possible to obtain the required amount of soil due to the limitations of the sampling techniques used. As a general rule it should be assumed that all split-spoon samples of soils containing coarse gravel do not meet the required sample size. In addition, all jar samples of soil containing particles larger than coarse sand may not meet the required sample size.

- ASTM D2488-93 requires the percentage of cobbles and boulders to be estimated on the basis of volume percentage. The gravel, sand, and fines percentages are to be determined based on an estimate of dry weight. However, in almost all cases this method overly complicates estimating the percentage of different soil components. Haley & Aldrich considers that estimates of percentage based on particle volume and particle weight (either wet or dry) are equivalent for practical purposes. Average specific gravities of soil range between 2.65 and 2.75. Percentages of particle fractions based on volume should, in general, vary by no more than 5 percent from percentages based on weight—well within the error limits of the procedure.

- To identify the fine grained fraction of a soil, ASTM D2488 requires that particles larger than No. 40 be removed from the sample. With some soils it may be impractical to remove medium and coarse sand from a sample in the field.

- Consistency of cohesive soil is based upon undrained strength as determined by a Torvane or Field Vane shear test. The Standard Penetration Test (SPT) is used in cases where no other data are available.

- The density of granular soils is determined by the Standard Penetration Test, ASTM Designation D1586, performed in test borings.

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP2000 Monitoring Field Explorations
- OP2005 Test Borings, Sampling, Standard Penetration Testing and Borehole Abandonment
- OP2026 Exploratory Test Pits

APPENDIX C
FORMS AND EXAMPLES

C.1 Forms

All Haley & Aldrich field forms are maintained on the server at K:\techproc\op\Forms. The following is a list of forms currently available specifically for the logging of soils using the USCS as practiced by H&A.

C.1.1 Test Boring Logging

- Form 2001 Test Boring Report
- Form 2002 Core Boring Report

C.1.2 Test Pit Logging

- Form 2006 Test Pit Log

C.2 Examples

The following examples of completed forms are intended to provide guidance in field logging. These examples are not intended to show all of the variations of USCS use, rather they are presented as a general reference of the standard logging conventions practiced by H&A.

HALEY & ALDRICH

TEST BORING REPORT

BORING NO.

Page 1 of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft.	Datum	Boring Location				
Item	Casing	Sampler	Core Barrel	Rig Make & Model	Hammer Type	Drilling Mud	Casing Advance
Type				☐ Truck ☐ Tripod ☐ Cat-Head	☐ Safety	☐ Bentonite	Type Method Depth
Inside Diameter (in.)				☐ ATV ☐ Geoprobe ☐ Winch	☐ Doughnut	☐ Polymer	
Hammer Weight (lb.)				☐ Track ☐ Air Track ☐ Roller Bit	☐ Automatic	☐ None	
Hammer Fall (in.)				☐ Skid ☐ ______ ☐ Cutting Head	Drilling Notes:		

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																	

Water Level Data						Sample ID		Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water	O	Open End Rod	Riser Pipe	Overburden (Linear ft.)
						T	Thin Wall Tube	Screen	Rock Cored (Linear ft.)
						U	Undisturbed Sample	Filter Sand	Number of Samples
						S	Split Spoon Sample	Cuttings	
						G	Geoprobe	Grout	BORING NO.
								Concrete	
								Bentonite Seal	

Field Tests Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH

TEST BORING REPORT

BORING NO.

Page of

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand				Field Test			
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength

NOTES:

FILE NO.

BORING NO.

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH

CORE BORING REPORT

BORING NO.	
Page 1 of	

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft	Datum	Boring Location

Item	Casing	Sampler	Core Barrel	Rig Make & Model				Drill Mud
Type				☐ Truck	☐ Tripod	☐ Cat-Head	Hammer Type	☐ Bentonite
Inside Diameter (in)				☐ ATV	☐ Geoprobe	☐ Winch	☐ Safety	☐ Polymer
Hammer Weight (lb)				☐ Track	☐ Air Track	☐ Roller Bit	☐ Doughnut	☐ None
Hammer Fall (in)				☐ Skid	☐ ________	☐ Cutting Head	Casing ☐ Driven	☐ Spun

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath-ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks

Water Level Data					
			Depth in feet to:		
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water

Sample ID

- **O** Open End Rod
- **T** Thin Wall Tube
- **U** Undisturbed Sample
- **S** Split Spoon Sample
- **G** Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.) ______

Rock Cored (Linear ft.) ______

Number of Samples ______

BORING NO.

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HALEY & ALDRICH

CORE BORING REPORT

BORING NO.

Page of

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery	RQD	Weath-ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks
			(in)	(%)				

FILE NO. BORING NO.

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HALEY & ALDRICH, INC.
SAMPLE

HALEY & ALDRICH

TEST BORING REPORT

BORING NO. B 7 (OW)

Page 1 of 2

PROJECT	Greenspace Development	**H&A FILE NO.**	27921-000
LOCATION	18 Riverside Road, Boston Massachusetts	**PROJECT MGR.**	S.R. Kraemer
CLIENT	Ecologic Investments	**FIELD REP.**	C.S. Osgood
CONTRACTOR	Guild Drilling Co., Inc.	**DATE STARTED**	13-Feb-01
DRILLER	Charlie O'Donnel	**DATE FINISHED**	14-Feb-01

Elevation 23.3 ft. **Datum** Boston City **Boring Location** See sketch on reverse of form.

Item	Casing	Sampler	Core Barrel
Type	NW	S	NV2
Inside Diameter (in.)	3	1.385	2
Hammer Weight (lb.)	300	140	
Hammer Fall (in.)	24	30	

Rig Make & Model: CME 75

☑ Truck	☐ Tripod	☑ Cat-Head
☐ ATV	☐ Geoprobe	☐ Winch
☐ Track	☐ Air Track	☑ Roller Bit
☐ Skid	☐ ________	☐ Cutting Head

Hammer Type	Drilling Mud
☑ Safety	☑ Bentonite
☐ Doughnut	☐ Polymer
☐ Automatic	☐ None

Casing Advance — Type Method Depth: NW Driven 29.0 ft.

Drilling Notes: Flushed slurry prior to coring.

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	10		0.0			SP-SM	Medium dense brown poorly graded SAND with silt (SP-SM),				20	70	10				
	12	S1					mps 2 mm, distinctly stratified, fines partially organic, no odor, dry.										
	15	21"															
	20		2.0		2.0		-ALLUVIUM-										
	11		2.0			SP	Dense brown poorly graded SAND (SP), mps 25 mm, no odor, dry.	5	5	20	30	35	5				
	15	S2															
	16	10"															
	17		4.0				-ALLUVIUM-										
					4.5												
5	WOR		5.0				Very soft, dark brown ORGANIC SOILS with sand (OL/OH), trace					25	75	S	M	H	VH
	WOR	S3				OL/OH	seashell fragments and particles, soil mps 0.5 mm, strong										
	WOH	24"					organic odor, moist.										
	WOH		7.0				-ORGANIC DEPOSIT-										
					8.0												
							Note: Drilling fluid returning medium to fine sand from 8.0 ft. to										
							10.0 ft. Drilling fluid color change to yellow red at 8.5 ft.										
							-PROBABLE MARINE DEPOSIT-										
					10.0												
10	3		10.0			CH	Stiff yellow brown fat CLAY (CH), trace fine sand, mps 0.5 mm,						100	N	M	H	
	6	S4					apparently laminated with frequent fine sand partings and										
	6	22"					possible organic fibers, no odor, moist.										
	6		12.0				-MARINE DEPOSIT-										
					13.5												
							Note: Drill action indicates gravel below 13.5 ft.										
15	12		15.0			CL	Very stiff yellow brown to gray sandy lean CLAY with gravel (CL),	5	10	10	10	15	50	S	M	M	
	14	S5					mps 35 mm, distinct disrupted laminae in discrete zones, coarse										
	15	17"					fraction consists of well rounded igneous and igneous and										
	19		17.0				metamorphic lithologies, no odor, moist.										
							-GLACIOMARINE DEPOSIT-										
					18.0												
							Note: Drill action and total loss of drilling fluid indicates gravel										
					19.0		and cobbles from 18.0 ft. to 19.0 ft.										
							Very dense gray silty SAND (SM) , mps 15 mm, very well bonded,										
20	21	S6	20.0			SM	coarse fraction consists partly of platy argillite fragments, no odor, moist.		10	15	20	30	25	R			
	25	10"	21.0		21.0		-GLACIAL TILL-										
	33	S6A	21.0			ML	Very dense gray SILT (ML), mps <0.1 mm, no structure, no odor,						100	R		N	
	34	7"	22.0				dry.										
							-RESIDUAL SOIL-										
							Note: Drilling advanced smoothly from 21.0 ft. to 25.0 ft.										
					25.0		PROBABLE TOP OF DECOMPOSED BEDROCK 25.0 FT.										
25	53		25.0				Very dense gray highly to completely weathered ARGILLITE.										
	28	S7					Possible extremely thin relect bedding subparallel to strong										
	39	5"					low angle foliation. Sample is generally well bonded and consists										
	35		27.0				of very soft angular fragments and particles which are easily										
							crushed with finger pressure.										
							-DECOMPOSED BEDROCK-										
							Note: Drill action indicates stratum change at 28.5 ft.										
					28.5		TOP OF "SOUND" BEDROCK 28.5 FT.										
							SEE SHEET 2 FOR CORE BORING REPORT										
30																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water
13-Feb-01	15:30	0	29.0	29.0	2.0
14-Feb-01	7:00	15.5	29.0	29.0	6.2
14-Feb-01	15:00	1.0	39.5	39.5	10.4

Sample ID

- O Open End Rod
- T Thin Wall Tube
- U Undisturbed Sample
- S Split Spoon Sample
- G Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.)	29.5
Rock Cored (Linear ft.)	10.0
Number of Samples	S7 C2
BORING NO.	**B 7 (OW)**

Field Tests Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

BORING NO. **B 7 (OW)**

Page 2 of 2

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath-ering	Stratum Change (ft)	Visual Classification and Remarks
							SEE SHEET 1 TEST BORING REPORT FOR OVERBURDEN DETAILS.
						21.0	TOP OF RESIDUAL SOIL 21.0 FT.
							Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through residual
							soil from 21.0 ft. to 25.0 ft.
					Residual		
					Soil		-RESIDUAL SOIL-
						25.0	TOP OF DECOMPOSED BEDROCK 25.0 FT.
25							
					High		Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through
					to		decomposed bedrock from 25.0 ft. to 28.5 ft.
					Complete		
							-DECOMPOSED BEDROCK-
						28.5	TOP OF "SOUND" BEDROCK 28.5 FT.
							Note: Seated NW casing at 29.0 ft. Advanced borehole with rollerbit to 29.5 ft. without sampling
							prior to coring.
		29.5	56"		Slight		C1: Moderately hard, slightly weathered, gray, aphanitic ARGILLITE. Bedding extremely thin to
30							very thin, generally low angle (30-35 degrees). Foliation low angle, commonly subparallel to
	6						bedding. Cleavage well developed along bedding/foliation planes where coincident.
					Mod.		Cleavage joints very close to close 29.5 -31.0 ft. and close below 32.5 ft. smooth-planar,
	3	C1			High		slightly oxidized, occasionally calcite-infilled, tight. High angle to vertical joints moderately
					Mod.		close, rough-undulatory, pyritized or highly oxidized and decomposed with silt infilling, open.
	5						Soft, moderately to highly weathered zone 31.0-32.5 ft. associated with extremely close,
					Slight		moderately dipping, slickensided-planar shears intersecting bedding plane and high angle features.
	6						Note: Partial water loss below 31.0 ft.
		34.5	24"	40%			Note: Lost core assumed 31.7-32.0 ft.
	6	34.5	60"	100%			C2: Similar to bottom of run C1 except cleavage joints close to moderately close. High angle to
35							vertical joints absent. Occasional thin zone of extremely close, extremely thin, moderately
	7						dipping to high angle (50-60 degrees) calcite stringers. Occasional calcite-healed low angle
							joint.
	6	C2			Slight		-CAMBRIDGE FORMATION-
	6					38.0	
							Lithology change at 38.0 ft. to hard, slightly weathered, dark gray to black, fine grained to
	8						aphanitic DIABASE. Single high angle joint at 38.7 ft. rough-stepped, slightly oxidized, tight.
		39.5	54"	90%			
	8						BOTTOM OF EXPLORATION 39.5 FT.
40							

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TEST PIT LOG

Test Pit No.	
Page 1	of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	
EQUIPMENT		WEATHER	

Ground El. ___ ft. El. Datum	Location	Groundwater depths/entry rates (in./min.):

Depth (ft.)	Sample ID	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand				Field Test			
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength

Obstructions:	Remarks:	Field Tests
		Dilatancy: R - Rapid S - Slow N- None
		Toughness: L - Low M - Medium H - High
		Plasticity: N - Nonplastic L - Low M - Medium H - High
		Dry Strength: N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:	Boulders: Diameter (in.)	Number	Approx. vol. (cu. ft.)	Test Pit Dimensions (ft.):
at depth ___ ft.	12 to 24		=	Pit Depth
measured after ___ hrs. elapsed	over 24		=	Pit Length X Width

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH

ENVIRONMENTAL TEST PIT LOG

Test Pit No.

Page of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	
EQUIPMENT		WEATHER	

Ground El. ft.
El. Datum

Location

Groundwater depths/entry rates (in./min.):

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength

Obstructions:

Remarks:

Bucket Decontamination Method:

Field Tests	
Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:
at depth ft.
measured after hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24		=	
over 24		=	

Test Pit Dimensions (ft.):
Pit Depth
Pit Length X Width

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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Form 2006 USCS Env.

HALEY & ALDRICH, INC.
SAMPLE

HALEY & ALDRICH

ENVIRONMENTAL TEST PIT LOG

Test Pit No. **TP 214**

Page 1 of 1

PROJECT	Mirror Lake Watershed Study	H&A FILE NO.	28675-309
LOCATION	Essex, Massachusetts	PROJECT MGR.	D.H. Gevalt
CLIENT	Citizens Advisory Partnership	FIELD REP	C.S. Osgood
CONTRACTOR	Stanley Lynde Const. Co., Inc.	DATE	19-Jul-02
EQUIPMENT	Case 580 rubber tire backhoe - 1/4 cu. yd. bucket	WEATHER	Thunderstorms 90's

Ground El.	74.5 ft.	Location	N 2,089,041.101	Groundwater depths/entry rates (in./min.):
El. Datum	NGVD		E 801,444.238	None

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (density/consistency, color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions,	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					Note: Ground surface strewn with boulders. Numerous depressions indicating										
					subsurface voids noted.										
	1.5				15% coarse to fine sand, 15% cinder fragments and particles, 10% unidentifiable, white										
					ash-like material, 10% fines (largely organic), 10% coarse to fine gravel, 10% wood										
					(manufactured and treated), 5% glass fragments, 5% metal strips and wire, 5% charcoa										
2	S2	15.9			5% plastic sheeting (possibly polyethelene bags), 5% brick particles, 5% clay pipe										
					fragments. Matrix generally dark brown to gray in color with pockets of white and red										
					15% boulders, 15 % cobbles. Maximum particle size 36 inches.										
	2.5				Distinct decomposed gasoline odor, possible faint napthalene odor. Visible irridescen										
					sheen on moist solids 4.6 to 5.2 ft.										
4					-FILL-										
	4.6														
	S1	140			Note: Bedrock surface smooth and flat, consisting of very hard to hard, slightly										
	5.2		5.2		weathered, light gray to pink, coarse to fine grained granite. Single high angle joint noted.										
					REFUSAL ON BEDROCK 5.2 FT.										
6															
8															

Obstructions:

Remarks:
Note: Sample S1 submitted for laboratory chemical analysis.
Note: Field monitoring of breathing zone and headspace screening conducted using an hNU 11.7 ev. PID.
Bucket Decontamination Method: Steam cleaned

Field Tests

Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:
at depth NE ft.
measured after 0.75 hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	6.0	=	18.0
over 24	1.0	=	33.0

Test Pit Dimensions (ft.):
Pit Depth 5.2
Pit Length X Width 10.5 x 4.3

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH, INC.
SAMPLE

HALEY & ALDRICH

TEST PIT LOG

Test Pit No. **TP-1**

Page 1 of 1

PROJECT	New England Hospital	**H&A FILE NO.**	10715-205
LOCATION	Boston, Massachusetts	**PROJECT MGR.**	M.X. Haley
CLIENT	PFT Associates	**FIELD REP**	C. S. Osgood
CONTRACTOR	J. Marchese & Sons Const.	**DATE**	07-Jan-02
EQUIPMENT	CAT 416 Rubber Tire Extendahoe	**WEATHER**	Mostly Clear 20s

Ground El. 36.3 ft. **Location** West of Pedestrian Tunnel
El. Datum NGVD
Groundwater depths/entry rates (in./min.): 7.8 ft. Steadily

Depth (ft.)	Sample ID	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (density/consistency, color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				Dark brown silty SAND (SM), mps 5 mm, organic odor, moist.		5	5	10	45	40	R			
	0.5		SM	Fines largely organic.										
				-LOAM FILL-										
		1.3												
2														
	S3			Yellow brown to olive brown sandy fat CLAY (CH), trace roots, clinker fragments,	5	5	5	10	15	60	N	M	H	
			CH	cinder particles and fragments, clay pipe fragments, metal wire, asphalt fragments										
				mps 24 in., no odor, moist.										
				-FILL-										
4	4.0			Note: Poured concrete foundation wall on east side of test pit from 0.0 -4.4 ft.										
	4.0													
6	S2													
8	8.0	8.0												
	8.0			Yellow brown fat CLAY (CH), trace fine sand. mps 0.5 mm, no odor, dry.					5	95	N	M	H	
	S1		CH	Appartantly laminated with frequent fine sand partings and possible organic fibers.										
	9.0			-MARINE DEPOSIT-										
10														
		11.0												
				Yellow brown to gray sandy lean CLAY (CL) with gravel. mps 35 mm.	5	10	10	10	15	50	S	M	L	
			CL	Distinct disrupted laminae in discrete zones. Coarse fraction consists of well-rounded										
				igneous and metemorphic lithologies.										
12	12.0	12.0		-GLACIOMARINE DEPOSIT-										
				Note: Possible stratum change to gray lean CLAY with sand (CL) below 12.0 ft										
				Coarse fraction apparantly less abundent.										
				-MARINE DEPOSIT-										
				BOTTOM OF EXPLORATION 13.5 FT.										
14														

Obstructions:

Remarks:
Note: Bag samples S1-S3 obtained for potential mechanical analysis from depths indicated.

Field Tests

Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:
at depth 13.2 ft.
measured after 0.1 hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	1	=	1.8
over 24	1	=	8.2

Test Pit Dimensions (ft.):
Pit Depth 13.5
Pit Length X Width 9.0 x 6.0

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

APPENDIX D
CRIBSHEETS

D.1 Cribsheets

The following cribsheets are provided as a quick reference to the major soil properties defined by the USCS as practiced by H&A. These abbreviated summary tables are not a comprehensive reference, rather they are intended to be used as a field aid during identification and description of soils by staff thoroughly familiar with OP2001.

COLOR EXAMPLES

- GRAY
- GRAY-BROWN
- OLIVE-BROWN
- OLIVE
- OLIVE-GRAY
- DARK BROWN
- RED-GRAY
- RED-BROWN
- BROWN
- RED
- LIGHT BROWN
- TAN
- YELLOW-BROWN
- RED-YELLOW
- YELLOW

GRAIN SIZE

Clear Square Sieve Openings — U.S. Standard Series Sieve

	12"	3"	3/4"		4	10	40	200
SOILS	Boulders	Cobbles	Gravel		Sand			Silts and Clays
			Coarse	Fine	Coarse	Medium	Fine	
FILLS	Blocks	Pieces	Fragments		Particles			Specks
	300mm	75mm	19mm		4.75mm	2.0mm	0.42mm	0.075mm

APPARENT/RELATIVE DENSITY NON-COHESIVE SOIL

APPARENT DENSITY	SPT (# blows/ft)	MODIFIED CA. SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very loose	0-4	0-4	0-5	0 -15
Loose	5-10	5-12	6-15	15-35
Medium dense	11-30	13-35	16-40	35-65
Dense	31-50	36-60	41-70	65-85
Very dense	> 50	>60	>70	85-100

CONSISTENCY COHESIVE SOIL

		TORVANE	POCKET PENETROMETER
CONSISTENCY	SPT (# blows/ft)	UNDRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)
Very soft	0 - 2	<0.13	<0.25
Soft	3 - 4	0.13 - 0.25	0.25 - 0.5
Medium Stiff	5 - 8	0.25 - 0.5	0.5 - 1.0
Stiff	9 - 15	0.5 - 1.0	1.0 - 2.0
Very Stiff	16 - 30	1.0 - 2.0	2.0 - 4.0
Hard	>30	>2.0	>4.0

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

SOIL IDENTIFICATION SHOULD INCLUDE:

1. Percent of gravel, sand & fines
2. Dilatancy, toughness, plasticity, dry strength
3. Density/Consistency
4. Color
5. Group name/Group symbol
6. Percent oversized
7. Maximum particle size
8. Structure
9. Odor
10. Moisture
11. Optional descriptions
12. Geologic interpretation

Criteria for Describing Soil Structure

Description	Criteria
Bed	A sedimentary layer bounded by depositional surfaces.
Blocky	A characteristic in which cohesive soil can be broken down into small angular lumps which resist further breakdown.
Bonded	Attached or adhering.
Fissured	Broken along definite planes of fracture.
Foliated	Planar arrangement of textural or structural features.
Frequent	More than one per foot of thickness.
Homogeneous	Same color and appearance throughout.
Interbedded	Alternating soil layers of different composition.
Laminae	A very thin cohesive layer.
Layer	A general term for material lying essentially parallel to the surfaces against which it was formed.
Lens	A lenticular deposit, larger than a pocket.
Occasional	One or less per foot of thickness.
Parting	A very thin granular layer.
Pocket	Small erratic deposits less than 12 in. in thickness.
Seam	A thin layer separating two distinctive layers of different composition or greater magnitude.
Stratified	Alternating layers of varying material or color.
Stratum	A stratigraphic unit.
Varve	A cyclic sedimentary couplet consisting of a coarser and a finer layer representing the variation in depositional energy resulting from the annual freeze-thaw cycle typically found in glaciolacustrine environments.

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USCSFORM.FH10 01-09-03

Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll a 1/8 in. (3 mm) thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8 in. (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger
High	pressure. The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

SUMMARY OF TEST RESULTS

	Dilatancy	Toughness	Plasticity	Dry Strength
ML	slow - rapid	low	none - low	none - low
MH	none - slow	low - medium	low - medium	low - medium
CL	none - slow	medium	medium	medium - high
CH	none	high	high	high - very high

Laminate 1B

K:\techproc\sop\Level 2 (Draft SOPs)\SOP2001\[Manual Tests for Fines Criteria.xls]Summary

APPENDIX E
ESTIMATING SOIL COMPONENT PERCENTAGES

E.1 Estimating Percentages by Weight or Volume

ASTM D2488 goes to great lengths to differentiate between soil component percentages determined by estimates of particle volume, particle weight, and particle dry weight. The dry weight of soil is calculated by dividing the weight of the moist soil by (1+ soil water content percentage expressed as a decimal). ASTM D2488 requires the percentage of cobbles and boulders to be estimated on the basis of volume percentage. Of the fraction of the soil smaller than 3 in., the gravel, sand, and fines percentages are to be determined based on an estimate of dry weight.

However, in almost all cases, this method overly complicates estimating the percentage of different soil components. Haley & Aldrich considers that estimates of percentage based on particle volume and particle weight (either wet or dry) are equivalent. Averages of specific gravity of soil range between 2.65 and 2.75. Percentages of particle fractions based on volume should, in general, vary by no more than 5 percent from percentages based on weight, well within the error limits of the procedure.

There are two cases where weight and volume measurements will not agree.

The first case is for organic soils. The organic portions of the soil will have a low specific gravity ($\leq$ 1.0) and even large quantities will weigh little, while the mineral portions will have a much higher specific gravity and higher weights for smaller volumes. Care and experience are needed to estimate percentages in an organic soil.

The other case where weight and volume measurements will not agree is in areas were soils contain an unusual amount of particles made up of minerals with a very low or very high specific gravity, such as mica and vermiculite, or pyrite and magnetite. Again, care and experience are required to accurately estimate soil fraction percentages.

Listed below are methods for estimating particle size fractions suggested by ASTM D2488. A review of these ASTM methods will show that the recommended methods are based not on dry weight of soil but on volume estimates.

E.2 Preparation for Identification

- The soil identification portion of this procedure is based on the portion of the soil sample that will pass a 3 in. (75 mm) sieve. The larger than 3 in. (75 mm) particles must be removed—manually for a loose sample, or mentally for an intact sample—before classifying the soil.

- Estimate and note the percentage of cobbles and the percentage of boulders.

E.3 Estimating Soil Component Percentages

Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage of the gravel, sand, and fines. Considerable experience is required to estimate the percentages of particle-size components. Frequent comparisons with laboratory particle-size analyses should be made. The percentages shall be estimated to the closest 5 percent. The percentages of gravel, sand, and fines must add up to 100 percent. If one of the components is present but not in sufficient quantity to be considered 5 percent of the smaller than 3 in. (75 mm) portion, indicate its presence by the term *trac*e, for example, trace of fines. A trace is not to be considered in the total of 100 percent for the components.

E.4 Suggested Procedures for Estimating the Percentages of Gravel, Sand, and Fines in a Soil Sample (ASTM D2488-93)

E.4.1 Jar Method

The relative percentage of coarse and fine grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 seconds. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

E.4.2 Visual Method

Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then do the same with the sand size particles and the fines. Then mentally compare the number of sacks to estimate the percentage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (A.4.3).

E.4.3 Wash Test (for relative percentages of sand and fines)

Select and moisten enough minus No. 4 sieve size material to form a 1 in. (25 mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

E.4.4 Other

While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.

APPENDIX F
ASTM D2488 CONSISTENCY TEST

ASTM D2488 determines consistency using a scale based on a thumb penetration test. This scale is presented here in the event that a client on a project requires it, but it is not used in H&A's general practice. If this scale is used, it should be noted on the exploration log.

For intact fine grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria listed below. This observation is inappropriate for soils with significant amounts of gravel.

ASTM Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about 1/4 in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

APPENDIX G
DESCRIPTIVE TERMINOLOGY FOR SOIL STRUCTURE

Describe the structure of intact soils in accordance with the criteria in listed below.

Criteria for Describing Soil Structure

Description	Criteria
Bed	A sedimentary layer bounded by depositional surfaces.
Blocky	A characteristic in which cohesive soil can be broken down into small angular lumps which resist further breakdown.
Bonded	Attached or adhering.
Fissured	Broken along definite planes of fracture.
Foliated	Planar arrangement of textural or structural features.
Frequent	More than one per foot of thickness.
Homogeneous	Same color and appearance throughout.
Interbedded	Alternating soil layers of different composition.
Laminae	A very thin cohesive layer.
Layer	A general term for material lying essentially parallel to the surfaces against which it was formed.
Lens	A lenticular deposit, larger than a pocket.
Occasional	One or less per foot of thickness.
Parting	A very thin granular layer.
Pocket	Small erratic deposits less than 12 in. in thickness.
Seam	A thin layer separating two distinctive layers of different composition or greater magnitude.
Stratified	Alternating layers of varying material or color.
Stratum	A stratigraphic unit.
Varve	A cyclic sedimentary couplet consisting of a coarser and a finer layer representing the variation in depositional energy resulting from the annual freeze-thaw cycle typically found in glaciolacustrine environments.

APPENDIX H
ADDITIONAL DESCRIPTIVE INFORMATION

The following additional descriptive information should be included as a part of a soil description.

H.1. Angularity of the Plus No. 10 Fraction

If requested by the Project Manager, the angularity of the plus No. 10 fraction (gravel and coarse sand) can be described as angular, subangular, subrounded, or rounded in accordance with the criteria in listed below and Fig. H-1. A range of angularity may be stated, such as: subrounded to rounded.

Criteria for Describing Angularity of Coarse Grained Particles (see Fig. H-1)

Description	Criteria
Angular	Particles have sharp edges and relatively planar sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly planar sides but have well rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

H.2. Particle Shape of the Plus No. 4 Fraction

Describe the shape of the Plus No. 4 fraction (gravel, cobbles and boulders) as flat, elongated, or flat and elongated if they meet the criteria listed below using the dimensions shown in Figure G-2. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

Criteria for Describing Particle Shape (see Fig. G-2)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness ratio > 3
Elongated	Particles with length/width ratio > 3
Flat and elongated	Particles meet criteria for both flat and elongated

H.3. Hardness of the Plus No. 10 Fraction

Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer; for example, gravel size particles fracture with considerable hammer blow, some gravel size particles crumble with hammer blow. “Hard” means particles do not crack, fracture, or crumble under a hammer blow.

H.4 Reaction with Hydrochloric Acid

Describe the reaction with HCl as none, weak, or strong, in accordance with the criteria listed below. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

Criteria for Describing the Reaction with HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

H.5. Additional Comments

Additional comments shall be noted. These may include:

In-situ bonding, particularly of glacial till soils: poor, moderate, well bonded.
Presence of obstructions: specifically for man-made features (not boulders).
"Running" or "Flowing" sands: typically below the water table, these are a good liquefaction indicator.
Validity of apparent density: Blow counts increased by gravel content.
Water loss: Very important in coring bedrock, but appropriate for soils.
Presence of roots or root holes.
Caving of trench or hole.

H.6. Additional Descriptive Information for Intact Samples - Cementation

Describe the cementation of intact coarse grained soils as weak, moderate, or strong as follows:

Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

FIGURE H-1 Typical Angularity of Grains

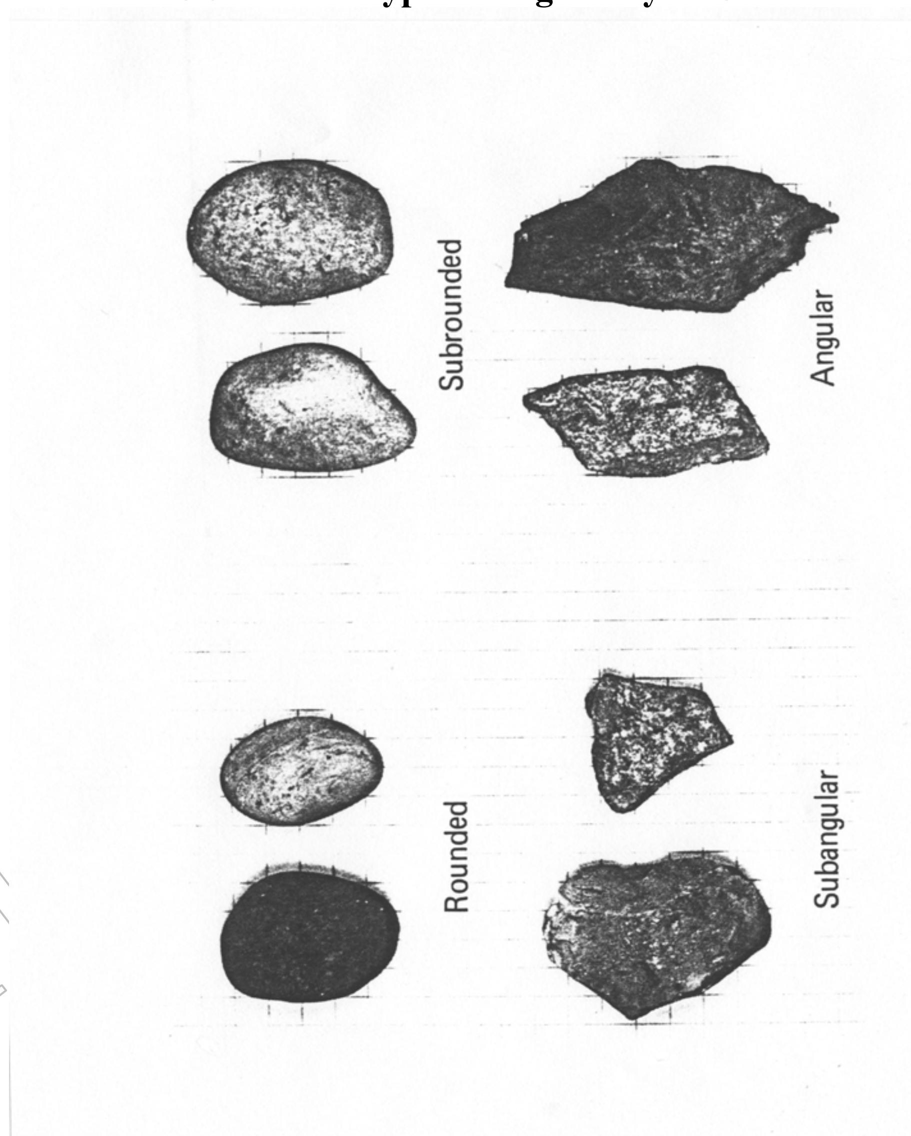
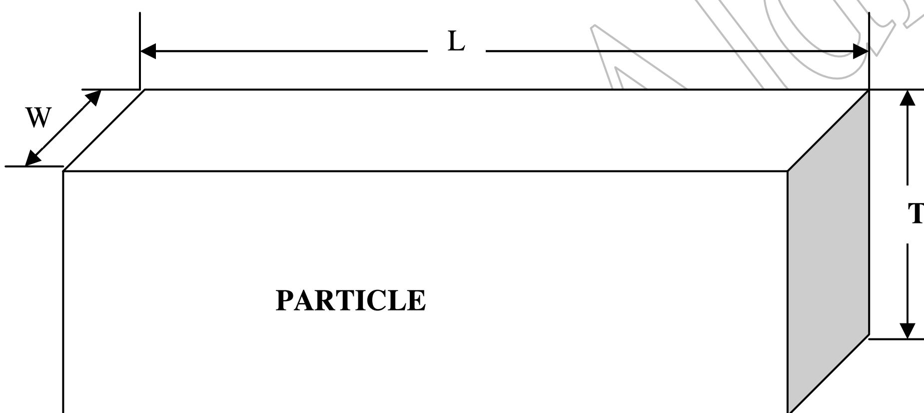


FIGURE H-2 Criteria for Particle Shape

Particle Shape

W = Width
T = Thickness
L = Length



FLAT: W/T >3

ELONGATED: L/W >3

FLAT and ELONGATED:
meets both criteria

APPENDIX I
FILLS

I.1 Fill Description

Fills can be separated into two distinct categories:

Fills consisting largely of natural components can usually be described in a similar manner to natural soils including a particle breakdown and designation of a USCS Group Symbol and Group Name.

Fills containing man-made or deleterious materials that constitute a significant percentage of the total volume cannot be described in the typical fashion, nor can a USCS Group Symbol and Group Name be designated. In fills with substantial quantities of man-made or deleterious materials the typical particle breakdown is not conducted and constituent estimates are simply listed in order of abundance.

The distinction between the two categories of fills defined above will in some cases be unclear. Determination of which method to use to describe fills is a field decision based on the character of the fills observed and the method which best conveys an accurate representation of the materials present.

Many artificial and deleterious materials have very low densities but may constitute a significant percentage of the total fill volume. In such cases constituent estimates may be based upon volume, not weight, and noted in the description.

Since artificial materials will commonly occur across a wide range of sizes it may be impractical to distinguish them separately from the total as oversize components. To do so may necessitate including them twice within a single description. In such cases the descriptive terms for size ranges may be included with the constituent estimates or noted in the description.

The presence of certain materials in extremely small quantities can be of critical importance in fills. Constituents comprising less than 5% of the total are qualified and preceded by the term “trace” and included in the particle breakdown, constituent estimates, or noted in the description.

I.2 Fill Types

Characterizing fill types based upon similarities can aid in estimating quantities for reuse, treatment or disposal. Caution must be exercised that any characterization of fill type is an accurate reflection of site conditions and that field assumptions do not conflict with the site history or project objectives. Consultation with the Project Manager to develop criteria upon which to base fill types is required. The following terminology is used by Haley & Aldrich to denote size ranges of artificial materials within fills:

Descriptive Fill Term	Size Range	Size Range Metric	Comparative Soil Term
Specks	< No. 200 Sieve	< 0.075 mm	Silt
Particles	No. 200 to 3/16 in.	0.075 mm to 5 mm	Sand
Fragment	3/16 in. to 3 in.	5 mm to 75 mm	Gravel
Pieces	3 in. to 12 in.	75 mm to 305 mm	Cobbles
Blocks	> 12 in.	> 305 mm	Boulders

Definitions of Common Fill Constituents and Terminology

Term	Definition
Anthropogenic	Impacted by man.
Artificial	Man-made.
Ash	Inorganic residue of combusted matter.
Ceramic	Nonmetallic mineral products manufactured by firing.
Charcoal	Carbonaceous residue of incompletely combusted organic material.
Cinder	General term for ash, charcoal, clinkers or slag.
Clinker	Solid waste formed in furnaces consisting of fused stony matter.
Concrete	Solid mass of cemented aggregate.
Deleterious	Having a harmful or obscure affect.
Loam	Soil containing roughly equal proportions of sand, silt and clay. Usually organic matter is present in varying amounts.
Slag	Clinker or solid waste from iron blast furnaces.
Tar	Viscous, dark, bituminous liquid.

Examples of Fills consisting largely of natural materials:

Example1 (Test Boring Description)

10% medium sand, 25% fine sand, 15% roots
50% fines: slow dilatancy, low toughness, nonplastic, low dry strength

Very loose, dark brown sandy ORGANIC SOIL (OL/OH)
15% roots estimated by volume, trace brick particles.
mps 2.0 mm.
No structure, musty odor, dry.
LOAM FILL

Example 2 (Stockpile Description)

100% coarse gravel

Purple, poorly graded GRAVEL (GP)
No oversize, mps 2.5 in.
Consists entirely of very hard angular processed rhyolite.
No odor, dry.
CRUSHED STONE

Example 3 (Test Pit Description)

15% coarse gravel, 10% fine gravel, 15% coarse sand, 15% medium sand, 25% fine sand
5% brick fragments to particles, 5% concrete or mortar, 10% fines: rapid dilatancy

Brown to dark brown, well graded SAND with silt and gravel (SW-SM)
10% cobbles, 5% boulders, mps 18 in.

Concrete present generally as moderately hard fragments with several elongated blocks observed measuring less than 30 in. maximum dimension. Minor decomposed concrete or mortar observed on brick fragments. Possible asbestos observed in trace quantities as friable white fibers in occasional extremely small pockets. Slight decomposed gasoline odor associated with observed water. Wet at 8.5 ft.
FILL

Examples of Fills consisting of significant percentages of artificial or deleterious matter:

Example 1 (Test Pit Description)

55% concrete, 20% brick, 10% medium to fine sand, 5% coarse to fine gravel
5% fines, 5% cobbles, mps 6 in., trace metal strips and wire, wood fragments, plastic pieces, glass shards, cinder particles to specks, unidentified apparent precipitate present as blue specks.

Soil components light brown. Consists entirely of apparent demolition debris. Concrete present primarily as hard flat or irregular blocks measuring 18 in. to 36 in. maximum dimension with most containing #6 to #8 rebar. Brick present generally as fragments. No odor, moist.
RUBBLE FILL

Example 2 (Test Pit Description)

20% ash, 20% charcoal particles, 15% clinker fragments to particles, 15% fines, 10% sand
5% paper, 5% glass pieces to fragments, 5% ceramic fragments, 5% wood blocks to fragments, trace metal pieces to fragments, asphalt pieces to fragments.

Color variable changing to dark gray below 4.0 ft. Fines not identified. Consists primarily of partially burned and decomposed household refuse by identifiable remains of newspaper, bottles and cans. Distinct fuel odor and oil saturation below observed water at 4.5 ft. Free product noted 5 mm thick on water surface after a 15 minute stabilization period.
REFUSE FILL

Example 3 (Test Pit Description)

50% cinder fragments to particles, 20% fines, 15% fly ash, 10% gravel, 5% sand, trace possible ceramic particles, glass shards.

Dark gray to black discoloration. Fines not identified. Heavily contaminated with coal tar in discrete zones or pockets of apparently higher permeability ranging in thickness from 6 in. to 24 in. at depths of 2.0 ft. to 7.5 ft. Strong naphthalene odor. Moist below 9.0 ft.
MGP WASTE

Example 4 (Test Boring Description)

15% coarse sand, 15% clinker fragments to particles, 15% fine gravel, 15% ash, 10% ceramic particles, 10% unidentified fines, 10% wood, 5% fine sand, 5% glass particles, trace brick particles.

Medium dense. Soil components brown to dark brown with dark gray discoloration. Coarse sand and gravel generally hard and angular. Possible organics present partly as fines. Wood present as lumber fragments and possible roots. Strong septic odor and faint possible solvent odor detected. Sample moisture probably due to drilling fluid.
FILL

Suggested Nomenclature

Suggested nomenclature for possible fill types are included below.

Primarily Natural Components	Significant Percentage Artificial or Deleterious
Loam Fill	Bark Mulch
Cohesive Fill	Stump Fill
Hydraulic Fill	Rubble Fill
Granular Fill	Refuse Fill
Structural Fill	Urban Fill
Till Fill	Medical Waste
Crushed Stone	Tannery Waste
Ballast	MGP Waste
Mine Tailings	Cinder Fill
Rock Fill	Miscellaneous Fill
Rip Rap	Grits and Screenings

OPERATING PROCEDURE: OP2000

MONITORING FIELD EXPLORATIONS

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	CSO/ 12-02	JAM/ 01-03		STP/6-1-03	SRK/7-1-03

Total Pages: 56

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OPERATING PROCEDURE: OP2000

MONITORING FIELD EXPLORATIONS

1. PURPOSE

Exploratory test borings, probes and test pits represent important sources of subsurface information relating to geologic conditions and site suitability fundamental to environmental site assessment and geotechnical engineering design recommendations. The following procedure is an outline of the field staff responsibilities while monitoring subsurface exploration methods utilized by Haley & Aldrich Inc. (H&A) to obtain the best possible data for geologic characterization, laboratory testing and subsequent engineering evaluations and environmental assessment.

2. EQUIPMENT & MATERIALS

2.1 Standard Required Equipment

	Required		Additional as Required
1.	Proposal (signed by Client)	20.	First Aid Kit
2.	Site Plan	21.	Cellular Phone
3.	Contract with Subcontractor (pay items)	22.	Health & Safety Plan
4.	Exploration Criteria/Specifications	23.	Respirator & Tyvek Suit
5.	Field Book	24.	Laptop Computer
6.	Clipboard	25.	Camera & Film
7.	Logs & Forms	26.	Field Procedures
8.	Office Supplies (pencils & markers)	27.	Maps and References
9.	Engineer's Scale	28.	Sample Bags & Jars with Labels
10.	6 ft. Ruler	29.	Survey Stakes/Paint/Flagging
11.	100 ft. Measuring Tape	30.	Shovel
12.	Hand Lens, magnifying	31.	Geologist's Pick
13.	Pocket Knife	32.	Flashlight
14.	Hard Hat	33.	Roadway Box Key/Socket Wrench
15.	Safety Glasses	34.	Water Level Indicator
16.	Sound Dampeners	35.	Hand Level
17.	Steel Toe Boots	36.	Brunton Compass
18.	Protective Gloves	37.	Pocket Penetrometer
19.	Rain Gear	38.	Torvane

2.2 Required Environmental Equipment

Most environmental fieldwork will have extensive equipment requirements and supplies specifically related to the project needs. The following list is a representative list of equipment classed as type-specific groups. A comprehensive list of equipment and materials must be developed for each project in coordination with the Project Manager (PM) and Health & Safety (H&S) Coordinator prior to the start of the field program.

1. Personal Protection Equipment (PPE)
   - Air Purifying Respirator & Cartridges (Type GMC-Type H)
   - Latex/Nitrile Inner Gloves/Boot Covers
   - Tyvek/Saranex Coveralls/Sleeves/Apron

2. Decontamination Equipment and Supplies
   - Decontamination Kit
     - 5 gallon bucket
     - 5 gallon water jug
     - alconox detergent
     - brushes & paper towels
     - methanol/hexane/deionized water
   - Decontamination Tub
   - Absorption Pads
   - Polyethylene Sheeting
   - Polyethylene Trash Bags

3. Air Quality/Headspace Monitoring Equipment
   - Photo-Ionization Detector (PID)
   - Flame Ionization Detector (FID)
   - Organic Vapor Analyzer (OVA)
   - Combustible Gas Meter-LEL/O2
   - Dust Monitor
   - Multigas Meter-HCn/Methane/H2S
   - Gas Pointer
   - Draeger Tube Sampling Kit
   - Radiation Survey Meter

4. Soil Sampling Equipment and Supplies
   - Hand Auger
   - Soil Core Sampler
   - Shovel/Trowel/Remote Sampler
   - Stainless Steel Bowl
   - Aluminum Foil
   - Tongue Depressors
   - Sample Bags/Laboratory Glassware & Labels
   - Cooler & Ice Blocks

5. Water Sampling Equipment and Supplies
   - Water Level Indicator
   - Oil/Water Interface Probe
   - Centrifugal Pump-Volume
   - Submersible Pump-Low Flow
   - Peristaltic Pump & Silicone Tubing
   - Purge Pump & DC Supply
   - Waterra® Tubing/Foot Valves/Filters
   - Stainless Steel/Teflon Bailers & Rope
   - Remote Sampler
   - Water Testing Equipment
     - Flow Cell (pH, temperature, conductivity, DO, turbidity, ORP and salinity)
     - Dissolved Oxygen (DO) Meter
     - Oxidation-Reduction Potential (ORP) Meter
     - Turbidity Meter
     - Downhole Temperature/Resistivity/Conductivity/Salinity Meter
     - pH/ Turbidity/DO/ Temperature/Resistivity/Conductivity/Salinity Meter
   - Laboratory Glassware & Labels
   - Cooler & Ice Blocks

2.3 Additional Equipment, Specialized Instrumentation, Materials & Company Vehicles

Company-wide, Haley & Aldrich maintains an array of equipment, vehicles and specialized instrumentation for a broad variety of uses in addition to the selected equipment listed above. Additional equipment, vehicles and materials may be rented or purchased as needed with the approval of the project manager. Project equipment needs should be addressed proactively so that interoffice allocation can take place. It is recommended that the field staff familiarize themselves with the use, function and availability of all types of equipment standard to the industry. The following list is representative of the additional equipment currently available but is not intended to be a comprehensive list.

1. Survey Instrumentation
   - Theodolite/Transit/ Level & Rod
   - Global Positioning System (GPS)

2. Subsurface Locating Equipment
   - Ground Penetrating Radar (GPR)
   - Metal Detector
   - Magnetometer

3. Air-Soil-Water Quality/Analytical Equipment
   - Gas Chromatograph (GC)
   - TPH Analyzer
   - Infrared Oil Analyzer
   - Radiation Survey Meter
   - Oxidation-Reduction Potential Meter (ORP)

4. Geotechnical Equipment & Instrumentation
   - Vane Shear Test Equipment
   - Vibrating Wire Piezometer Equipment
   - Pressuremeter Testing Equipment
   - Seismograph Equipment
   - Inclinometer Equipment
   - Nuclear Moisture-Density Gauge
   - Sound Level Meter

5. Hydrogeologic Equipment & Instrumentation
   - Datalogger/Levelogger Hardware & Software
   - Stream Flow Gauge & Equipment

6. Photographic Equipment
   - Video Camera
   - Digital Camera
   - 35mm Camera

7. Communication Equipment
   - Cellular Telephone
   - Satellite Telephone
   - Two-Way Radio

8. Computer Hardware & Software

2.4 Billing Equipment & Materials

Equipment and materials are billed to the project as used on a daily or per item basis. Completion of equipment usage and billing forms and submission of original receipts for items purchased or rented is required in order to charge the project for reimbursement.

3. PROCEDURE

3.1 Preliminary Preparations

3.1.1 Project Briefing

Prior to the beginning of an exploration program all field staff should attend a project briefing with the project manager and office staff involved in the proposed project. At this time a file folder for the field activities should be created for the purpose of containing all relevant project information including: copies of the original proposal, site and utility plans, contract documents and drawings, applicable regulations, exploration and sampling criteria, site contacts, phone numbers of team members, health and safety (H&S) plans, log and report forms and any other related documents or references. The field folder should be organized and maintained such that all documents likely to be useful for the completion of field activities by others are readily available in the event of personnel changes.

During the project briefing each team member should become thoroughly familiar with the overall scope of the project in addition to the task items and individual requirements of the work plan. Development of an outline of the specific activities envisioned and a review of the details concerning each task may facilitate the formulation of alternate approaches to field methods as well as the creation of action, materials and equipment lists.

Field staff should review all existing applicable information that relates to site geology and possess detailed familiarity and understanding of the contract specifications in order that knowledgeable field decisions can be made. Field staff should be experienced in all of the various field exploration procedures, instrumentation installation and sampling techniques required for the project. Requests for training, guidance or assistance should be made by the field staff as needed. Haley & Aldrich, Inc. fosters a supportive environment where all staff are encouraged to share knowledge and experiences with each other.

3.1.2 Health & Safety

Safety in the workplace is a prime concern of Haley & Aldrich, Inc. on all projects. It is essential that field personnel understand and comply with all regulations governing worker safety in the field including applicable OSHA guidelines. Certain projects will require the field staff to attend a Health & Safety briefing due to specific occupational safety concerns. The nature of these concerns will be addressed by a site specific Health & Safety Plan. It is the responsibility of the project manager to notify the field staff of the existence of the Health & Safety Plan, however all field staff are encouraged to inquire with the Project Manager and with the Health & Safety Coordinator directly to avoid any possible oversight. Safety awareness and safe work practices are the responsibility of the field staff at all times and on all projects whether or not site or task specific guidelines are in existence. In the event of an accident, exposure or if unexpected contamination is encountered, the Project Manager and the Health & Safety Coordinator must be contacted immediately. Standard H&A safety recommendations for subsurface explorations are provided OP1001 Excavation and Trenching Safety and OP1002 Drilling Safety.

3.2 Duties and Responsibilities

3.2.1 General

The principal reason for providing Haley & Aldrich field representation is to assure that the field data being collected is accurate and of the type necessary to properly evaluate the site geologic conditions for use in the subsequent engineering analyses and environmental assessment.

3.2.2 Supervision of Subsurface Exploration Programs

Each subsurface exploration program carried out under H&A supervision is designed to accommodate the specific requirements of a given project. Subsurface exploration programs routinely include the excavation of test pits and the drilling of test borings with associated instrumentation installation, special testing and sampling requirements. Modifications to the fieldwork criteria, sampling and testing are often made during the execution of the subsurface exploration program as the accumulated geologic data and test results are interpreted. For this reason it is essential that all records are current and complete and that uncertainties are identified for resolution. Field staff are responsible for maintaining communication with the project manager and logistical coordination of the field effort within the workscope and budgetary limits.

3.2.3 Verification of Subsurface Exploration Techniques and Services

It is the role of H&A field staff to verify that instrumentation installation, subsurface sampling and testing methods are in conformance with applicable approved standards and specifications and to document conditions and results. Performance of sampling and testing is commonly conducted with subcontractor support and equipment. It is the responsibility of the H&A field staff to verify that proper equipment and techniques are employed and to obtain measurements and make observations independently. H&A field staff are responsible for complete field logging of groundwater, soil and bedrock conditions, the maintenance of accurate test records and field exploration location sketches, and ensuring proper instrumentation installation, sample preservation and handling. In addition, payment for services rendered on behalf of the client is commonly handled with H&A providing a daily field report (DFR) including an accurate breakdown of the work activities and itemized costs on a daily basis. Subcontractor pay items and method of payment are defined in their contract.

3.2.4 Right of Access

Prior to site entry, Haley & Aldrich staff members must ensure that permission has been gained from the property owner to access the property.

3.2.5 Layout and Utility Clearance

Prior to the start of any subsurface exploration all proposed locations must have utility clearance from all appropriate agencies and utility owners. Utility owners typically do not enter private properties. If there are particular concerns regarding utilities on private property, arrangements can be made with a private utility locating service. Prior to contacting any utility agency or service all proposed exploration locations must first be clearly marked in the field either with white paint or staked and white flagged. Additional colors can be used to highlight the location if the ground is snow covered. Alternate locations should be laid out in areas of suspected utilities. H&A requires the subsurface exploration subcontractor to obtain the utility clearance within the terms of the contract or services agreement. H&A field staff should verify with the driller/test pit contractor that the utilities have been cleared and obtain the clearance number prior to the start of subsurface explorations. Pre-excavation may be necessary in areas of closely spaced utilities either by hand, vacuum, or other means. Additional guidance is provided in OP1003 Utility Clearance.

3.2.6 Site Safety and Subcontractor Briefing

At the start of fieldwork, H&A field staff should coordinate a site briefing to review the schedule and workscope with all subcontractors involved with the project. This briefing should include a review of the equipment and material needs, exploration criteria and priority, testing and sampling specifics, pay items, site conditions, environmental concerns, known or suspected contamination, H&S information, decontamination requirements, site restoration and waste disposal issues, a site walkover and utility check. While it is the subcontractor's responsibility to obtain the utility clearance, the field representative should pay attention to the utility plans as well as surface manifestations of utilities involving manholes or catch basin grates, and gate or roadway boxes. Distance to overhead utilities must be considered as well. Observations of potential conflicts with utilities should be addressed with the subcontractor for their consideration.

3.2.7 Exploration Monitoring

3.2.7.1 General

Haley & Aldrich field staff should become familiar with the technical details and suitability of all exploration equipment and methods. Test borings are the most common method employed by H&A to obtain high quality data on subsurface conditions. Unsampled probes can be used in a limited capacity to document overburden thickness. Specialty equipment is routinely used in sampled probes for environmental sampling. Test pits are preferred for surficial geological mapping and to document fill or overburden thickness. In addition to these typical exploration methods a variety of special testing techniques and instrumentation installations may supplement the subsurface exploration program. Specific H&A procedures must be consulted for details relating to special testing, sampling and instrumentation installation.

3.2.7.2 Exploration Equipment and Use

Exploration equipment selection is based upon a detailed understanding of the capabilities of the equipment with regard to the anticipated site geological conditions. In addition, the particular project needs may necessitate or preclude certain techniques and equipment. During the initial site walkover or layout, equipment access is considered and the type of exploration method is determined. Relatively small drill rigs are routinely used for overburden sampling, bedrock coring and groundwater monitoring well installations on a variety of projects. Larger pneumatic-percussive well rigs are used for drilling aquifer test and production wells. Excavation equipment may be preferred for initial surficial geologic mapping and to provide access prior to drilling. Various probe equipment may be considered for preliminary estimation of overburden thickness. Access to a water supply must be arranged for cased test borings and rock coring. Shallow water conditions and potentially liquefaction-susceptible soils preclude the use of augers. Bedrock monitoring wells must be cored in sufficient diameter to allow sand pack and seals. Enclosed areas may necessitate alternate fuels or low overhead equipment. Ecologically sensitive areas may require non-petroleum-based hydraulics or lightweight equipment. Many factors affect the equipment selection resulting in some trade-off in performance, cost and reliability of data.

3.2.7.3 Test Boring Techniques

A. *Cased Borings* - Cased borings are the primary method of obtaining high quality overburden samples and for penetration to bedrock prior to rock coring. The drill casing (pipe) is typically advanced in 5 ft. increments either by driving or spinning and then is washed out with an axially discharging tricone rollerbit pumping water or drill slurry from the recirculation tub. Upon flushing, the rollerbit is removed and a splitspoon sampler is fixed to the drill string (rods), lowered to the bottom of the borehole and driven into the undisturbed soils below the bottom of the casing. The procedure is repeated until the termination depth criterion is reached or bedrock is encountered. Common casing inside diameter (I.D.) ranges from 3 inch to 6 inch depending upon conditions and criteria. Rollerbits are sized to fit inside the casing with approximately 1/16 to 1/8 in. clearance. Typically boreholes are started with 5 or 6 in. I.D. casing fitted with a hard-shoe or drive-shoe in the lead (bottom) section. The casing is driven and splitspoon sampling is conducted at 5 ft. intervals (standard sampling) until an obstruction is encountered or the casing is seated into material such as clay that will maintain itself uncased. In the event of an obstruction the rollerbit or a buttonbit may be used to advance through the obstruction. In some cases the obstruction may break or a boulder-buster may be successfully employed and the casing is advanced. In other cases the next smaller diameter casing will be telescoped down the borehole and advanced through the hole in the obstruction created by the buttonbit. In the event that material such as clay that will maintain itself uncased is encountered, the open hole is extended as deep as possible. The borehole may be maintained by a bentonite or polymer slurry (mud rotary drilling). Casing fitted with a spin-shoe (econoshoe) is advanced by drilling in a similar manner to rollerbit advancement. Slurry or water is pumped down the casing to cool the bit and flush away the drill solids. Prior to splitspoon sampling the rollerbit must be lowered down the borehole and the spun casing must be drilled out in the same fashion as with driven casing. Spun or driven casing must be seated into the top of the bedrock in order to achieve an effective seal prior to rock coring.

B. *Mud Rotary Drilling* - Mud rotary drilling typically is conducted in deeper overburden borings and on projects where there are special concerns for soil sample integrity or particularly soft soils. Various products are used to make drill mud depending upon conditions and project requirements. Some mud is bentonite-silica based (heavy mud), some are compatible with saline conditions for ocean drilling, and some polymers are biodegradable for use in boreholes intended for environmental groundwater monitoring well installation. In all cases, mud drilling requires that a positive head be maintained in the casing at all times to stabilize the borehole. The practice is to fit a bypass line to the recirculation circuit that can be easily used to fill the casing as the rollerbit is being withdrawn. Use of a mud balance is required under certain circumstances to ensure sample integrity at the bottom of the borehole. The specific gravity to maintain in the drill mud will be specified on these projects.

C. *Auger Borings* - Hollow stem augers (HSA) are an effective and fast method for drilling shallow borings in softer soils above the water table without introducing water or drill slurry. Hollow stem augers are preferred for environmental studies where continuous soil sampling and minimization of potential cross contamination due to the use of drilling fluids is desired. Hollow stem augers and solid stem augers are also used as shallow probes. Auger flights are typically 5 ft. in length and are commonly 3.5 to 4.25 in. I.D. The lead section is fitted with a cutter head upon which are fixed several hardened, replaceable teeth. Using a center plug fixed to the bottom of the rods, hollow stem augers are typically advanced by drilling to the desired depth whereupon the center plug is replaced by the splitspoon and driven below the bottom of the lead section. Disturbance below the bottom of the augers due to the cutter head is typically substantial and heave is common at the bottom of the borehole due to the piston like effect of the center plug during removal. As such, augers are not favored for test borings on many geotechnical projects where high quality samples and penetration resistance data are required.

D. *Splitspoon Sampling and the Standard Penetration Test (SPT)* - The typical method for obtaining representative samples and a measure of the penetrative resistance of soils in test borings is by means of the Standard Penetration Test (SPT). This is accomplished utilizing a hollow tube splitspoon sampler assembly attached to the drill rods and driven into the soils at the bottom of the borehole at regular intervals. Splitspoon samplers are manufactured in various sizes with the most commonly used being 1 3/8 in. I.D. (2 in. O.D.) and having an interior sample chamber length of 24 in. (approximately 36 in. overall length). Once lowered to the sampling depth, the sampler is typically driven 24 in. into the soils with a 140 lb. hammer freely-falling over a 30 in. drop and the number of blows (SPT blowcount) required for each 6 in. of penetration is recorded. The penetrative resistance in blows per foot obtained from the summation of the blowcounts from 6 in. to 18 in. is referred to as the “N-value”. Terminology for density of granular soils and consistency of cohesive soils has been correlated to N-values. When performed properly the SPT provides useful data for determination of the geotechnical behavior of soils and engineering design in addition to representative remolded soil samples for geological interpretation.

E. *Bedrock Coring* - Bedrock coring is conducted in cased borings to obtain accurate detail of the bedrock properties and high quality samples for laboratory testing. A wide variety of rock core equipment is available and rock coring techniques vary greatly depending upon the driller, rock type, equipment and many other factors. Observations related to drilling activities are a primary focus during rock coring including bit weight, feed restriction, head speed, engine speed and gear, pump volume, water loss and fluid return, core rate, drilling halts, jamming, rapid advances, equipment defects, bit type, bit wear, core barrel type, core barrel adjustment. For all projects it is essential that accurate measurements be made when determining the depth of the bedrock surface from drill action or SPT and that detailed observations are recorded concerning the effects noted and the procedures executed upon encountering bedrock. Coring should begin at the minimum depth below the bedrock surface required to seat the casing in order to document the bedrock condition in the uppermost zone where typically fracturing and weathering transitions are greatest. Core hole depth must be verified following each run to account for lost core. When necessary, logging should be broken down into a two step process beginning with sample preservation, labeling and recording of a simple description including recovery and RQD measurements followed by detailed logging of individual features and properties as time and conditions permit.

F. *Observation Well Installation* - Groundwater observation or monitoring wells are commonly installed in completed test borings as a means obtaining accurate stabilized groundwater readings essential to engineering design, and hydrogeologic modeling. In addition, permanent observation or monitoring well installations provide for continual long-term sampling for environmental analyses. A wide variety of material types and sizes are employed depending upon the intended use. Typical observation or monitoring wells installations consist of 2 in. I.D. PVC pipe with a machine slotted screen section backfilled with filter sand and sealed with bentonite within the desired stratum or zone. Solid riser sections above the sealed zone may be grouted or backfilled with a variety of materials depending upon the project needs and finished at the ground surface with either a flush-mount roadway box or with a protective casing such as a guard pipe and padlock for undeveloped sites. Careful attention to the placement of screens, backfill and seals is required and accurate depth measurements must be recorded during installation. Initial well development may occur immediately upon completion in order set the sand pack and remove the effects of drill fluids from the formation waters.

3.2.7.4 Probes

A. *Unsampled Probes* - The term probe has historically referred to the advancement of a solid drill bit or rod by various means without sampling in order to estimate potential soft sediment thickness and refusal or obstruction depths. Small diameter rods advanced by hand have been useful in determining minimum peat and organic thickness in wetlands. Mechanical advancement of solid stem augers with conventional drilling equipment and pneumatic-percussive air track drilling are routinely used to supplement or replace test borings in areas of known shallow bedrock. Direct-push methods include simple rod assemblies to sophisticated electro-piezocone mechanisms. The principle advantage to conducting probes is that a great deal of data points can be rapidly obtained to create detailed contours of the desired surface or stratum. Implicit in the conduct of non-instrumented unsampled probes is that variations in drill action or rod advance is used to estimate strata changes. Acoustic listening devices placed within a saturated bedrock well near an air track rig will enhance the listener's ability to hear the pneumatic-percussive bit encounter bedrock. Primary among the disadvantages to conducting probes is the uncertainty resulting from relying strictly upon drill action without a hard data sample. Close proximity probes in zones of shallow refusal and repeated probes adjacent to those terminated on suspected obstructions help boost confidence and define aberrations. Secondary among the disadvantages to conducting probes is the inaccuracy inherent in the measurement of an often rapidly moving reference point as the drill advances through obstructions or variable zones into progressively more competent bedrock. Solid stem augers with conventional drilling equipment are slow to progress through dense soils and may be defeated by boulders but can be advanced below the water table without problems. Pneumatic-percussive air track drilling will rapidly advance through dense soils, boulders and bedrock but is inhibited below the groundwater table by borehole collapse and particularly when the air evacuation is suspended as rods are added to the drill string. Depending upon site conditions and termination depth, dozens of probes may be conducted in a single day. As such, horizontal and vertical control should be established at each probe location separate from the probe effort in order to obtain the most use from the rig time and to maximize the accuracy of the data.

B. *Sampled Probes* - Small diameter hand augers, soil plugs and manual soil cores are routinely used for surface soil sampling for rudimentary site reconnaissance, environmental sampling and hydric soils mapping. Direct-push and percussive or vibration driven soil core equipment preferred for shallow environmental sampling ranges in size from small diameter hand held units to vehicle mounted machinery capable of obtaining soil cores within polycarbonate liners 3.6 in. I.D. by 8 ft. length. As with any uncased borehole, additional soil cores may be obtained until the termination depth criterion is reached or sample integrity is compromised due to borehole collapse. Care must be exercised in establishing collapsed or resampled zones when documenting direct-push samples or soil cores.

3.2.7.5 Test Pits

Test pits are an extremely economical and effective way to rapidly characterize shallow subsurface conditions. Test pits are particularly useful for surficial geologic mapping, determining fill thickness and content, contouring shallow bedrock conditions and in determining oversized (cobble and boulder) percentages. Small backhoes with an approximately ¼ cubic yard bucket capacity are capable of excavating test pits up to 12 ft. depth in most materials and can be used with minimal site damage. Larger excavators with an approximately ¾ cubic yard bucket capacity are capable of excavating test pits up to 16 to 20 ft. depth and can be used to construct access for drill rigs on difficult sites. Given sufficient area, excavators can safely enter the excavation and extend the test pit indefinitely. During test pit excavation careful consideration must be given to potential bearing surface disturbance within proposed structures. In addition, care must be taken to minimize other site impacts requiring costly restoration including damage to trees, pavement, curbing, landscaping and utilities.

3.2.7.6 Environmental Sampling & Monitoring

Environmental sampling combined with discrete field screening of soil and groundwater for contaminants is routinely conducted during the performance of subsurface explorations. In addition, continuous monitoring of air quality within the work zone or at the project site may be required to address H&S concerns. Potential contaminants and sources may be identified in the initial stage of project planning and prior arrangements made for PPE, monitoring, sampling and laboratory analysis.

To minimize the risk of cross-contamination typical environmental sampling programs work from known or suspected clean areas toward areas of known or suspected contamination. Contamination encountered unexpectedly may present serious exposure risks to field personnel without proper PPE and monitoring instrumentation, particularly if the contamination is gross or unidentified. In the event unexpected contamination is encountered, all fieldwork should be suspended and the area evacuated immediately until the Project Manager and the Health & Safety Coordinator can be contacted so that H&S and sampling guidelines can be developed.

A. *Decontamination Procedures & Waste Management* - Standard equipment decontamination practices may include the establishment of a decontamination area such that decontamination fluids are collected and properly stored for disposal. Typically a location within the site is chosen away from sensitive or occupied zones and a decontamination pad is created within a bermed area using polyethylene sheeting. A high-pressure steam cleaner is used to wash all equipment prior to each exploration and wastewater is pumped into adjacent drums. Splitspoons and hand sampling tools are scrubbed between samples at the exploration location using a detergent (water and alconox) solution rinsed with control (tap) water followed by a solvent (methanol) rinse, wiped with a paper towel and rinsed with deionized water before being allowed to air dry. Hexane may be needed for removal of heavy petroleum, grease and coal tar. Decontamination waste, sample residue and drill cuttings are typically drummed, labeled and staged onsite for proper disposal.

B. *Environmental Soil Sampling* - Environmental soil samples obtained for chemical analyses are collected in surface samples and by using many of the techniques employed in typical subsurface explorations with special attention given to decontamination procedures. Preservation, handling and glassware for environmental soil samples varies considerably depending upon several factors including the type and degree of contamination, the analytical method to be conducted, the analytical laboratory being used and the governing regulations. In addition, the depth and location of samples may be strictly controlled under agency guidelines. Documentation of volatile organic compounds (VOC) in the soil through headspace screening is required in order to provide real-time guidance in the field to direct the sampling.

Clean 8 oz. jars are partially filled with newly obtained soils and covered with aluminum foil and allowed to stabilized prior to screening with a photoionization detector (PID). The presence of metals in soils is not associated with odors, while coal tar, fuels and solvents are often easily distinguished. Particular attention is given to discoloration or odors noted, however it is company policy to avoid fumes and odors at all times. Soils collected from a discrete zone should be homogenized and a representative portion placed into laboratory glassware and labeled. Analytical samples are kept in a cooler with ice blocks and a Chain of Custody form is maintained until transfer to the analytical laboratory.

C. *Environmental Water Sampling* - Groundwater monitoring (observation) wells must undergo an initial well development following installation and prior to sampling. This is intended optimize well function and to produce formation-derived groundwater samples and valid analytical testing results. Groundwater sampling from existing monitoring wells for chemical analyses involves initially gauging the static groundwater level and the well depth in order to determine the well volume. Waterra® footvalves and tubing, bailers, submersible pumps or peristaltic pumps may be used to purge a minimum of three well volumes in order to minimize well effects. Turbidity, conductivity, resistivity, salinity, dissolved oxygen, oxidation-reduction potential, temperature and pH are recorded periodically after purging and groundwater parameters must be stable prior to sampling. Low-flow groundwater sampling is required for certain analyses to be valid. In such cases, variable speed submersible pumps are used at extremely slow rates to minimize drawdown and turbidity. Sampling of surface waters or open-body water at depth may be done with remote or variable depth, bottle-type samplers. Preservation, handling and glassware for environmental water samples varies considerably depending upon several factors including the type and degree of contamination, the analytical method to be conducted, the analytical laboratory being used and the governing regulations.

4.2.7.7 Special Testing, Sampling and Instrumentation

H&A utilizes a wide variety of well established and state-of-the-art soil, rock and groundwater testing procedures and instrumentation to supplement many subsurface exploration programs. Among the methods and techniques routinely used are fixed-piston tube sampling, vane shear testing, pressuremeter testing, permeability testing, water pressure (packer) testing in rock, inclinometer installation, multiposition borehole extensometers (MPBX) installation and aquifer (pump) testing. Prior to attempting an unfamiliar technique H&A field staff must review all related procedures and consult experienced personnel. Outside support or training that may be necessary to perform new procedures shall be sought with project manager approval. Notes and references obtained should be retained for potential development into new operating procedure.

APPENDIX A
REFERENCES

A.1 References

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D420-98, "Standard Guide to Site Characterization for Engineering Design and Construction Purposes."

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D653-01, "Standard Terminology Relating to Soil, Rock and Contained Fluids."

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D1452-80, "Standard Practice for Soil Investigation and Sampling by Auger Borings."

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6151-97, "Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling."

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- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.11.04, E1528-00, “Standard Practice for Environmental Site Assessments: Transaction Screen Process.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.11.04, E1903-97, “Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5730-98, “Standard Guide for Site Characteristics for Environmental Purposes with Emphasis on Soil, Rock, the Vadose Zone and Ground Water.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5088-90, “Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6286-98, “Standard Guide for Selection of Drilling Methods for Environmental Site Characterization.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6169-98, “Standard Guide for Selection of Soil and Rock Sampling Devices for Environmental Investigations.”

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- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D5782-95, "Standard Guide for the Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices."
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- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6452-99, "Standard Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations."

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6517-00, “Standard Guide for Field Preservation of Ground-Water Samples.”

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1001 Excavation and Trenching Safety
- OP1002 Drilling Safety
- OP1003 Utility Clearance
- OP2001 Identification & Description of Soils in the Field Using Visual-Manual Methods
- OP2002 Identification & Description of Rock in the Field Using Visual-Manual Methods
- OP2003 Surficial Geologic Mapping
- OP2005 Test Borings, Sampling, Standard Penetration Testing (STP) and Borehole Abandonment
- OP2017 Rock Coring
- OP2020 Groundwater Monitoring (Observation) Well Installation, Development and Abandonment
- OP2026 Exploratory Test Pits
- OP2028 Exploratory Probes
- OP2030 Direct Push Borings (Percussion-Vibration Driven Probes)

APPENDIX C
FORMS AND EXAMPLES

C.1 Forms

All Haley & Aldrich field forms are maintained on the server at K:\techproc\sop\Forms. The following is a list of selected current forms available for use in routine field exploration programs.

Site Investigations

- Form 2024 Site Investigation Form

Test Borings

- Form 2004 Subcontractor Quantities For Test Borings
- Form 2029 Sampling Labels - Geotechnical
- Form 2003 Test Boring Daily Field Report
- Form 2001 Test Boring Reports
- Form 2002 Core Boring Reports
- Form 2028 Geotechnical Sample Receiving Form

Observation (Monitoring) Wells

- Form 2007 Observation Well Installation Form
- Form 2013 Well Decommissioning Report
- Form 3006 Monitoring Well Development Report
- Form 2021 Groundwater Monitoring Report

Test Pits

- Form 2006 Test Pit Logs
- Form 2028 Geotechnical Sample Receiving Form

Test Probes

- Form 2022 Test Probe Report
- Form 2023 Test Probe Summary
- Form 2025 Vibracore Report

Environmental Sampling

- Form 1010 Headspace Screening Report
- Form 3001 Sampling Labels – Environmental
- Form 3002 Chain of Custody Electronic
- Form 3003 Chain of Custody Field
- Form 3004 Sampling Record
- Form 3005 Groundwater Sampling Record

C.2 Examples

The following examples of selected completed forms are intended to provide guidance in the standard documentation conventions practiced by H&A.

HALEY & ALDRICH

SITE INVESTIGATION FORM

PROJECT ____________ **H&A FILE NO.** ____________
LOCATION ____________ **PROJECT MGR.** ____________
CLIENT ____________ **FIELD REP** ____________
CONTRACTOR ____________ **DATE** ____________

SITE ACCESS
☐ Paved ☐ Gravel ☐ Trails ☐ None ☐ Water ☐ Inside ☐ Other ____________

ENTRANCE
☐ Enclosed ☐ Gate/Keys Comments: ____________

EXPLORATION EQUIPMENT
☐ Truck Rig ☐ ATV Rig ☐ Skid Rig ☐ Tripod ☐ Geoprobe ☐ Other ____________
☐ Backhoe ☐ Bobcat ☐ Excavator ☐ Sm Excavator ☐ Barge ☐ Other ____________
☐ Chainsaw ☐ Haybales ☐ Plywood ☐ 4WD Vehicle ☐ Other ____________

WATER SUPPLY AVAILABLE
☐ Hydrant ☐ Tap ☐ River/Lake ☐ None

ELECTRIC AVAILABLE:
☐ Yes ☐ No

TOPOGRAPHY
☐ Low Lying ☐ Level ☐ Sloping ☐ Cliffs ☐ Mountains ☐ Other ____________

PHYSIOGRAPHY
☐ Bedrock ☐ Till Upland ☐ Valley Floor ☐ Flood Plain ☐ Coastal Plain ☐ Other ____________
☐ Wetlands ☐ Tidal Marsh ☐ Estuarine ☐ Lakes/Ponds ☐ Outwash Plain ☐ Other ____________
☐ Developed ☐ Filled Land ☐ Paved ☐ Landscaped ☐ Other ____________

DRAINAGE
☐ Rivers ☐ Streams ☐ Rills ☐ Canals ☐ Ditches ☐ Culverts ☐ Other ____________

ESTIMATED GROUNDSURFACE ELEVATION: ____________ ft

ESTIMATED GROUNDWATER DEPTH/ELEVATION: ____________ ft

WOODED
☐ Heavily ☐ Partially ☐ Sparsely ☐ Comments: ____________

VEGETATION
☐ Brush ☐ Grass ☐ None ☐ Comments: ____________

BEDROCK OUTCROPS
LOCATION: ____________
TYPE: ____________

SOIL EXPOSURES
LOCATION: ____________
TYPE: ____________

EXISTING STRUCTURES
☐ Buildings ☐ Warehouse ☐ Slabs ☐ Bridges ☐ Foundations ☐ Other ____________

UNDERGROUND STORAGE TANKS
☐ Yes ☐ No

VISIBLE EVIDENCE OF CONTAMINATION
☐ Drums ☐ Staining ☐ Site history ☐ Unauthorized dumping ☐ Other ____________

OVERHEAD UTILITIES
LOCATION: ____________
TYPE: ____________

UNDERGROUND UTILITIES
LOCATION: ____________
TYPE: ____________

COMMENTS: ____________

HALEY & ALDRICH

SITE INVESTIGATION FORM

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	

SITE SKETCH

North Arrow

OVERALL DESCRIPTION AND REMARKS:	LEGEND
	Scale: 0

SUBCONTRACTOR QUANTITIES FOR TEST BORINGS

HALEY & ALDRICH

Form #2005

Project	File No.
Location	Date
Contractor	Project Manager

No.	Description	Unit	Quantity
I	**MOBILIZATION/DEMOBILIZATION**		
1	Mob/Demob of Truck rig w/ OSHA-trained crew within 100 miles of contractor yard*	ea	
2	Mob/Demob of Skid rig with OSHA-trained crew within 100 miles of contractor yard*	ea	
3	Mob/Demob of Bomb/ATV rig with OSHA-trained crew within 100 miles of contractor yard*	ea	
4	Mob/Demob of Geoprobe rig w/ OSHA-trained crew within 100 miles of contractor yard*	ea	
II	**DRILLING - FOOTAGE RATE**		
5	3-in. dia. cased overburden drilling (0-100 ft.) with no sampling	lf	
6	cased overburden drilling (0-100 ft.) with standard 5-ft. interval sampling	lf	
7	cased overburden drilling (0-100 ft.) continuous sampling	lf	
8	4-in. dia. cased overburden drilling (0-100 ft.) with no sampling	lf	
9	cased overburden drilling (0-100 ft.) with standard 5-ft. interval sampling	lf	
10	cased overburden drilling (0-100 ft.) continuous sampling	lf	
11	4-¼ in. dia. hollow stem auger overburden drilling (0-100 ft.) with no sampling	lf	
12	hollow stem auger overburden drilling (0-100 ft.) w/ standard 5-ft. interval sampling	lf	
13	hollow stem auger overburden drilling (0-100 ft.) continuous sampling	lf	
14	NX rock core via double-tube core barrel (includes bit wear)	lf	
15	HX rock core via double-tube core barrel (includes bit wear)	lf	
16	Extra split spoon samples (for footage rates only)	ea	
17	3-in. undisturbed tube samples	ea	
18	Standby Time for rig and crew/Decon of equipment	hr	
III	**DRILLING - DAY RATE**		
19	Truck mounted drill rig with OSHA-trained crew	day	
20	Truck mounted drill rig with OSHA-trained crew (overtime rate)	hr	
21	Skid rig with OSHA-trained crew	day	
22	Skid rig with OSHA-trained crew (overtime rate)	hr	
23	Bomb/ATV drill rig with OSHA-trained crew	day	
24	Bomb/ATV drill rig with OSHA-trained crew (overtime rate)	hr	
25	Geoprobe rig with OSHA-trained crew	day	
26	Geoprobe rig with OSHA-trained crew (overtime rate)	hr	
27	NX rock core via double-tube core barrel (includes bit wear for day rates)	lf	
28	HX rock core via double-tube core barrel (includes bit wear for day rates)	lf	
29	Geoprobe push samples liners (4' section)	ea	
IV	**OBSERVATION WELL INSTALLATION**		
30	1-in. dia. piezometer (Sch 40 PVC) installed	lf	
31	2-in. dia. well (Sch 40 PVC) installed (slotted and screened)	lf	
32	4-in. dia. well (Sch 40 PVC) installed (slotted and screened)	lf	
33	Standard 4-in. dia. roadway box	ea	
34	Standard 8-in. dia. roadway box	ea	
35	5 ft. protective guard pipe with padlock (4-in. diameter)	ea	
V	**ADDITIONAL ITEMS**		
36	Utility Clearance	ea	
37	Permits - Determined on a job to job basis	ls	
38	State Police Detail	hr	
39	Laborer	hr	
40	Chain Saw	day	
41	Steam Cleaner with Generator	day	
42	Upgrade Crew Personnel Protection to Level "C"	hr	
43	55 gal. soil/water drum	ea	
44	Borehole Grouting (4-in. diameter)	lf	
45	Sand	bag	
46	Concrete	bag	
47	Cold Patch	bag	
48			
49			
VI	**COMMENTS**		

Driller Signature ______________________ **Date** ________

Geologist Signature ______________________ **Date** ________

WHITE - FIELD SERVICE MANAGER **CANARY** - CONTRACTOR **PINK** - PROJECT MANAGER

Haley & Aldrich, Inc.
465 Medford St., Suite 2200
Boston, MA 02129
Tel: 617-886-7400

Boring ID:	**File Number:**
Sample Interval:	**Project:**
Depth:	**PM:**
Recovery:	**Blow Counts:**
Collected By:	/ / /
Comments:	

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Sample Interval:	**Project:**
Depth:	**PM:**
Recovery:	**Blow Counts:**
Collected By:	/ / /
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Recovery:	**Blow Counts:**
Collected By:	/ / /
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Depth:	**PM:**
Recovery:	**Blow Counts:**
Collected By:	/ / /
Comments:	

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Tel: 617-886-7400

Boring ID:	**File Number:**
Sample Interval:	**Project:**
Depth:	**PM:**
Recovery:	**Blow Counts:**
Collected By:	/ / /
Comments:	

HALEY & ALDRICH

TEST BORING DAILY REPORT

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MANAGER	
CLIENT		FIELD REPRESENTATIVE	
CONTRACTOR		DATE	
DRILLER		DFR NUMBER	
TYPE OF RIG(S)		NUMBER OF RIGS	

SUBCONTRACTOR'S TIME ON SITE

Rig Type	Arrived	Left Site	Lunch/Other	Downtime	Standby Time	Total Billable Hours

HALEY & ALDRICH'S TIME ON SITE

Field Representive(s)	Arrived	Left Site	Lunch/Other	Paperwork	Travel Time	Total Billable Hours

WORK PRODUCTION TO DATE

Boring No.	Type of Drilling	Over Burden (lf)	Rock Core (lf)	Obstr. Drilling	Total Footage (lf)	Tubes Samples	Extra Split Spoons*	Misc. (Wells etc.)	Materials Encountered (Type and Depth Range)

STATUS OF TOTAL PRODUCTION

Unsampled	Continuos	Standard	Inside Dia.	Boring Footages					Additional pay Items	Today	Total to Date
				Item	Today	Total to Date	Estimate	% Complete	Observation Wells I.D. (ft)		
									Roadway Boxes (ea)		
				H.S.A.					Guard Pipes (ea)		
				Casing					Steamer and Generator (day)		
				Casing					Grout (lf)		
				Casing					Undisturbed Tube Samples (ea)		
				Uncased					Extra Split Spoons (ea)*		
				Rock Core					55 Gallon Drums (ea)		
				Geoprobe					Police Details (hr)		
									Stand by Time (hr)		

No. of Borings Completed	Remaining	Rig-Days to Date	Remaining

SYMBOLS

B 2-1/2 inch Standard	**A** 4 inch Hollow Stem Auger	**Z** Probes of Soundings	**T** 2 inch Shelby Tube	**Y** Pressure Test
N 3 inch Standard	**W** Water Borings	**C** Rock Core	**V** Vane Shear Test	**S** Observation Well
H 4 inch Standard	**X** Continuous Sampling	**U** 3 inch Piston Tube	**P** Permeability Test	

* Extra split spoon samples are for footage contracts only.

HALEY & ALDRICH

TEST BORING DAILY REPORT

REMARKS

HALEY & ALDRICH

TEST BORING REPORT

BORING NO.
Page 1 of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft.	Datum	Boring Location

Item	Casing	Sampler	Core Barrel	Rig Make & Model			Hammer Type	Drilling Mud	Casing Advance
Type				☐ Truck	☐ Tripod	☐ Cat-Head	☐ Safety	☐ Bentonite	Type Method Depth
Inside Diameter (in.)				☐ ATV	☐ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer	
Hammer Weight (lb.)				☐ Track	☐ Air Track	☐ Roller Bit	☐ Automatic	☐ None	
Hammer Fall (in.)				☐ Skid	☐ ________	☐ Cutting Head	Drilling Notes:		

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																	

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water

Sample ID

- O Open End Rod
- T Thin Wall Tube
- U Undisturbed Sample
- S Split Spoon Sample
- G Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.) ______
Rock Cored (Linear ft.) ______
Number of Samples ______

BORING NO.

Field Tests Dilatancy: R - Rapid S - Slow N - None   Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High   Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH

TEST BORING REPORT

BORING NO.

Page of

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand				Field Test			
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength

NOTES:

FILE NO.

BORING NO.

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

HALEY & ALDRICH

BORING NO.

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft	Datum			Boring Location
Item	Casing	Sampler	Core Barrel	Rig Make & Model
Type				
Inside Diameter (in)				
Hammer Weight (lb)				
Hammer Fall (in)				

☐ Truck	☐ Tripod	☐ Cat-Head	**Hammer Type**
☐ ATV	☐ Geoprobe	☐ Winch	☐ Safety
☐ Track	☐ Air Track	☐ Roller Bit	☐ Doughnut
☐ Skid	☐ ________	☐ Cutting Head	**Casing** ☐ Driven ☐ Spun

Drill Mud: ☐ Bentonite ☐ Polymer ☐ None

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath-ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks

Water Level Data					
			Depth in feet to:		
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water

Sample ID

- O Open End Rod
- T Thin Wall Tube
- U Undisturbed Sample
- S Split Spoon Sample
- G Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.) ______

Rock Cored (Linear ft.) ______

Number of Samples ______

BORING NO.

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HALEY & ALDRICH

CORE BORING REPORT

BORING NO.

Page of

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery RQD (in)	Recovery RQD (%)	Weath- ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks

FILE NO. BORING NO.

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GEOTECHNICAL SAMPLE RECEIVING REPORT

HALEY & ALDRICH

Page ___ of ___

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**PROJECT ENGR.**	
DELIVERED BY		**DATE**	

TYPE OF SAMPLE

SOIL:

Jar Samples ________ box(es)

Undisturbed Tube Samples:

Outside Diameter: ☐ 3-in. ☐ 2-in. ________ tube(s)

*** Bag Samples ________ bag(s)

*** 5-gal. Bucket Samples ________ bucket(s)

ROCK CORE:

Boxes: ________ box(es)

Other: ________ sample(s)

OTHER: ________________________

HAZARDOUS MATERIALS? ☐ Yes ☐ No

CONTAMINANTS (please list major contaminants)

If geology/pre-construction project, fill out Section A - If Con-Mon project, fill out Section B.

A:

Box No.	Exploration No.	Sample No.(s) From - To	Depth From - To	Remarks {if multiple types of samples, list type, (e.g., jars, tube, bag, rock)}

B:

Explor. No.	Sample No.	Depth Range (ft)	Sample Description (USCS or geologic unit)	Sample Source (on-site, Contractor Pit, etc.)	Proposed Use (see below)

For "Proposed Use" try to use the term from the specifications (e.g., structural fill, common fill, dense graded, State Highway Spec. No., etc.)

Notes:

*** ANY BAG/BUCKET SAMPLE WHICH HAS NOT HAD TESTING ASSIGNED AFTER 3 WEEKS OF RECEIVING WILL BE AUTOMATICALLY DISPOSED OF UNLESS THE LABORATORY MANAGER IS GIVEN PRIOR WRITTEN NOTIFICATION OF THE NEED TO RETAIN THE SAMPLE.

To be completed by lab personnel:

Sample received by: ________________ Boxes Labeled? ☐ Yes ☐ No

STORAGE LOCATION:

☐ Geotechnical Laboratory ☐ Storage Room / Shelf Location: ________________

☐ Humid Room ☐ Other: ________________

Form 2028

HALEY & ALDRICH

GEOTECHNICAL SAMPLE RECEIVING REPORT

PROJECT	MAXIM OFFICE PARK	**H&A FILE NO.**	11111-030
LOCATION	BOSTON, MASSACHUSETTS	**PROJECT MGR.**	S. KRAEMER
CLIENT	BOSTON ARCHITECTS, INC.	**PROJECT ENGR.**	M. LALLY
DELIVERED BY	JOE SAND	**DATE**	03/14/02

TYPE OF SAMPLE

SOIL:

Jar Samples 2 box(es)

Undisturbed Tube Samples:

Outside Diameter: ☐ 3-in. ☐ 2-in. 2 tube(s)

*** Bag Samples 3 bag(s)

*** 5-gal. Bucket Samples ____ bucket(s)

ROCK CORE:

Boxes: 2 box(es)

Other: ____ sample(s)

OTHER: ____

HAZARDOUS MATERIALS? ☐ Yes ☑ No

CONTAMINANTS (please list major contaminants)

If geology/pre-construction project, fill out Section A - If Con-Mon project, fill out Section B.

A:

Box No.	Exploration No.	Sample No.(s) From - To	Depth From - To	Remarks {if multiple types of samples, list type, (e.g., jars, tube, bag, rock)}
1	B-01	S01 - S19	-	jars
1	B-02	S01 - S04	-	jars
2	B-02	S05 - S14	-	jars
-	B-01	U1	58.0 - 60.0	tube R=24
-	B-02	U1	68.0 - 70.	tube R=22
1	B-01	C01 - C03	-	rock core
-	TP-01	B01	5.0 - 9.0	ziplock bag

B:

Explor. No.	Sample No.	Depth Range (ft)	Sample Description (USCS or geologic unit)	Sample Source (on-site, Contractor Pit, etc.)	Proposed Use (see below)
TP-04	B01	8.5 - 10.7	Glacial Till	on-site	Common Fill
-	S12	n/a	Brown silty sand	Joe's Borrow Pit, Stoughton, MA	Structural Fill

For "Proposed Use" try to use the term from the specifications (e.g., structural fill, common fill, dense graded, State Highway Spec. No., etc.)

Notes:

*** ANY BAG/BUCKET SAMPLE WHICH HAS NOT HAD TESTING ASSIGNED AFTER 3 WEEKS OF RECEIVING WILL BE AUTOMATICALLY DISPOSED OF UNLESS THE LABORATORY MANAGER IS GIVEN PRIOR WRITTEN NOTIFICATION OF THE NEED TO RETAIN THE SAMPLE.

To be completed by lab personnel:

Sample received by: ____ Boxes Labeled? ☐ Yes ☐ No

STORAGE LOCATION:

☐ Geotechnical Laboratory ☐ Storage Room / Shelf Location: ____

☐ Humid Room ☐ Other: ____

OBSERVATION WELL INSTALLATION REPORT

HALEY & ALDRICH

Well No.

Boring No.

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE INSTALLED	
DRILLER		WATER LEVEL	

Ground El. ______ ft

El. Datum ______

Location ______

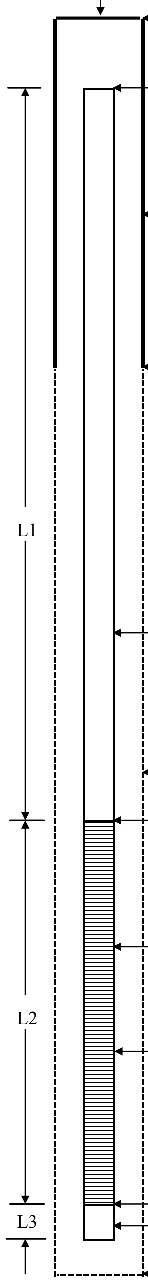
☐ Guard Pipe

☐ Roadway Box

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock ______

Height/Depth of top of guard pipe/roadway box above/below ground surface ______ ft

Height/Depth of top of riser pipe above/below ground surface ______ ft

Type of protective casing: ______

Length ______ ft

Inside Diameter ______ in

Depth of bottom of guard pipe/roadway box ______ ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete		
Bentonite Seal		

Type of riser pipe: ______

Inside diameter of riser pipe ______ in

Type of backfill around riser ______

Diameter of borehole ______ in

Depth to top of well screen ______ ft

Type of screen ______

Screen gauge or size of openings ______ in

Diameter of screen ______ in

Type of backfill around screen ______

Depth of bottom of well screen ______ ft

Bottom of Silt trap ______ ft

Depth of bottom of borehole ______ ft

(Not to Scale)

______ ft + ______ ft + ______ ft = ______ ft

Riser Pay Length (L1) + Length of screen (L2) + Length of silt trap (L3) = Pay length

COMMENTS: ______

Form 2007

HALEY & ALDRICH

MONITORING WELL DEVELOPMENT REPORT

Well No.

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE	
ELEVATION SUBTRAHEND			

Estimated Volume of Water Lost During Drilling: ______________ gallons

Comments: ______________

Depth to Water Before Development: ______________ feet

Comments: ______________

Depth to Well Bottom Before Development: ______________ feet

Comments: ______________

Turubitiy of Water Before Development: ______________ NTU

Comments: ______________

Volume of Water Removed: ______________ gallons

Comments: ______________

Method of Removal (bailing, pumping): ______________

Comments: ______________

Depth to Well Bottom After Development: ______________ feet

Comments: ______________

Depth to Water After Development: ______________ feet

Comments: ______________

Turubitiy of Water After Development: ______________ NTU

Comments: ______________

HALEY & ALDRICH

GROUNDWATER MONITORING REPORT

OW/PZ NUMBER

Page of

PROJECT

LOCATION

CLIENT

CONTRACTOR

ELEVATION SUBTRAHEND

H&A FILE NO.

PROJECT MGR.

FIELD REP.

DATE

Date	Time	Elapsed Time (days)	Depth of Water from Ground Surface	Elevation of Water	Remarks	Read By

HALEY & ALDRICH

TEST PIT LOG

Test Pit No.

Page 1 of

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	
EQUIPMENT		**WEATHER**	

Ground El. ft. **Location**
El. Datum

Groundwater depths/entry rates (in./min.):

Depth (ft.)	Sample ID	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand				Field Test			
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength

Obstructions:

Remarks:

Field Tests	
Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:
at depth ft.
measured after hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24		=	
over 24		=	

Test Pit Dimensions (ft.):
Pit Depth
Pit Length X Width

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH

ENVIRONMENTAL TEST PIT LOG

Test Pit No.

Page of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	
EQUIPMENT		WEATHER	

Ground El. ft. Location Groundwater depths/entry rates (in./min.):

El. Datum

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength

Obstructions:

Remarks:

Bucket Decontamination Method:

Field Tests	
Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:

at depth ft.

measured after hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24		=	
over 24		=	

Test Pit Dimensions (ft.):

Pit Depth

Pit Length X Width

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

J:\forms\final\Frm_3709.xls

HALEY & ALDRICH

TEST PROBE REPORT

PROBE NO.

Page 1 of

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	
EQUIPMENT		**DRILLER**	

Rig Type:	**TOP OF ROCK BASED ON:**		Datum
Diameter of Hole:	☐ Rate of Penetration	☐ Acoustic Device	Ground El.
Drill Bit type:	☐ Driller's Opinion	☐ Other	Water El.
Drill Bit O.D.:	DEPTH TO TOP OF SOUND ROCK		Location:

Scale In Feet	Cutting Description and Remarks

Form 2022

TEST PROBE SUMMARY

Page of

PROJECT

LOCATION

CLIENT

CONTRACTOR

EQUIPMENT

H&A FILE NO.

PROJECT MGR.

FIELD REP

DATE

DRILLER

Probe Type

Probe No.	Location	Ground Surface Elevation	Depth to Water (ft)	Depth Probed		Soil Strata Description	Remarks
				From (ft)	To (ft)		

HALEY & ALDRICH

VIBRACORE REPORT

Probe No.	
Page 1 of 1	

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		GEOLOGIST	
CONTRACTOR		DATE	
EQUIPMENT		CHECKED BY	

Depth (ft)	Sketch	Visual Description	Recovery			
			Section	Tube Length	Sample Length	Total Weight
0			Top: Bottom:			
1			Notes: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.			
2						
3						
4			Remarks:			
5						
6						
7						
8						
9						
10						

Form 2025

HALEY & ALDRICH

HEADSPACE SCREENING REPORT

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
INSTRUMENT		DATE SAMPLED	
DATE CALIBRATED [1]	LAMP (eV)	DATE SCREENED	
AMBIENT TEMPERATURE	CALIBRATED BY	SCREENING LOC.	

Exploration	Sample Number	Depth (ft)	Sample Description	Sample Reading (ppm)[2]	Back-Ground Reading (ppm)[2]	Remarks	GC[3]	Containers			
								Drill Jar			

1. Instrument calibrated to the manufacturer standard.
2. ppm represents concentration of detectable volatile gaseous compounds in parts per million of air.
3. Sample assigned for gas chromatograph screening.

Sampled and relinquished by:	Received by:	Relinquished by:	Received by:
Sign:	Sign:	Sign:	Sign:
Print:	Print:	Print:	Print:
Firm:	Firm:	Firm:	Firm:
Date: Time:	Date: Time:	Date: Time:	Date: Time:

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St., Suite 2200
Boston, MA 02129
Tel: 617-886-7400

Sample ID:	File Number:
Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

HALEY & ALDRICH

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465 Medford St., Suite 2200
Boston, MA 02129
Tel: 617-886-7400

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Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St.,
Suite 2200,
Boston, MA 02129-1400

CHAIN OF CUSTODY RECORD

Phone (617) 886-7400
Fax (617) 886-7700

Page ____ of ____

H&A FILE NO. ____________ LABORATORY ____________ DELIVERY DATE ____________
PROJECT NAME ____________ ADDRESS ____________ TURNAROUND TIMI ____________
H&A CONTACT ____________ PROJECT MANAGER ____________ DELIVERY DATE ____________

Sample No.	Date	Time	Depth	Type	Container Size	No. of Containers	Analysis Requested	Preservatives	Comments - (special instructions, precautions, additional method numbers, etc.)

Sampled and Relinquished by	Received by	PRESERVATION KEY	Sampling Comments
Sign	Sign	A Sample chilled	
Print	Print	B Sample filtered	
Firm	Firm	C NaOH	
Date Time	Date Time	D HNO_3	
Relinquished by	**Received by**	E H_2SO_4	
Sign	Sign	F HCL	
Print	Print	G Methanol	
Firm	Firm	H Sodium Bisulfate	
Date Time	Date Time	I	

Relinquished by	Received by	Evidence samples were tamperd with? YES NO
Sign	Sign	If YES, please explain in section below.
Print	Print	
Firm	Firm	
Date Time	Date Time	

WHITE - Laboratory **CANARY** - Project Manager **PINK** - Haley & Aldrich Laboratory **GOLDENROD** - Haley & Aldrich Contact

Form 3002

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St., Suite 2200
Boston, MA 02129
Tel: 617-886-7400

Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Boston, MA 02129
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Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

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Sample ID:	**File Number:**
Depth:	**Project:**
Date:	**Analysis:**
Time:	**Preservative:**
Collected By:	**Laboratory:**
Comments:	

HALEY & ALDRICH

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Boston, MA 02129-1400

CHAIN OF CUSTODY RECORD

Phone (617) 886-7400
Fax (617) 886-7600

H&A FILE NO.		LABORATORY		DELIVERY DATE	
PROJECT NAME		ADDRESS		TURNAROUND TIME	
H&A CONTACT		CONTACT		PROJECT MANAGER	

Sample No.	Date	Time	Depth	Type	Analysis Requested: VOA	ABNs PAH only	Metals RCRA (8) PP(13)	Pesticides PCBs	VPH Full Suite C-ranges only	EPH Full Suite C-ranges only	TPH (specify)	TCLP (specify)	Reactivity Ignitability Corrosivity				Number of Containers	Comments (special instructions, precautions, additional method numbers, etc.)

Sampled and Relinquished by	Received by
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time

LIQUID

												VOA Vial
												Amber Glass
												Plastic Bottle
												Preservative
												Volume

SOLID

												VOA Vial
												Amber Glass
												Clear Glass
												Preservative
												Volume

PRESERVATION KEY

A Sample chilled	**C** NaOH	**E** H_2SO_4	**G** Methanol
B Sample filtered	**D** HNO_3	**F** HCL	**H** Sodium Bisulfate

Sampling Comments

Evidence samples were tampered with? YES NO

If YES, please explain in section below.

WHITE - Laboratory **CANARY** - Project Manager **PINK** - Haley & Aldrich Laboratory **GOLDENROD** - Haley & Aldrich Contact

WATER AND WASTEWATER METHODS

Analysis Description	Method No.	Preservative	Solid Sample Volume/Container	Liquid Sample Volume/Container	Holding Time
Alkalinity	310	Cool 4° C	N/A	250 mL HDPE	14 days
Amenable Cyanide	Std. Mth. 412 F.	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
Ammonia	350	pH<2 H2SO4, Cool 4° C	N/A	1 L HDPE	28 days
Base/Neutral & Acid Extractables	625	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Biochemical Oxygen Demand (BOD)	405.1	Cool 4° C	N/A	2 L HDPE	48 hours
Chemical Oxygen Demand (COD)	410	pH<2 H2SO4, Cool 4° C	N/A	125 mL HDPE	28 days
Chloride	300.0, 325	None Required	N/A	125 mL HDPE	28 days
Chromium, Hexavalent	3500D, 218.4/5	None Required	N/A	1 L HDPE	24 hours
Fluoride	300.0, 340	None Required	N/A	500 mL HDPE	28 days
Hardness, Total (as CaCO3)	130	pH<2 H2SO4, Cool 4° C	N/A	250 mL HDPE	6 Months
Nitrate	300.0, 352.1	Cool 4° C	N/A	250 mL HDPE	48 Hours
Nitrite	300.0, 354.1	Cool 4° C	N/A	125 mL HDPE	48 Hours
Orthophosphate	300.0, 365	Filter, Cool 4° C	N/A	125 mL HDPE	48 Hours
PCBs	608	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Pesticides	608	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Physiologically Available Cyanide	MADEP draft	pH>12 NaOH, 4° C	N/A	1 L HDPE	14 days
Priority Pollutant Metals (13 Metals)	200.7/AA, 200 Series	pH<2 HNO3, 4° C	N/A	1 L HDPE	28 days (Hg), 6 mos. (others)
Purgeable Halocarbons & Aromatics	601/602	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
RCRA Metals (8 Metals)	200.7/AA, 200 Series	pH<2 HNO3, 4° C	N/A	1 L HDPE	28 days (Hg), 6 mos. (others)
Sulfate	300.0, 375	Cool 4° C	N/A	250 mL HDPE	28 days
Sulfide	376	pH>9 NaOH, Zn Acetate, Cool 4° C	N/A	1 L HDPE	7 days
Sulfite	377.1	None Required	N/A	125 mL HDPE	Analyze Immediately
Total Cyanide	335	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
Total Dissolved Solids (TDS)	209	Cool 4° C	N/A	250 mL HDPE	7 days
Total Organic Carbon (TOC)	415	pH<2 HCl or H2SO4, Cool 4° C, Dark	N/A	40 mL Amber	28 days
Total Organic Halogen (TOX)	506	pH<2 HNO3, 4° C	N/A	1 L Amber	check with lab
Total Phenolics	420.1	pH<2 H2SO4, Cool 4° C	N/A	1 L Amber	28 days
Total Phosphorus	365	pH<2 H2SO4, Cool 4oC	N/A	125 mL HDPE	28 days
Total Solids (TS)	160.3	Cool 4° C	N/A	250 mL HDPE	7 days
Total Suspended Solids (TSS)	160.2	Cool 4° C	N/A	250 mL HDPE	7 days
Volatile Organics	624	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
Weak and Dissociable Cyanide	Std. Mth. 412 H.	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
DRINKING WATER ANALYSIS					
Volatile Organics	502.2 or 524.2	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
MICROBIOLOGY					
Fecal Coliform	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Standard Plate Count	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Total Coliform	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Yeast and Mold	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours

SOIL/SEDIMENTS/WATER

Analysis Description	Method No.	Solids (S) / Liquids (L) Preservative	Solid Sample Volume/Container	Liquid Sample Volume/Container	Holding Time
Acid Extractables/Base/Neutral Extractables	8270	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Amenable Cyanide	-	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Chromium, Hexavalent	3060A/7196	S/L: Cool 4° C	8 oz. CWM	1 L HDPE	24 hours
Extractable Hydrocarbons	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Herbicides	8150	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Non-Halogenated Organics	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
PAH (low level)	8310 or GC/MS SIM	S/L: Cool 4° C	8 oz. AWM	1 L Amber	7 days Ext/40 days Analyze
Paint Filter Liquids Test	9095	S: Cool 4° C	8 oz. CWM	1 L Amber	Analyze ASAP
PCBs	8082	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Pesticides	8081	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Physiologically Available Cyanide	MADEP draft	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Priority Pollutant Metals(13 Metals)	6010&7000	S: 4° C / L: pH<2 HNO3, 4° C	8 oz. CWM	1 L Amber	28 days (Hg), 6 mos. (others)
RCRA Metals (8 Metals)	6010&7000	S: 4° C / L: pH<2 HNO3, 4° C	8 oz. CWM	1 L Amber	28 days (Hg), 6 mos. (others)
Total Cyanide	9010	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Volatile Hydrocarbons	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
Volatile Organics	8260B, 8021	S: methanol/$NaHSO_4$, 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
RCRA HAZARDOUS WASTE CHARACTERIZATION					
Corrosivity (pH only)	SW846-7.2	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
Ignitability/Flashpoint	SW846-7.1	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
Reactivity (CN-/S2-)	SW846-7.3	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
TCLP (RCRA 8) Metals (check for mercury)	1311	S: Cool 4° C	16 oz. CWM	check with lab	6 mos. Ext/6 mos. Analyze
TCLP Pesticides/Herbicides	1311	S: Cool 4° C	16 oz. CWM	check with lab	14 days Ext/40 days Analyze
TCLP Semivolatiles	1311	S: Cool 4° C	16 oz. CWM	check with lab	14 days Ext/40 days Analyze
TCLP Volatiles	1311	S: Cool 4° C	8 oz. CWM	check with lab	14 days Ext/14 days Analyze
HYDROCARBON OIL & GREASE ANALYSIS					
MADEP EPH Method	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
MADEP EPH Method (C-Ranges only)	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
MADEP VPH Method	MADEP REV. 0	S: methanol, 4° C / L: pH<2 HCl, 4° C	40 mL+2 oz. CWM.	40 mL Glass Vial	S: 28 days / L: 14 days
MADEP VPH Method (C-Ranges only)	MADEP REV. 0	S: methanol, 4° C / L: pH<2 HCl, 4° C	40 mL+2 oz. CWM.	40 mL Glass Vial	S: 28 days / L: 14 days
MADEP EPH Method - with selected PAHs (including acenaphthene, naphthalene, 2-methylnaphthalene, and phenanthrene)	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
Petroleum Identification	ASTM D3328				
Quantitative (include Chromatograms)		S: Cool 4° C / L: pH<2 H_2SO_4, 4° C	4 oz. CWM	1 L Amber	S: 7 days / L: 28 days
Total Petroleum Hydrocarbons (Infrared)	418.1	S: Cool 4° C / L: pH<2 H_2SO_4, 4° C	4 oz. CWM	1 L Amber	S: 7 days / L: 28 days

AIR METHODS

Analysis Description	Method No.	Preservative	Sample Volume/Container		Holding Time
Volatile Organic Compounds	EPA T01/T02	tubes: 4° C; Tedlar Bags: dark	N/A	N/A	tube: 14 days; bag: 72 hours
Volatile Organic Compounds	EPA T014	check with lab	N/A	N/A	can: 14 days; bag: 72 hours
VPH in air	EPA T01/T02	tubes: 4° C; Tedlar Bags: dark	N/A	N/A	tube: 14 days; bag: 72 hours
VPH in air	EPA T014	check with lab	N/A	N/A	can: 14 days; bag: 72 hours

HALEY & ALDRICH

SAMPLING RECORD

Page ____ of ____

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

Weather ________________________ **Temperature** ____________

Ground surface Conditions ☐ Dry ☐ Wet ☐ Damp ☐ Standing Water ☐ Snow (_____in) ☐ Other___________

Comments ________________________

SOIL SAMPLING AND SURFACE WATER SAMPLING INFORMATION

Sample No.	Location	Depth (ft)	Time	Sample Description	Sampling Device	Cleaning Prodedure	Container Type

General Comments: (ie: field filtrations, persons communicated with at site, etc.)

HALEY & ALDRICH

GROUNDWATER SAMPLING RECORD

Page of

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

GROUNDWATER SAMPLING INFORMATION

Well No.							
Water Depth (ft)							
Time							
Product							
Depth Of Well (ft)							
Inside Diameter (in)							
Standing Water Depth (ft) (1)							
Volume Of Water In Well (gal)							
Purging Device							
Volume of Bailer/Pump Capacity							
Cleaning Procedure							
Bails Removed/ Volume Removed							
Time Purging Started							
Time Purging Stopped							
Sampling Device							
Cleaning Procedure							
TIME SAMPLES TAKEN	VOA						
	ABN						
	Metals						
PARAMETERS	Color						
	Odor						
	pH						
	Conductivity						
	Turbidity						
	Dissolved Oxygen						
	Temp, ^{0} C						
	Salinity						

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

1. Standing Water Depth = Depth of Well - Water Depth

HALEY & ALDRICH

TEST BORING REPORT

BORING NO. B 7 (OW)

Page 1 of 2

PROJECT	Greenspace Development	**H&A FILE NO.**	27921-000
LOCATION	18 Riverside Road, Boston Massachusetts	**PROJECT MGR.**	S.R. Kraemer
CLIENT	Ecologic Investments	**FIELD REP.**	C.S. Osgood
CONTRACTOR	Guild Drilling Co., Inc.	**DATE STARTED**	13-Feb-01
DRILLER	Charlie O'Donnel	**DATE FINISHED**	14-Feb-01

Elevation 23.3 ft. **Datum** Boston City **Boring Location** See sketch on reverse of form.

Item	Casing	Sampler	Core Barrel	Rig Make & Model: CME 75			Hammer Type	Drilling Mud	Casing Advance
Type	NW	S	NV2	☑ Truck	☐ Tripod	☑ Cat-Head	☑ Safety	☑ Bentonite	Type Method Depth
Inside Diameter (in.)	3	1.385	2	☐ ATV	☐ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer	NW Driven 29.0 ft.
Hammer Weight (lb.)	300	140		☐ Track	☐ Air Track	☑ Roller Bit	☐ Automatic	☐ None	
Hammer Fall (in.)	24	30		☐ Skid	☐	☐ Cutting Head	Drilling Notes: Flushed slurry prior to coring.		

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	10		0.0			SP-SM	Medium dense brown poorly graded SAND with silt (SP-SM),				20	70	10				
	12	S1					mps 2 mm, distinctly stratified, fines partially organic, no odor, dry.										
	15	21"															
	20		2.0		2.0		-ALLUVIUM-										
	11		2.0			SP	Dense brown poorly graded SAND (SP), mps 25 mm, no odor, dry.	5	5	20	30	35	5				
	15	S2															
	16	10"															
	17		4.0				-ALLUVIUM-										
					4.5												
5	WOR		5.0				Very soft, dark brown ORGANIC SOILS with sand (OL/OH), trace					25	75	S	M	H	VH
	WOR	S3				OL/OH	seashell fragments and particles, soil mps 0.5 mm, strong										
	WOH	24"					organic odor, moist.										
	WOH		7.0				-ORGANIC DEPOSIT-										
					8.0												
							Note: Drilling fluid returning medium to fine sand from 8.0 ft. to										
							10.0 ft. Drilling fluid color change to yellow red at 8.5 ft.										
							-PROBABLE MARINE DEPOSIT-										
					10.0												
10	3		10.0			CH	Stiff yellow brown fat CLAY (CH), trace fine sand, mps 0.5 mm,						100	N	M	H	
	6	S4					apparently laminated with frequent fine sand partings and										
	6	22"					possible organic fibers, no odor, moist.										
	6		12.0				-MARINE DEPOSIT-										
					13.5												
							Note: Drill action indicates gravel below 13.5 ft.										
15	12		15.0			CL	Very stiff yellow brown to gray sandy lean CLAY with gravel (CL),	5	10	10	10	15	50	S	M	M	
	14	S5					mps 35 mm, distinct disrupted laminae in discrete zones, coarse										
	15	17"					fraction consists of well rounded igneous and igneous and										
	19		17.0				metamorphic lithologies, no odor, moist.										
							-GLACIOMARINE DEPOSIT-										
					18.0												
							Note: Drill action and total loss of drilling fluid indicates gravel										
					19.0		and cobbles from 18.0 ft. to 19.0 ft.										
							Very dense gray silty SAND (SM) , mps 15 mm, very well bonded,										
20	21	S6	20.0			SM	coarse fraction consists partly of platy argillite fragments, no odor, moist.		10	15	20	30	25	R			
	25	10"	21.0		21.0		-GLACIAL TILL-										
	33	S6A	21.0			ML	Very dense gray SILT (ML), mps <0.1 mm, no structure, no odor,						100	R		N	
	34	7"	22.0				dry.										
							-RESIDUAL SOIL-										
							Note: Drilling advanced smoothly from 21.0 ft. to 25.0 ft.										
					25.0		PROBABLE TOP OF DECOMPOSED BEDROCK 25.0 FT.										
25	53		25.0				Very dense gray highly to completely weathered ARGILLITE.										
	28	S7					Possible extremely thin relect bedding subparallel to strong										
	39	5"					low angle foliation. Sample is generally well bonded and consists										
	35		27.0				of very soft angular fragments and particles which are easily										
							crushed with finger pressure.										
							-DECOMPOSED BEDROCK-										
							Note: Drill action indicates stratum change at 28.5 ft.										
					28.5		TOP OF "SOUND" BEDROCK 28.5 FT.										
							SEE SHEET 2 FOR CORE BORING REPORT										
30																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water
13-Feb-01	15:30	0	29.0	29.0	2.0
14-Feb-01	7:00	15.5	29.0	29.0	6.2
14-Feb-01	15:00	1.0	39.5	39.5	10.4

Sample ID

- O Open End Rod
- T Thin Wall Tube
- U Undisturbed Sample
- S Split Spoon Sample
- G Geoprobe

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.)	29.5
Rock Cored (Linear ft.)	10.0
Number of Samples	S7 C2
BORING NO.	**B 7 (OW)**

Field Tests Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

CORE BORING REPORT

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath-ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks
								SEE SHEET 1 TEST BORING REPORT FOR OVERBURDEN DETAILS.
							21.0	TOP OF RESIDUAL SOIL 21.0 FT.
								Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through residual
								soil from 21.0 ft. to 25.0 ft.
					Residual			
					Soil			-RESIDUAL SOIL-
25							25.0	TOP OF DECOMPOSED BEDROCK 25.0 FT.
					High			Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through
					to			decomposed bedrock from 25.0 ft. to 28.5 ft.
					Complete			
								-DECOMPOSED BEDROCK-
							28.5	TOP OF "SOUND" BEDROCK 28.5 FT.
								Note: Seated NW casing at 29.0 ft. Advanced borehole with rollerbit to 29.5 ft. without sampling
								prior to coring.
30		29.5	56"		Slight			C1: Moderately hard, slightly weathered, gray, aphanitic ARGILLITE. Bedding extremely thin to
								very thin, generally low angle (30-35 degrees). Foliation low angle, commonly subparallel to
	6							bedding. Cleavage well developed along bedding/foliation planes where coincident.
					Mod.			Cleavage joints very close to close 29.5 -31.0 ft. and close below 32.5 ft. smooth-planar,
	3	C1			High			slightly oxidized, occasionally calcite-infilled, tight. High angle to vertical joints moderately
					Mod.			close, rough-undulatory, pyritized or highly oxidized and decomposed with silt infilling, open.
	5							Soft, moderately to highly weathered zone 31.0-32.5 ft. associated with extremely close,
					Slight			moderately dipping, slickensided-planar shears intersecting bedding plane and high angle features.
	6							Note: Partial water loss below 31.0 ft.
		34.5	24"	40%				Note: Lost core assumed 31.7-32.0 ft.
35	6	34.5	60"	100%				C2: Similar to bottom of run C1 except cleavage joints close to moderately close. High angle to
								vertical joints absent. Occasional thin zone of extremely close, extremely thin, moderately
	7							dipping to high angle (50-60 degrees) calcite stringers. Occasional calcite-healed low angle
								joint.
	6	C2			Slight			-CAMBRIDGE FORMATION-
	6						38.0	
								Lithology change at 38.0 ft. to hard, slightly weathered, dark gray to black, fine grained to
	8							aphanitic DIABASE. Single high angle joint at 38.7 ft. rough-stepped, slightly oxidized, tight.
		39.5	54"	90%				
40	8							BOTTOM OF EXPLORATION 39.5 FT.

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TEST PIT LOG

Test Pit No. TP-1

Page 1 **of** 1

PROJECT	New England Hospital	**H&A FILE NO.**	10715-205
LOCATION	Boston, Massachusetts	**PROJECT MGR.**	M.X. Haley
CLIENT	PFT Associates	**FIELD REP**	C. S. Osgood
CONTRACTOR	J. Marchese & Sons Const.	**DATE**	07-Jan-02
EQUIPMENT	CAT 416 Rubber Tire Extendahoe 0.24 cu.yd. bucket capacity	**WEATHER**	Mostly Clear 20s

Ground El.	36.3 ft.	**Location**	West of Pedestrian Tunnel
El. Datum	NGVD	**Groundwater depths/entry rates (in./min.):**	7.8 ft. Steadily

Depth (ft.)	Sample ID	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (density/consistency, color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				Dark brown silty SAND (SM), mps 5 mm, organic odor, moist.		5	5	10	45	40	R			
	0.5		SM	Fines largely organic.										
				-LOAM FILL-										
		1.3												
2	S3			Yellow brown to olive brown sandy fat CLAY (CH), trace roots, clinker fragments,	5	5	5	10	15	60	N	M	H	
			CH	cinder particles and fragments, clay pipe fragments, metal wire, asphalt fragments.										
				10% cobbles, <5% boulders, mps 30 in., no odor, moist.										
				-FILL-										
4	4.0			Note: Poured concrete foundation wall on east side of test pit from 0.0 -4.4 ft.										
	4.0													
				Note: Poured concrete foooting 4.4-5.4 ft.										
6	S2													
8	8.0	8.0												
	8.0			Yellow brown fat CLAY (CH), trace fine sand. mps 0.5 mm, no odor, dry.					5	95	N	M	H	
	S1		CH	Appartantly laminated with frequent fine sand partings and possible organic fibers.										
	9.0			-MARINE DEPOSIT-										
10														
		11.0												
				Yellow brown to gray sandy lean CLAY (CL) with gravel. mps 35 mm,	5	10	10	10	15	50	S	M	L	
			CL	Distinct disrupted laminae in discrete zones. Coarse fraction consists of well-rounded										
				igneous and metemorphic lithologies.										
12	12.0	12.0		-GLACIOMARINE DEPOSIT-										
				Note: Possible stratum change to gray lean CLAY with sand (CL) below 12.0 ft.										
				Coarse fraction apparantly less abundent.										
				-MARINE DEPOSIT-										
				BOTTOM OF EXPLORATION 13.5 FT.										
14														

Obstructions:

Remarks:
Note: Bag samples S1-S3 obtained for potential mechanical analysis from depths indicated.

Field Tests

Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:
at depth 13.2 ft.
measured after 0.1 hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	1	=	1.8
over 24	1	=	8.2

Test Pit Dimensions (ft.):
Pit Depth 13.5
Pit Length X Width 9.0 x 6.0

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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ENVIRONMENTAL TEST PIT LOG

Test Pit No. **TP 214**

Page 1 of 1

PROJECT	Mirror Lake Watershed Study	**H&A FILE NO.**	28675-309
LOCATION	Essex, Massachusetts	**PROJECT MGR.**	D.H. Gevalt
CLIENT	Citizens Advisory Partnership	**FIELD REP**	C.S. Osgood
CONTRACTOR	Stanley Lynde Const. Co., Inc.	**DATE**	19-Jul-02
EQUIPMENT	Case 580 rubber tire backhoe - 1/4 cu. yd. bucket	**WEATHER**	Thunderstorms 90's

Ground El. 74.5 ft. **Location** N 2,089,041.101

El. Datum NGVD E 801,444.238

Groundwater depths/entry rates (in./min.): None

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (density/consistency, color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions,	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					Note: Ground surface strewn with boulders. Numerous depressions indicating subsurface voids noted.										
	1.5				15% coarse to fine sand, 15% cinder fragments and particles, 10% unidentifiable, white ash-like material, 10% fines (largely organic), 10% coarse to fine gravel, 10% wood (manufactured and treated), 5% glass fragments, 5% metal strips and wire, 5% charcoa										
2	S2	15.9			5% plastic sheeting (possibly polyethelene bags), 5% brick particles, 5% clay pipe fragments. Matrix generally dark brown to gray in color with pockets of white and red. 15% boulders, 15 % cobbles. Maximum particle size 36 inches.										
	2.5				Distinct decomposed gasoline odor, possible faint napthalene odor. Visible irridescen sheen on moist solids 4.6 to 5.2 ft.										
4					-FILL-										
	4.6														
	S1	140			Note: Bedrock surface smooth and flat, consisting of very hard to hard, slightly										
	5.2		5.2		weathered, light gray to pink, coarse to fine grained granite. Single high angle joint noted.										
					REFUSAL ON BEDROCK 5.2 FT.										
6															
8															

Obstructions:

Remarks:

Note: Sample S1 submitted for laboratory chemical analysis.

Note: Field monitoring of breathing zone and headspace screening conducted using an hNU 11.7 ev. PID.

Bucket Decontamination Method: Steam cleaned

Field Tests

Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:

at depth NE ft.

measured after 0.75 hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	6.0	=	18.0
over 24	1.0	=	33.0

Test Pit Dimensions (ft.):

Pit Depth 5.2

Pit Length X Width 10.5 x 4.3

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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Form #3008

APPENDIX D
CHECKLISTS

D.1 Field Monitoring Checklist

D.1.1 Preliminary Preparation

A. Project Briefing
B. Field Project File and Document Assembly
  - Proposal
  - Contract Documents
  - Locus, Site & Utility Plans
  - Exploration Criteria
  - Subcontractor Agreement
  - Site and Project Contacts
  - Forms
    - DFR
    - Subcontractor Quantities
    - Test Boring Report
    - Core Boring Report
    - Observation Well Installation Form
    - Test Pit Log
    - Special Testing / Instrumentation Forms
    - COC
    - Equipment Usage and Billing Form
    - Sample Receiving Form

C. H&S Briefing
  - H&S Plan

D. Equipment Request and Assembly

D.1.2 Onsite Duties

A. Site Walkover and Subcontractor Utility and Safety Briefing
B. Exploration Program Review
  - Exploration Layout
  - Site Conditions Sketch
  - Preliminary Surficial Geologic Map
  - Exploration Monitoring
    - Equipment Inventory
    - Exploration Layout & Utility Check
    - Field Logging Soil & Rock
    - Water Level Measurements
    - Production and Budget Quantities
    - Sample Handling & Transport
    - Instrumentation & Testing Records
    - As-Built Sketches & Exploration Locations

D.1.3 Follow Up & Summary

- Proof Logs and Test Reports
- Finalize DFR and Subcontractor Quantities
- Sample Receiving and Disposition
- Equipment Return and Billing
- Exploration Program Summary
- Final Site & Geological Conditions Summary
- Geologic Profiles

OPERATING PROCEDURE: OP2005

TEST BORINGS, SAMPLING, STANDARD PENETRATION TESTING (SPT) AND BOREHOLE ABANDONMENT

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	CSO/ 1-16-03	JAM/ 01-03		STP/6-1-03	SRK/7-1-03

Total Pages: 45

HALEY & ALDRICH

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OPERATING PROCEDURE: OP2005

TEST BORINGS, SAMPLING, STANDARD PENETRATION TESTING (SPT) AND BOREHOLE ABANDONMENT

1. PURPOSE

Exploratory test borings are important sources of subsurface information relating to geologic conditions and site suitability fundamental to environmental site assessment and geotechnical design. The following procedure is an introduction to test boring equipment and techniques and an outline of field staff responsibilities while monitoring test boring methods utilized by Haley & Aldrich Inc.

2. EQUIPMENT & SUPPLIES

2.1 Standard Required Equipment

	Required		Additional as Required
1.	Proposal (signed by Client)	20.	First Aid Kit
2.	Site Plan	21.	Cellular Phone
3.	Contract with Subcontractor (pay items)	22.	Health & Safety Plan
4.	Exploration Criteria/Specifications	23.	Respirator & Tyvek Suit
5.	Field Book	24.	Laptop Computer
6.	Clipboard	25.	Camera & Film
7.	Logs & Forms	26.	Field Procedures
8.	Office Supplies (pencils & markers)	27.	Maps and References
9.	Engineer's Scale	28.	Sample Bags & Jars with Labels
10.	6 ft. Ruler	29.	Survey Stakes/Paint/Flagging
11.	100 ft. Measuring Tape	30.	Shovel
12.	Hand Lens, magnifying	31.	Geologist's Pick
13.	Pocket Knife	32.	Flashlight
14.	Hard Hat	33.	Roadway Box Key/Socket Wrench
15.	Safety Glasses	34.	Water Level Indicator
16.	Sound Dampeners	35.	Hand Level
17.	Steel Toe Boots	36.	Brunton Compass
18.	Protective Gloves	37.	Pocket Penetrometer
19.	Rain Gear	38.	Torvane

2.2 Required Environmental Equipment

Test borings programs conducted for environmental purposes will require specific equipment for personal protection, air quality monitoring, headspace screening, sampling, testing and decontamination. A comprehensive list of equipment and materials must be developed for each project in coordination with the Project Manager (PM) and the Health & Safety (H&S) Coordinator prior to the start of the field program.

2.3 Additional Equipment, Specialized Instrumentation, Materials & Company Vehicles

Company-wide, Haley & Aldrich maintains an array of equipment, vehicles and specialized instrumentation for a broad variety of uses in addition to the selected equipment listed above. Additional equipment, vehicles and materials may be rented or purchased as needed with the approval of the project manager. Project equipment needs should be addressed proactively so that interoffice allocation can take place. It is recommended that the field staff familiarize themselves with the use, function and availability of all types of equipment standard to the industry.

2.4 Billing Equipment & Materials

Equipment and materials are billed to the project as used on a daily or per item basis. Completion of equipment usage and billing forms and submission of original receipts for items purchased or rented is required in order to charge the project for reimbursement.

3. PROCEDURE

3.1 Preliminary Preparations

Prior to the beginning of a test boring program attendance at a project briefing is required for the purpose of reviewing the proposal, site and utility plans, contract documents and drawings, applicable regulations, test boring sampling, testing and termination criteria, site contacts, phone numbers of team members, and other related documents and references. In addition, certain projects will require the field staff to attend a Health & Safety briefing due to specific occupational safety concerns.

A file folder for the field activities should be created and maintained such that all relevant documents and log forms likely to be useful for the completion of field activities by others are readily available in the event of personnel changes.

3.2 Duties and Responsibilities

3.2.1 General

The principal reason for providing Haley & Aldrich field representation during test boring drilling is to assure that the field data being collected is accurate and of the type necessary to properly evaluate the site geologic conditions for the subsequent engineering analyses and environmental assessment.

3.2.2 Supervision of Test Boring Programs

Test boring activities regularly include routine soil sampling and testing, rock coring and groundwater observation well installations in addition to more specialized instrumentation or testing. Modifications to the test boring criteria are often made during the execution of the drilling program as the accumulated geologic data and test results are interpreted. For this reason it is essential that all records are maintained current and complete and that uncertainties are identified for resolution as they occur. Supervising field staff are responsible for maintaining communication with the project manager and logistical coordination of the field effort within the workscope and budgetary limits.

3.2.3 Verification of Test Boring Methods and Services

It is the responsibility of H&A field staff to verify that test borings and related instrumentation installation, subsurface sampling and testing methods are in conformance with applicable approved standards and specifications and to document conditions and results. It is the responsibility of the H&A field staff to verify that proper equipment and techniques are employed and to obtain measurements and make observations independently. H&A field staff are responsible for complete field logging of groundwater, soil and bedrock conditions, the maintenance of accurate test records and field exploration location sketches, and ensuring proper instrumentation installation, sample preservation and handling. In addition, payment for services rendered on behalf of the client is commonly handled with H&A providing a daily field report (DFR) including an accurate breakdown of the work activities and itemized costs on a daily basis.

Test boring subcontractor pay items and method of payment are defined in their contract. Typically test borings are paid for in one of the following ways:

- Footage and item basis with stand-by time charged for testing or delays incurred due to no fault of the subcontractor.

- Day rate basis with overtime premium, materials and footage charged for selected items.

3.2.4 Right of Access

Prior to site entry, Haley & Aldrich staff members must ensure that permission has been gained from the property owner to access the property.

3.2.5 Layout and Utility Clearance

Prior to the start of drilling all proposed locations must be laid out and have utility clearance from all appropriate agencies and utility owners. H&A requires the test boring subcontractor to obtain the utility clearance within the terms of the contract or services agreement. H&A field staff should verify with the contractor that the utilities have been cleared and obtain the clearance number prior to the start of drilling.

3.2.6 Site Safety and Subcontractor Briefing

At the start of fieldwork H&A field staff should coordinate a site briefing and review the schedule and workscope with all subcontractors involved with the project. This briefing should include a review of the following:

- Drilling, sampling and testing equipment and materials,
- Observation well materials
- Test boring lay out, criteria and priority,
- Testing and sampling specifics
- Pay items
- Site conditions
- Environmental concerns, known or suspected contamination
- H&S information
- Decontamination requirements
- Site restoration and waste disposal issues
- A site walkover and utility check

While it is the subcontractor's responsibility to obtain the utility clearance, it is important to verify with the driller that the utilities have been cleared at each proposed test boring location. The field representative should pay attention to the available utility plans, manholes or catch basin grates, and gate or roadway boxes. Distance to overhead utilities must be verified by the driller as well.

3.2.7 Test Boring Monitoring

3.2.7.1 General

Haley & Aldrich field staff must become familiar with the technical details and suitability of all exploration equipment and methods. Test borings are the most common method employed by H&A to obtain high quality data on subsurface conditions. In addition, a variety of special testing techniques and instrumentation installations may supplement the test boring program.

Specific H&A procedures must be consulted for additional details relating to special testing, sampling and instrumentation installation. See Appendix B: Related Haley & Aldrich Procedures.

3.2.7.2 Test Boring Equipment and Use

Test boring equipment selection is based upon a detailed understanding of the capabilities of the equipment with regard to the anticipated site geological conditions. In addition, the particular project needs may necessitate or preclude certain methods and equipment.

The following table presents several of the common drill rig platform (mounting frame) types and general uses.

Type	Use
Tripod	Shallow soil displacement borings, chop and wash methods remote or difficult access
Skid	General purpose soil and rock drilling difficult access, steep terrain
ATV	General purpose soil and rock drilling off road upland areas, remote access
Track	General purpose soil and rock drilling off road lowland and upland areas, remote or difficult access
Truck	General purpose soil and rock drilling street access

In addition, drill rigs of all types are frequently barge-mounted for drilling over water. Conventional drill rig engines are primarily diesel or gasoline fueled however propane and electric models are available for use in enclosed spaces. There are many drill rig manufacturers and a great deal of variation in drill rig size and capability. Engine horsepower, rig reaction weight, pump capacity and tooling are some of the factors relating to rotary drill rig performance. The suitability of a particular drill rig to a given function is as much a measure of rig design as of the drilling method employed.

Conventional drill rigs vary in size and design but there are several components that are common to most drilling equipment. All rotary drill rigs have engines and transmissions that deliver torque to a drill head. The drill head rotates the drill spindle and controls vertical advance through a feed and bit weight control mechanism. A water or mud pump may be mounted to the drill rig chassis or included separately for wash borings. Drill rigs all have derricks (masts) and hoists for lifting drilling tools. An introduction to the most common drilling tools and equipment is given in the following topic discussions.

3.2.7.3 Test Boring Methods

Test borings methods generally fall into one of the following categories:

- Displacement Borings
- Pneumatic Borings
- Sonic Borings
- Wash Borings
- Auger Borings

Displacement borings are a simple form of uncased boring conducted by directly advancing sampling tools into unstabilized soils. These probe-type borings may be suitable for reconnaissance mapping or preliminary environmental site investigations. Several methods of displacement borings are discussed in OP2030 Direct Push Borings (Percussion-Vibratory Driven Probes).

Pneumatic or air-rotary borings are typically larger diameter borings conducted for the installation of groundwater production or test wells. Techniques similar to wash and mud-rotary methods are used in combination with air-rotary tooling and pneumatic evacuation.

Sonic borings utilize high frequency resonant sound to advance specialized core barrel and casing equipment for continuous soil and soft rock recovery. This technology is particularly applicable for environmental site investigations and especially where dense, non-aqueous phase liquids (DNAPL) are present or if vertical groundwater profiling is desired.

Wash borings (by cased or mud rotary methods) and auger borings are the principle means of conducting test borings for most geotechnical and many environmental investigations. The details of these test boring methods and preference of use are discussed below.

A. *Cased Borings* - Cased borings are the primary means of borehole stabilization for obtaining high quality overburden samples, conducting in-situ testing, installing instrumentation devices and penetrating to bedrock prior to rock coring. Casing (pipe) is typically advanced to depth and washed out prior to sampling or coring. Cased borings are preferred in geotechnical analysis because the chance of soil disturbance is minimized when the various techniques are properly executed. Telescoping casing allows the test boring to be continued through boulders or other obstructions and facilitates drilling through cohesionless soils encountered at depth. Cased borings also provide a degree of flexibility over the other test boring methods. Permeability testing and most in-situ soil tests may be conducted at depth in cased borings and mud-forming products may be added or flushed out of the drill slurry as needed. Cased borings are preferred for instrumentation installation because the risk of borehole collapse is minimal and for rock coring due to the effective seating obtained by casing at the bedrock surface.

Casing - Typical drill casing consists of heavy steel pipe in standard 1, 2, 5 and 10 ft. lengths that may be threaded together with flush joints. The following table presents the common flush joint casings with diameter and volume.

Designation	O.D. (in.)	I.D. (in.)	Volume (gal./ft.)
RW	1.44	1.19	0.058
EW	1.81	1.50	0.092
AW	2.25	1.91	0.148
BW	2.88	2.38	0.230
NW	3.50	3.00	0.367
HW	4.50	4.00	0.652
PW	5.50	5.00	1.022
SW	6.63	6.00	1.472
UW	7.63	7.00	2.000
ZW	8.63	8.00	2.610

Driven Casing and Casing Hammers - Casing (drop) hammers usually weigh approximately 300 lbs. and are commonly classified as either a doughnut hammer or as a safety hammer. Safety hammers consist of an external weight with an internal anvil and stem (guide rod) assembly that attaches to the flush coupling (plug) threaded into the top of the uppermost section of casing (pipe). An internal stop on the stem prevents the external weight from coming off the stem during lifting and driving. Doughnut hammers are simply heavy steel weights that have a central hole. These are used in conjunction with a separate drive head anvil and stem assembly that threads to the flush coupling at the top of the casing. Casing hammers are lifted by means of a winch or cathead hoist approximately 24 to 30 inches and allowed to free fall. The energy delivered though the drive head forces the casing into the underlying soils. Driven casing is fitted with a hard-shoe (drive-shoe) on the lead (bottom) section. It is not uncommon to record the number of blows delivered per foot of casing advance as a rough measure of relative penetrative resistance.

Spun Casing - Spun casing is advanced into underlying materials by means of the drill head. Connection is made through a drill rod threaded into the flush plug at the top of the casing. Drill fluid or water is pumped down the casing to cool the bit and flush away the drill solids. Spun casing is fitted with a spin-shoe (econoshoe) in the lead section.

Casing Clean Out and Drill Bits - Whether the casing is driven or spun, the accumulated material within the casing must be completely removed prior to sampling. This is accomplished by means of simultaneously drilling and flushing with fluid pressure forced through a drill bit connected by the drill rods to the water swivel at the drill head. The use of a positive displacement pump is essential for providing sufficient lift to remove heavier solids from the annulus. Properly sized drill bits are typically 1/8 to 1/4 inch smaller than the casing being drilled through. Several common drill bit types are used to clean out casing and into the underlying soils depending upon soil conditions as indicated below.

Type	Description and Use
Tricone Rollerbits	Also referred to as tricone roller rock bits or simply rollerbits, these are general purpose, axially discharging drill bits used for casing clean out and borehole advance through overburden and bedrock. Button bits are similar except with carbide tips on the individual teeth of the rollers for drilling through obstructions and hard bedrock.
Drag Bits	Also referred to as wing bits, fish tail bits and mud bugs, these are axially discharging drill bits used for the same purposes as the rollerbits and particularly in cohesive soils where rollerbits may become clogged. Commonly adapted with defectors at the fluid ports that direct the discharge upward to minimize disturbance of underlying sensitive soils.
Chopping Bits	Also referred to chisel bits, these are axially discharging drill bits used for casing clean out, chop and wash techniques and fragmenting lost core in boreholes.

Drilling Fluid, Recirculation and Pumps - Drilling fluid (slurry or mud) may consist primarily of water and soil particles suspended during drilling or may include a number of natural and artificial products developed to coat and stabilize the borehole and aid in lifting coarser materials. Slurry is discussed in more detail in the section dealing with mud-rotary drilling below.

Drilling fluid must be continuously pumped down the borehole during drilling in order to cool the drill bit and flush away the drill solids. For practical reasons it is necessary to collect the returning fluid at the borehole collar into a settling tank (wash or mud tub) by means of a wash "T" or gasket if a through-hull tub is used. Baffles or dams are used to prevent solids from reaching the suction hose strainer at the return sump.

Positive displacement pumps are the standard used in the test boring drilling industry. The progressive cavity (Moyno®) pump is widely used in test borings which may involve heavier drill fluids (greater than 75 pcf), higher volumes (up to 35 gpm) and lower pressures (under 650 psi).

Verification of Clean Out Prior to Sampling - In is necessary to verify that the casing is completely cleaned out prior to sampling. Small amounts of collapsed or settled material at the bottom of the borehole can interfere with sample recovery, confuse or obscure the true nature of the in-situ soils and greatly affect the determination of penetrative resistance as outlined in the section on the Standard Penetration Test (SPT) below.

It is customary to drill slightly below the bottom (ahead) of the casing in order to reduce the possibility of sampling soils densified or disturbed by the casing advance. In collapsing conditions or non-cohesive soils this usually means less than 6 inches below the casing shoe. Careful observation of the drill action and wash return during drilling is an important step toward understanding the conditions within the borehole.

After flushing is complete, the pump is stopped and a reference mark is placed on the drill rods while the drill bit is at the bottom of the borehole. The rods and bit are then lifted into the casing for a short period and any suspended materials are allowed to settle to the bottom of the borehole. The rods and bit are then lowered without restarting the pump or head rotation. The reference mark placed on the drill rods should be in exactly the same position as when the flushing was first completed. If the reference mark is higher, flushing is repeated until clean out is verified. If the reference mark is lower an attempt should be made to determine whether jetting, sinking or some other effect has occurred.

Standard and Continuous Sampling in Overburden - Typically in overburden (soil) borings, once casing clean out has been verified the rods are lifted (pulled), the drill bit is removed and a soil sampler is fixed to the drill string (rods). The soil sampler is then lowered to the bottom of the borehole and advanced into the undisturbed soils.

Several different types of soil samplers are routinely used including thick-walled drive samplers that offer a measure of penetrative resistance as well as a remolded (disturbed) sample and thin-walled fixed-piston tube samplers for undisturbed samples in softer cohesive soils. The 1.385 inch I.D. split barrel (splitspoon) sampler is the most common general purpose sampler for overburden sampling of all types of soils and the standard upon which the Standard Penetration Test (SPT) is based. The SPT is discussed in detail in the section relating to Splitspoon Sampling and the Standard Penetration Test below.

Soil samplers are advanced in test borings by driving, direct-push or drilling into overburden soils at the bottom of the borehole a distance equal to or less than the length of the sample chamber. Care is exercised to prevent undue disturbance, consolidation, compaction or densification of soils due to “stroking”, “bobbing” or excessive penetration (over-drive).

Standard Sampling refers to the common practice of taking soil samples at 5 foot intervals. The sample is taken and the casing is advanced and washed or the boring is drilled to the next interval with the drill bit prior to the next sample attempt. Since the typical penetration for many soil samplers is two feet and that sample recovery commonly is somewhat lower in coarser and denser materials, approximately 20% to 40% of the soil stratigraphy is directly observed in a standard test boring.

Continuous Sampling refers to the practice of taking repeated soil samples beginning at the bottom of the previous sample. Following each sample attempt the casing may be advanced and washed or the boring drilled to the bottom of sampler penetration. Depending upon the project requirements and soil conditions it may be acceptable to "double up" the soil sampling by skipping the clean-out step between every other sample attempt. In such cases an extension rod with an O.D. equal to or less than that of the sampler itself must be used and care must be exercised to observe and record collapsed or resampled material and to note any increase in penetrative resistance due to the additional skin friction.

Careful observation of the drill action, wash return and the penetrative resistance encountered by the drill bit and sampler is necessary to infer strata changes whether standard or continuous sampling is conducted. Stratigraphic contacts encountered in soil samples are treated with particular care. Split samples are discussed in detail in the section relating to Sample Handling and Preservation below.

Casing Advance, Telescoping and Borehole Stabilization - Typical test borings are conducted with the smallest diameter casing that is anticipated will be needed to advance the boring and all required sampling and testing tools to a particular stratum or depth. Test borings are usually begun with the largest diameter practical in order to provide for the possible successive telescoping of smaller diameter casings should it become necessary. Drill slurry may stabilize the borehole to allow for uncased (open-hole) drilling in cohesive soils or in non-collapsing conditions.

Routinely test borings are begun with the largest casing fitted with a hard-shoe or drive-shoe in the lead (bottom) section. Initially the process of driving casing, washing and standard sampling is repeated until an obstruction is encountered or the casing is seated into material such as clay that will maintain itself uncased.

If an obstruction is encountered a roller bit or button bit may be used to advance through the obstruction. In some cases the drill bit may break the obstruction or a wedge (boulder-buster) may be successfully employed and the casing is advanced. In other cases the next smaller diameter casing will be telescoped down the borehole and advanced through the hole in the obstruction created by the drill bit.

In the event that cohesive soils or non-collapsing conditions are encountered standard sampling may be continued while the casing is not advanced further. Below the casing the drill bit is used to advance the boring and the open hole is extended until the test boring termination criteria is reached or subsurface conditions require stabilization techniques be used. Borehole stabilization may be maintained by the suspended fine grained particles naturally developed in the drill wash water or through the use of a bentonite or polymer slurry. Drilling slurry is discussed in detail in the section relating to mud rotary drilling below.

Casing fitted with a spin-shoe (econoshoe) may be telescoped down a borehole cased to a shallower depth and advanced by drilling in a similar manner to drill bit advancement. Slurry or water is pumped down the casing to cool the bit and flush away the drill solids. Prior to sampling the drill bit must be lowered down the borehole and the spun casing must be drilled out in the same fashion as with driven casing.

Spun or driven casing must be seated into the top of the bedrock in order to achieve an effective seal prior to rock coring. Techniques and methods relating to the set up and execution of rock coring are described in detail in OP2017 Rock Coring.

B. *Mud Rotary Drilling* - Mud rotary drilling employs many of the tools and techniques used in cased wash borings with the addition of various commercially prepared products into the native drilling fluid. The method typically is conducted in deeper overburden borings and on projects where there are special concerns for in-situ testing and soil sample integrity such as with sensitive or soft soils. Borehole stabilization is enhanced by the use of a bentonite or polymer based drilling slurry under positive hydrostatic conditions.

*Set Up and Maintenance of Positive Hydrostatic Condition*s - Initially a surface casing is installed to provide a stable borehole collar and an outlet to the recirculation tank (mud tub). Mud rotary drilling requires a higher capacity pump to handle the heavier fluids used to remove cuttings from the borehole and a substantial mud tub complete with baffles (dividers or dams) to allow for effective settling of drill solids and separation from the suction screen at the return sump. Special emphasis is placed upon mixing, de-sanding and maintaining the viscosity and specific gravity of the drilling slurry in order to allow for open-hole drilling below the initial casing. A bypass line should be included in the recirculation circuit to allow the pump to remain operational while the rods are disconnected at the drill head.

Mud drilling requires that positive hydrostatic conditions (head) be maintained in the casing at all times to stabilize the borehole. The practice is to direct the drilling fluid from the bypass line to the top of casing to displace any tooling being withdrawn from the borehole. Use of a mud balance is necessary under certain circumstances to ensure that the required specific gravity is being maintained in the drilling fluid.

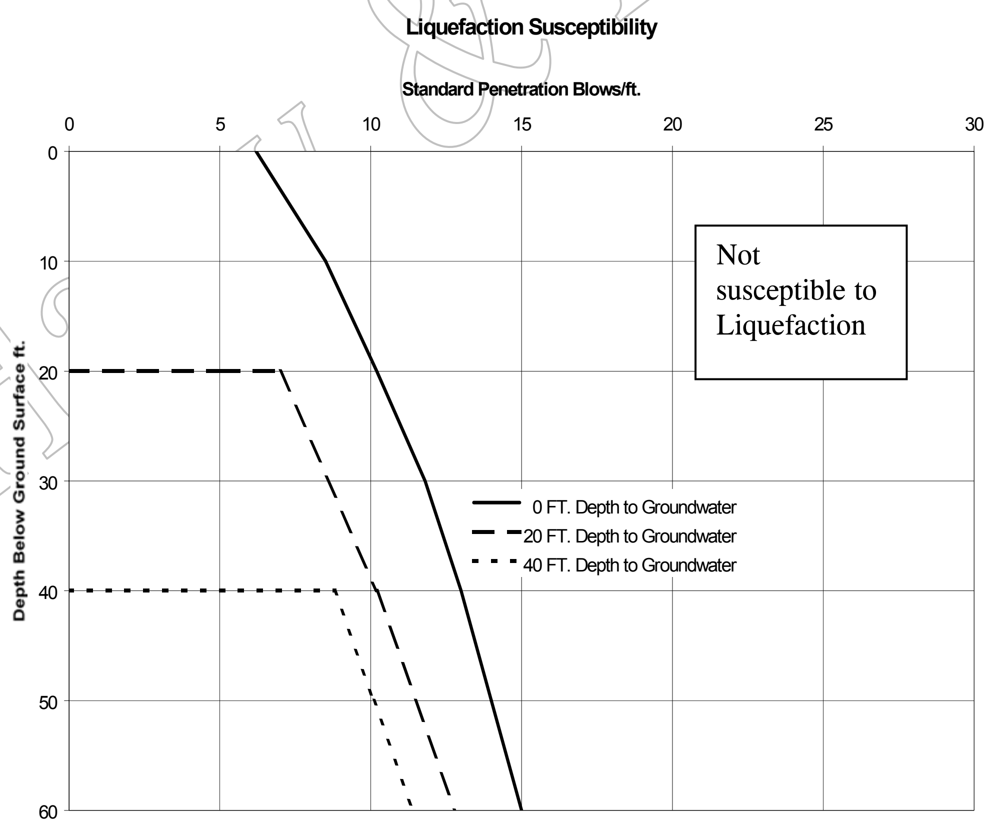
Drill Mud - Drill mud is a properly proportioned slurry prepared from products carefully selected based upon their properties and suitability for the intended purpose under the anticipated conditions. Standard mud forming products consist of highly colloidal, gel-forming, thixotropic clays (primarily bentonite), with various chemicals added to control dispersion, thixotropy, viscosity and gel-strength. Additives and special products are used to prevent flocculation under saline conditions or when anhydrite is encountered. Weighting materials such as ground barite, hematite, galena or other heavy minerals are available in products for use in order increase the specific gravity of the drilling fluid. Biodegradable polymers may be used in boreholes intended for groundwater monitoring well installation.

C. *Auger Borings* - Hollow stem augers (HSA) are an effective and fast method for drilling shallow overburden borings in softer soils above the water table without the introduction of water or drill slurry. Hollow stem augers are routinely used on preliminary geotechnical investigations and are preferred for environmental studies where continuous soil sampling and minimization of potential cross contamination due to the use of drilling fluids is desired. Hollow stem augers and solid stem augers are also used for shallow probes.

Hollow stem augers are a form of casing manufactured with external spiral flighting designed for boring advancement by drilling. Typical hollow stem augers used for test borings range from 2.5 in. to 8 in. I.D. in 5 ft. length sections. The lead section is fitted with a cutter head upon which are fixed several hardened, replaceable teeth. Using a center plug fixed to the bottom of the rods, hollow stem augers are typically advanced by drilling to the desired depth whereupon the center plug is withdrawn to allow for soil sampling. Disturbance below the bottom of the augers due to the cutter head may be substantial and heave is common at the bottom of the borehole due to the piston-like effect of the center plug during removal. As such, augers are not favored for test borings on many geotechnical projects where high quality samples and penetration resistance data are required.

D. *Splitspoon Sampling and the Standard Penetration Test (SPT)* - The typical method for obtaining representative samples and a measure of the penetrative resistance of soils in test borings is by means of the Standard Penetration Test (SPT). This is accomplished utilizing a thick wall, ring-lined, split barrel, split barrel, drive sampler (splitspoon) assembly attached to the drill rods and driven into the soils at the bottom of the borehole at regular intervals. Splitspoon samplers are manufactured in various sizes with the most commonly used being 1 3/8 in. I.D. (2 in. O.D.) and having an interior sample chamber length of 24 in. (approximately 36 in. overall length). Once lowered to the sampling depth, the sampler is typically driven 24 in. into the soils with a 140 lb. hammer freely-falling over a 30 in. drop and the number of blows (SPT blowcount) required for each 6 in. of penetration is recorded. The penetrative resistance in blows per foot obtained from the summation of the blowcounts from 6 in. to 18 in. is referred to as the “N-value”. Terminology for density of granular soils and consistency of cohesive soils has been correlated to N-values. When performed properly the SPT provides useful data for determination of the geotechnical behavior of soils and engineering design in addition to representative remolded soil samples for geological interpretation.

E. *Liquefaction* - Loose, saturated, naturally deposited sands will fail when subjected to a sudden shearing stress under certain conditions. Liquefaction susceptible soils have a void ratio greater than the critical void ratio for which a change in volume remains constant during shearing. As such, a sudden decrease in volume may occur during a seismic or blasting event or due to vibrations resulting from railroad traffic or other dynamic activity. Liquefaction potential may be identified during a test boring at a given depth by the relationship between the standard penetrative resistance and the groundwater depth.



Geotechnical protocols for liquefaction susceptible soils supercede all other testing and termination criteria and require that the entire stratum thickness of liquefaction susceptible soils be identified. Practically this means that test borings must be cased and that positive hydrostatic conditions must be strictly maintained and continuous sampling conducted until it is determined that the zone of liquefaction susceptible soils has been penetrated. The Project Manager should be notified in the event of the unexpected encounter of liquefaction susceptible soils.

F. *Bedrock Coring* - Bedrock coring is conducted in cased borings to obtain accurate detail of the bedrock properties and high quality samples for laboratory testing. A wide variety of rock core equipment is available and rock coring techniques vary greatly depending upon the driller, rock type, equipment and many other factors. Observations related to drilling activities are a primary focus during rock coring including bit weight, feed restriction, head speed, engine speed and gear, pump volume, water loss and fluid return, core rate, drilling halts, jamming, rapid advances, equipment defects, bit type, bit wear, core barrel type, core barrel adjustment. For all projects it is essential that accurate measurements be made when determining the depth of the bedrock surface from drill action or SPT and that detailed observations are recorded concerning the effects noted and the procedures executed upon encountering bedrock. Coring should begin at the minimum depth below the bedrock surface required to seat the casing in order to document the bedrock condition in the uppermost zone where typically fracturing and weathering transitions are greatest. Core hole depth must be verified following each run to account for lost core. When necessary, logging should be broken down into a two step process beginning with sample preservation, labeling and recording of a simple description including recovery and RQD measurements followed by detailed logging of individual features and properties as time and conditions permit. Techniques and methods relating to the set up and execution of rock coring are described in detail in OP2017 Rock Coring. Rock core description and logging is covered in OP2002 Identification and Description of Rock in the Field Using Visual-Manual Methods.

G. *Groundwater Monitoring (Observation) Well Installation* - Groundwater observation or monitoring wells are commonly installed in completed test borings as a means obtaining accurate stabilized groundwater readings essential to engineering design, and hydrogeologic modeling. In addition, permanent observation or monitoring well installations provide for continual long-term sampling for environmental analyses. A wide variety of material types and sizes are employed depending upon the intended use. Typical observation or monitoring wells installations consist of 2 in. I.D. PVC pipe with a machine slotted screen section backfilled with filter sand and sealed with bentonite within the desired stratum or zone. Solid riser sections above the sealed zone may be grouted or backfilled with a variety of materials depending upon the project needs and finished at the ground surface with either a flush-mount roadway box or with a protective casing such as a guard pipe and padlock for undeveloped sites. Careful attention to the placement of screens, backfill and seals is required and accurate depth measurements must be recorded during installation. Initial well development may occur immediately upon completion in order set the sand pack and remove the effects of drill fluids from the formation waters. Rationale and details of groundwater observation or monitoring well installation are given in OP2020 Groundwater Monitoring (Observation) Well Installation, Development and Abandonment.

H. *Special Testing, Sampling and Instrumentation* - H&A utilizes a wide variety of well established and state-of-the-art soil, rock and groundwater testing procedures and instrumentation to supplement many subsurface exploration programs. Among the methods and techniques routinely used are fixed-piston tube sampling, vane shear testing, pressuremeter testing, permeability testing, water pressure (packer) testing in rock, inclinometer installation, multiposition borehole extensometers (MPBX) installation and aquifer (pump) testing. Prior to attempting an unfamiliar technique H&A field staff must review all related procedures and consult experienced personnel. Outside support or training that may be necessary to perform new procedures shall be sought with project manager approval. Notes and references obtained should be retained for potential development into procedure format.

I. *Borehole Abandonment* - For many subsurface exploration programs it may be acceptable to simply backfill the borehole upon completion with the accumulated borehole cuttings. Ground surface restoration may be accomplished by removing any drilling residue or debris and installing a concrete surface plug or asphalt cold patch. Often times borehole abandonment procedures may be outlined in the project guidelines in order to accommodate a particular purpose.

Tremie grouting of completed boreholes is commonly specified in order to prevent aquifer cross contamination or the inflow of groundwater into proposed construction excavations. A typical grout mix ratio consists of 7.5 gallons of water to one bag of Portland cement and approximately 5 lbs. of bentonite powder. The grout batch is mixed in a drum and pumped to the bottom of the borehole prior to casing withdrawal until all drill fluid has been purged. The borehole is topped off with grout periodically as the casing is withdrawn to ensure that the grout column is continuous. Grout take is accurately measured and recorded for comparison with the calculated borehole volume in order to verify complete grouting and to identify zones of high transmissivity.

3.2.7.4 Sample Preservation and Shipment

A. *Jar Samples* - Soil samples obtained in test borings are retained in clean, unused, 8 oz. glass jars that have been clearly labeled with the following boring and sample information.

- File Number
- Boring Number
- Sample Number
- Depth
- SPT Blow Counts
- Recovery

Soil samples should be carefully selected and placed in sample jars as nearly intact and undisturbed as possible. Original soil structure, including bonding, foliation and stratification, are critical to the geological interpretation and understanding the engineering properties of soils. Careless handling of samples may destroy soil structure making any geologic interpretation of soils during the review process impossible. If more than one soil type is obtained in a single sample interval each distinct unit should be preserved in separate jars and identified with the sample drive number distinguished with the sequential letters A, B, C, etc. in addition to the estimated depth range of each material.

Jar samples must be placed in new, unused cardboard boxes identified with the following:

- File Number
- Boring Number
- Sample Number
- Depth

Transportation from the site should be addressed by the project specifications and coordinated with the driller. In some cases the drillers will be required to produce boring bogs and may require the samples for a period of time in order to conduct an independent soil review for their boring report. More commonly samples will be taken at the site by H&A field staff and entered into the sample receiving storage and tracking database.

B. *Tube Samples* - Complete details concerning Thin-Walled Open Drive samples and Undisturbed Fixed-Piston Tube sampling are covered in OP2007 including specifics related to the special care necessary in handling, transportation and storage.

All tube samples must be kept in a vertical position and protected from shock, freezing and desiccation prior to storage in a moisture and temperature controlled environment. The following information must be written on both the top and side of the tube sample:

- File Number
- Boring Number
- Sample Number
- Depth
- Top Indicator
- Recovery

To ensure proper handling during transportation all tube samples must be taken at the site by H&A field staff and entered into the sample receiving storage and tracking database.

C. *Rock Core* - Complete details concerning rock coring are covered in OP2017 Rock Coring. Rock core description and logging is covered in OP2002 Identification and Description of Rock in the Field Using Visual-Manual Methods.

Rock core is carefully placed in new unused wooden core boxes upon completion of each core run. The core boxes must have been constructed expressly for the purpose of containing rock core with a hinged wooden lid and a hook and eyelet for securing the lid closed. For NX size core the core boxes must be no longer than is necessary to provide a minimum inside length of 5.0 ft. The interior of the core box must be partitioned with wooden dividers such that four 5.0 ft. length runs may accommodated. Interior width of the core boxes must be sized to accept the four cores, the dividers and the use of cardboard liners if split inner core barrels have been specified in the rock core specifications. Blocking must be provided to separate between the top and bottom of consecutive runs.

Placement of the rock core into the core box is conducted with the assistance of the driller to ensure that the structure and orientation is preserved and that undue breakage does not occur. The first core run is placed toward the hinge side of the core box with the top of the run oriented toward the left when viewed such that the hinges and cover are toward the top. (See Figure 1.) Subsequent runs are placed progressively away from the hinged side with the top oriented left. Due to varying length recovery runs may straddle more than one partitioned section. Wooden blocks must be placed between runs identifying top or bottom and run number on either side of the block.

A grid should be drawn on the interior lid of the core box and clearly labeled with the following information:

- File Number
- Project Name
- Boring Number
- Run Number
- Depth
- Recovery
- RQD
- H&A Office Address

It is very important that the exterior top and both ends of the core boxes are be labeled with the following information in order to identify the contents of the box should it be at the bottom of a pallet or stack of core boxes:

- File Number
- Boring Number
- Run Number
- Depth

3.2.7.5 Environmental Sampling and Monitoring

Environmental sampling combined with discrete field screening of soil and groundwater for contaminants is routinely conducted during the performance of subsurface explorations. In addition, continuous monitoring of air quality within the work zone or at the project site may be required to address H&S concerns. Potential contaminants and sources may be identified in the initial stage of project planning and prior arrangements made for PPE, monitoring, sampling and laboratory analysis.

To minimize the risk of cross-contamination typical environmental sampling programs work from known or suspected clean areas toward areas of known or suspected contamination. Contamination encountered unexpectedly may present serious exposure risks to field personnel without proper PPE and monitoring instrumentation, particularly if the contamination is gross or unidentified. In the event unexpected contamination is encountered, all fieldwork should be suspended and the area evacuated immediately until the Project Manager and the Health & Safety Coordinator can be contacted so that H&S and sampling guidelines can be developed.

A. *Decontamination Procedures and Waste Management* - Standard equipment decontamination practices may include the establishment of a decontamination area such that decontamination fluids are collected and properly stored for disposal. Typically a location within the site is chosen away from sensitive or occupied zones and a decontamination pad is created within a bermed area using polyethylene sheeting. A high-pressure steam cleaner is used to wash all equipment prior to each exploration and wastewater is pumped into adjacent drums. Splitspoons and hand sampling tools are scrubbed between samples at the exploration location using a detergent (water and alconox) solution rinsed with control (tap) water followed by a solvent (methanol) rinse, wiped with a paper towel and rinsed with deionized water before being allowed to air dry. Hexane may be needed for removal of heavy petroleum, grease and coal tar. Decontamination waste, sample residue and drill cuttings are typically drummed, labeled and staged onsite for proper disposal.

B. *Environmental Soil Sampling* - Environmental soil samples obtained for chemical analyses are collected in surface samples and by using many of the techniques employed in typical subsurface explorations with special attention given to decontamination procedures. Preservation, handling and glassware for environmental soil samples varies considerably depending upon several factors including the type and degree of contamination, the analytical method to be conducted, the analytical laboratory being used and the governing regulations. In addition, the depth and location of samples may be strictly controlled under agency guidelines. Documentation of volatile organic compounds (VOC) in the soil through headspace screening is required in order to provide real-time guidance in the field to direct the sampling. Clean 8 oz. jars are partially filled with newly obtained soils and covered with aluminum foil and allowed to stabilized prior to screening with a photoionization detector (PID). The presence of metals in soils is not associated with odors, while coal tar, fuels and solvents are often easily distinguished. Particular attention is given to discoloration or odors noted, however it is company policy to avoid fumes and odors at all times. Soils collected from a discrete zone should be homogenized and a representative portion placed into laboratory glassware and labeled. Analytical samples are kept in a cooler with ice blocks and a Chain of Custody form is maintained until transfer to the analytical laboratory. Applicable environmental sampling protocols must be followed as given in OP3000 General Environmental Field Procedures and Protocol, OP3001 Preservation and Shipment of Environmental Samples, OP3002 Headspace Screening Procedure, and OP3006 Procedures for Subsurface Soil Sampling for Chemical Analysis.

C. *Environmental Water Sampling* - Groundwater monitoring (observation) wells must undergo an initial well development following installation and prior to sampling. This is intended optimize well function and to produce formation-derived groundwater samples and valid analytical testing results. Groundwater sampling from existing monitoring wells for chemical analyses involves initially gauging the static groundwater level and the well depth in order to determine the well volume. Waterra® footvalves and tubing, bailers, submersible pumps or peristaltic pumps may be used to purge a minimum of three well volumes in order to minimize well effects. Turbidity, conductivity, resistivity, salinity, dissolved oxygen, temperature and pH are recorded periodically after purging and groundwater parameters must be stable prior to sampling. Low-flow groundwater sampling is required for certain analyses to be valid. In such cases, variable speed submersible pumps are used at extremely slow rates to minimize drawdown and turbidity. Preservation, handling and glassware for environmental water samples varies considerably depending upon several factors including the type and degree of contamination, the analytical method to be conducted, the analytical laboratory being used and the governing regulations. Applicable environmental sampling protocols must be followed as given in OP3000 General Environmental Field Procedures and Protocol, OP3001 Preservation and Shipment of Environmental Samples, OP3002 Headspace Screening Procedure, OP3008 Manual Water Level Measurement Procedure, OP3009 Monitoring Well Development Procedure, OP3010 Groundwater Quality Sampling Procedure, OP3011 Groundwater Sampling Procedure Using Geoprobe System, OP3012 Low Stress/Low Flow Groundwater Sample Collection Procedure, OP3013, and OP3014 NAPL Monitoring and Sampling Procedure.

3.2.7.6 Documentation

Thorough field documentation is the primary responsibility of H&A field staff throughout the execution of any test boring program. Site conditions, soil and rock logging, sample identification and tracking, test and data collection, sketches, photographs, pay item quantities, events, personnel onsite, incidents, discussions and issues must be recorded in the appropriate manner in order to comply with contractual agreements, regulatory requirements and recommended loss prevention practices.

All field documentation must be duplicated, photocopied or reproduced as soon as is practical in order to guard against loss. In no case should originals be mailed, transferred or removed from the author's custody until a back up copy is made. Copies of field documentation should be delivered to the project manager in a timely fashion as the project warrants. Originals may be issued to word processing or data entry personnel directly upon completion of a short-term test boring program or periodically throughout longer term projects.

Documentation related to environmental sampling, testing and chemical analysis is covered in detail in specific procedures developed for the particular sampling practice, medium, compound and applicable regulations.

A. *Field Book* - The field book is a first line repository of anything observed or discussed onsite without regard to potential use or merit. While the type of information in the field book may in some cases be informal or general in nature, the field book is a legal document and is the property of H&A. Long after a project is completed and the file is closed the field notes may provide an invaluable record of details that may not have been recorded elsewhere. The standard format of the daily field book entry typically includes the following:

- File Number
- Project & Location
- Date
- Weather
- Personnel Onsite
- Equipment Onsite
- Activities
- Observations
- Conversations
- Data
- Issues
- Incidents
- Other items not recorded elsewhere

B. *Photographs* - Photographic documentation of site conditions, activities and incidents are very useful for conveying a visual perspective to what may be difficult to describe otherwise. The fundamentals of good photography must be applied for the images to be of use including:

- Lighting (adequate but not excessive)
- Composition (frame the subject properly)
- Perspective (include a scale)

In addition, subject identification within the photograph by means of a white board and use of the camera date/time feature (if so equipped) renders ease to later captioning as does indicating on a site plan during shooting the approximate location and direction of the shot by frame number.

C. *Test Boring Logging* - Test boring logs must be completed entirely and without omission to stand alone as documentation of the subsurface conditions at a given point. See Test Boring Report Form 2700 and Core Boring Report Form 2703. To guard against loss, test boring logs should be proofed in the field and photocopied or faxed as soon as is practical. Protocols for electronic logging using a PDA or laptop computer require periodic file back-up and memory card replacement as well as daily transmission to the H&A server.

Each first page test boring log contains a header to identify the project and boring and to document the boring location and elevation, the contractor equipment and personnel, the H&A representative and the date. Within the body of the overburden log each sampling event is recorded including SPT blow counts (if applicable), sample type and designation, recovery, depth and sample material description. Core boring reports contain fields for core rate and RQD. A column for sketching groundwater monitoring well installation appears in the body of the overburden and rock core logs. In the first page boring log footer the groundwater observations noted during the execution of boring are carefully recorded in relation to the drilling activity in order to assist in the interpretation of the reading. A summary of the drilling and sampling totals also appears in the first page footer. Guidelines for soil and rock logging are detailed in OP2001 Identification & Description of Soils in the Field Using Visual-Manual Methods and OP2002 Identification & Description of Rock in the Field Using Visual-Manual Methods.

In addition to project, boring, groundwater and sample details, numerous field observations should be noted during the conduct of the boring such as casing blow counts, drilling action, the sequence of drilling events, comments on the drilling practices utilized and clues to the subsurface conditions encountered. Notes are typically included within the description field on the boring log, however, the boring log margins may also be used in cases where side bar comments or an additional column for data tied to depth is needed. Commonly the space above the header is used for special callouts relating to boring draft status or disclaimers while the space below the footer is used to record a simple boring location sketch.

D. *Special Testing and Instrumentation* - Forms for documenting specific field sampling procedures, special testing and instrumentation installations are available for use as appropriate. A complete index of forms may be accessed at K:\techproc\sop\Forms\Form Number Index.xls. In addition, new forms may be created as the need arises from a template located within the same directory. Specific guidelines for documenting special testing and instrumentation installations may be given within established procedures. In the absence of documentation standards for a particular procedure the general standards of scope, precision, accuracy and completeness from related procedures should be referred to until specific guidelines are developed.

E. *Groundwater Monitoring (Observation) Well Installation* - Geologic conditions within a borehole will generally influence well design, function and purpose. For this reason the relationship between the stratigraphy and the placement of well materials must be recorded during the installation process on Form 2010 Groundwater Observation Well Installation Report. As previously indicated, a separate well sketch is also included on the Test Boring and Rock Coring Reports for quick reference relative to the stratigraphy. These sketches are not intended to replace or be submitted in lieu of the more detailed installation report. In order to ensure that wells perform properly and that subsequent samples or readings are valid and interpretable all borehole depths and well materials must be carefully measured during placement. Improper placement of seals, screens or filter materials may result in false or confusing chemical analyses or misinterpretation of phreatic surfaces and hydraulic gradients.

A separate Form 2170 Groundwater Monitoring Report is used to maintain a record of successive groundwater readings in monitoring (observation) wells.

F. *Borehole Sealing* - A Borehole Sealing Report is used to detail the grout mixture, volumes, equipment and placement techniques employed when a record is required to document the sealing of terminated or abandoned boreholes upon completion and to verify the effectiveness of the effort.

A separate Form 2016 Well Decommissioning Report is used to document groundwater monitoring (observation) well abandonment.

G. *Daily Field Report* - Test boring activities, production and pay items are recorded on a daily basis on Form 2500 Test Borings Daily Report. This record must be continually updated as events unfold in order to maintain a current status of the exploration program production and budget. Blank fields on the form are intended for additional project-specific pay items. An accurate break down of pay items and drilling activities must be maintained for each boring with a detailed record of the daily progress included on the reverse side of the form.

A separate Form 2005 Subcontractor Quantities for Test Borings is used to summarize the pay item totals as defined in the contract or agreement with the subcontractor. This form must be reviewed and signed by the subcontractor's representative upon completion of the subsurface exploration program. Carbon copies are distributed to the subcontractor's representative, the project file and the Field Services Manager.

H. *As-Drilled Test Boring Locations and Elevations* - An accurate sketch showing the actual (as-drilled) location of completed test borings must accompany the test boring logs. In addition, the estimated elevation of the ground surface or boring reference elevation must also be included. Locations and elevations should be measured with 0.1 ft. precision from known or permanent features whenever possible, however establishment of a temporary baseline and/or series of benchmarks may be necessary in open or virgin sites. An existing site plan with location and elevation data may have been provided for use during the test boring program. In such cases the scale and elevation datum should be verified and the accuracy of the horizontal and vertical data should be checked. All borings and field references should be painted or staked in the field as appropriate for future field survey.

I. *Geologic Profiles* - Simple geologic columns of individual borings (stick diagrams) may be quickly sketched in the field and combined as needed in order to produce a two-dimensional stratigraphic cross-section or geologic profile. This exercise may be useful in the development and support of the geologic interpretation of the stratigraphy and in the identification of data gaps during the test boring program.

3.2.7.7 Final Review and Summary

The final complete package of field data must include copies of all first draft field logs, test reports, raw data, field book entries, photographs, plans and sketches, daily field reports, subcontractor quantities and any additional notes. All field data must be reviewed for discrepancies, errors and omissions as well as for the identification of factors of critical importance and any areas of uncertainty.

In addition to the field generated data, all relevant research, correspondence, contracts, drawings, test boring rationale and criteria, sample receiving forms, environmental regulations and health and safety protocols assembled for the test boring program should be included in the final package to the file.

A summary of the test boring program should be prepared including the subcontractor and equipment, dates of execution, the total number of borings, sampling types and quantities, drilling depths and total footages of overburden and bedrock.

The site features and geologic conditions should be described incorporating the synthesized data from the test boring program and all available published literature or research. The geologic summary should present the reasoning behind the interpretation and any supporting documentation including geologic profiles developed for the site and related references.

FIGURES

Figure 1 Core Box Labeling.pdf

Figure 2 Suburface Exploration Key.pdf

OUTSIDE END

FILE NO. 18675-309

HA 317 C7-C8 152.5-162.0 BOE
HA 318 C1-C3 77.0-90.3

OUTSIDE TOP

FILE NO. 18675-309

BORING	RUN	DEPTH	
HA 317	C7-C8	152.5-162.0	BOE
HA 318	C1-C3	77.0-90.3	

OUTSIDE END

FILE NO. 18675-309

HA 317 C7-C8 152.5-162.0 BOE
HA 318 C1-C3 77.0-90.3

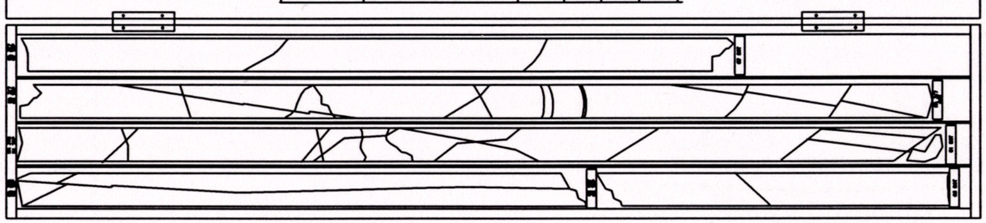
INSIDE COVER

X = drill breaks
/ = joints
* = RQD qualifier

BORING	RUN	DEPTH	REC in.	REC %	RQD in.	RQD %
HA 317	C7	152.5-157.5	48	80	48	80
	C8	157.5-162.0	54	100	31	57
HA 318	C1	77.0-72.0	58	97	19	32
	C2	82.0-87.0	33	55	30	50
	C3	87.0-90.3	24	71	24	71

FILE NO. 18675-309
BATTERYMARCH TOWERS
BOSTON MA

Haley & Aldrich, Inc.
465 Medford St.
Suite 2200
Boston, MA 02129-1400



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UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

CORE BOX LABELING

FIGURE 1

DESCRIPTION AND CLASSIFICATION OF SUBSURFACE MATERIALS

SOIL

Soil description on logs of subsurface explorations are based on Standard Penetration Test results, visual–manual examination of exposed soil and soil samples, and the results of laboratory tests on selected samples. The criteria, descriptive terms and definitions are as follows:

DENSITY OR CONSISTENCY

Density of Cohesionless Soils	Penetration Resistance (Blows per ft.)	Consistency of Cohesive Soils	Penetration Resistance (Blows per ft.)
Very Loose	0–4	Very Soft	0–2
Loose	5–10	Soft	3–4
Medium	11–30	Medium	5–8
Dense	31–50	Stiff	9–15
Very Dense	over 50	Very Stiff	16–30
		Hard	over 30

PENETRATION RESISTANCE

Standard Penetration Test (ASTM D–1586) – Number of blows required to drive a standard 2 in. O.D. split spoon sampler 1 ft. with a 140 lb. weight falling freely through 30 in.

COLOR: Basic colors and combinations: black, brown, gray, yellow–brown, etc.

SUPPLEMENTAL SOIL TERMINOLOGY:

Lamina	– 0 to 1/16 in. thick (cohesive)
Parting	– 0 to 1/16 in. thick (granular)
Seam	– 1/16 to 1/2 in. thick
Layer	– 1/2 to 12 in. thick
Stratum	– > 12 in. thick
Pocket	– Small, erratic deposit less than 12 in. size
Lens	– Lenticular deposit larger than a pocket
Occasional	– One or less per 12 in. of thickness
Frequent	– More than one per 12 in. of thickness
Interbedded	– Alternating soil layers of differing composition
Varved	– Alternating thin seams of silt and clay
Mottled	– Variation of color

GEOLOGIC INTERPRETATION

Deposit type – GLACIAL TILL, ALLUVIUM, FILL.....

The natural soils are identified by criteria of Unified Soil Classification System (USCS), with appropriate group symbol in parenthesis for each soil description. Fill materials may not be classified by USCS criteria.

U.S. Standard Series Seive / Clear Square Sieve Openings	12"	3"	3/4"	4	10	40	200	
	Boulders	Cobbles	Gravel – Coarse	Gravel – Fine	Sand – Coarse	Sand – Medium	Sand – Fine	Silts and Clays
	305 mm	76 mm	19 mm	4.75 mm	2.00 mm	0.43 mm	0.074 mm	

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			Group Symbol	TYPICAL NAMES
Coarse grained soils: more than half is larger than number 200 sieve	Gravels More than half of coarse fraction is larger than number 4 sieve	Gravels with little or no fines	GW	Well graded gravels, gravel–sand mixtures
			GP	Poorly graded gravels, gravel–sand mixtures
		Gravels with over 12% fines	GM	Silty gravels, poorly graded gravel–sand–silt mixtures
			GC	Clayey gravels, poorly graded gravel–sand–clay mixtures
	Sands More than half of coarse fraction is smaller than number 4 sieve	Sands with little or no fines	SW	Well graded sands, gravelly sands
			SP	Poorly graded sands, gravelly sands
		Sands with over 12% fines	SM	Silty sands, poorly graded sand–silt mixtures
			SC	Clayey sands, poorly graded sand–clay mixtures
Fined–grained soils: more than half smaller than number 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic clays and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silty, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			PT	Peat and other highly organic soils

ROCK

Rock descriptions noted on logs of subsurface explorations are based on visual–manual examination of exposed rock outcrops and core samples. The criteria, descriptive terms and definitions used are as follows:

FIELD HARDNESS: A measure of resistance to scratching.

Very Hard	Cannot be scratched with a knife point or sharp pick.
Hard	Can be scratched with a knife point or sharp pick, only with difficulty.
Moderately Hard	Can be readily scratched with a knife point or pick.
Medium Hard	Can be grooved or gouged 1/16 in. deep with firm pressure on a knife point or sharp pick.
Soft	Can be grooved or gouged easily with a knife point or pick.
Very Soft	Can be carved with a knife and excavated with a pick point.

WEATHERING: The action of organic and inorganic and chemical and physical processes resulting in alteration of color, texture and composition.

Weathering:

Fresh–FR	No visible sign of alteration, except perhaps slight discoloration on major discontinuity surfaces.
Slight–SL	Discoloration of rock material and discontinuity surfaces.
Moderate–MOD	Less than half the rock material decomposed to soil. Some fresh rock; continuous "framework".
High–HIGH	More than half the rock material decomposed and/or disintegrated to soil. Fresh rock corestones or discontinuous "framework".
Complete–COMP	All rock material disintegrated to soil, but mass still intact.
Residual Soil	All rock material converted to soil. Volume of mass changed, but material has not been significantly transported.

COLOR: Basic colors and combinations: gray, light gray, brown, red–brown.

TEXTURE: Size, shape and arrangements of constituents.

Aphanitic	Individual grains invisible.
Fine–grained	Grains barely visible to the unaided eye, up to 1/16 in. diameter.
Medium–grained	Grains between 1/16 and 3/16 in. diameter
Coarse–grained	Grains between 3/16 and 1/4 in. diameter
Very Coarse–grained	Grains larger than 1/4 in.

LITHOLOGY: Rock classification and modifiers; accepted formation names.

DISCONTINUITIES:

Type	Definition
Joint	A natural fracture along which no displacement has occurred. May occur in parallel groups called sets.
Shear	A natural fracture along which displacement has occurred. Surface may be slickensided or striated.
Fault	A natural fracture along which displacement has occurred. Usually lined with gouge and slickensides.
Shear or Fault Zone	Zone of fractured rock and gouge bordering the displacement plane.

ORIENTATION/ATTITUDE:

Term	Angle (degrees)
Horizontal	0–5
Low Angle	6–35
Moderately Dipping	36–55
High Angle	56–85
Vertical	86–100

SPACING:

Term	Inches
Extremely Close	< 3/4
Very Close	3/4 – 2–1/2
Close	2–1/2 – 8
Moderate	8 – 24
Wide	24 – 80
Very Wide	80 – 20 ft.
Extremely Wide	> 20 ft.

PERSISTENCE/CONTINUITY:

Term	Feet
Very Low	0–3
Low	3–10
Medium	10–40
High	40–80
Very High	> 80

SOLUTION CAVITIES:

Term	Size
Pit	Barely visible – 1/4 in.
Vug	1/4 – 2 in.
Cavity	2 in. – 2 ft.
Cave	> 2 ft.

APERTURE/GAP:

Term	Inches
Very Tight	< 0.004
Tight	0.004 – 0.01
Partly Open	0.01 – 0.02
Open	0.02 – 0.1
Moderately Wide	0.1–0.4
Wide	> 0.4
Very Wide	0.4 – 4.0
Extremely Wide	4.0 – 40
Cavernous	> 40

BEDDING:

Term	Inches	Term
Very thin	< 2.5	Thick
Thin	2.5–8	Very thick
Medium	9–24	Massive

GENERAL NOTES

1. Logs of subsurface explorations depict soil, rock and groundwater conditions only at the locations specified on the dates indicated. Subsurface conditions may vary at other locations and at other times.
2. Water levels noted on the logs were measured at the times and under the conditions indicated. During test borings, these water levels could have been affected by the introduction of water into the borehole, extraction of tools on other procedures and thus may not reflect actual groundwater level at the test boring location. Groundwater level fluctuations may also occur as a result of variations in precipitation, temperature, season, tides, adjacent construction activities and pumping of water supply wells and construction dewatering systems.

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SUBSURFACE EXPLORATION KEY

NOT TO SCALE

FILENAME: EXPLKEY.DWG

APPENDIX A
REFERENCES

A.1 References

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D420-98, "Standard Guide to Site Characterization for Engineering Design and Construction Purposes."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D653-01, " Standard Terminology Relating to Soil, Rock and Contained Fluids."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D1452-80, "Standard Practice for Soil Investigation and Sampling by Auger Borings."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6151-97, "Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D1586-99, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6066-96, "Standard Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D3550-01, "Standard Test Method for Thick Wall, Ring-Lined, Split Barrel Drive Sampling of Soils."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D1587-00, "Standard Practice for Thin-Walled Tube Sampling of Soils."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D2113-99, "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D2488-93, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)."
- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D4220-95, "Standard Practices for Preserving and Transporting Soil Samples."

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5079-90, “Standard Practices for Preserving and Transporting Rock Core Samples.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5092-90, “Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5434-97, “Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock.”

- American Society of Civil Engineers, 1976," Subsurface Investigations for Design and Construction of Foundations of Buildings", Manual and Report on Engineering Practice, No. 56, 61 p.

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5088-90, “Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6286-98, “Standard Guide for Selection of Drilling Methods for Environmental Site Characterization.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6169-98, “Standard Guide for Selection of Soil and Rock Sampling Devices for Environmental Investigations.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D5781-95, “Standard Guide for the Use of Dual-Wall Reverse Circulation Drilling for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D5782-95, “Standard Guide for the Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D5783-95, “Standard Guide for the Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D5784-95, “Standard Guide for the Use of Hollow-Stem Augers for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices.”

- Acker II, W.L., 1974, "Basic Procedures for Soil Sampling and Core Drilling", Acker Drill Co., Inc., Scranton, PA, 246 p.

- Hvorslev, M.J., 1949, "Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes", U.S. Army Engineer Waterways Experiment Station, Vicksburg, MI, 251 p.

- Mohr, H.A., 1948, "Exploration of Soil Conditions and Sampling Operations", Bulletin No. 376, Soil Mechanics Series No. 21, Graduate School of Engineering, Harvard University, Cambridge, MA, 79 p.

- U.S. Department of the Army, 1972, "Soil Sampling", Engineer Manual EM1110-2-1907, U.S. Government Printing Office, Washington, D.C., various pages.

- U.S. Department of the Navy, 1986, "Design Manual, Soil Mechanics, Foundations and Earth Structures", NAVFAC DM7.1, U.S. Government Printing Office, Washington, D.C., pp. 7.1-49 through 7.1-110

APPENDIX B
RELATED HALEY AND ALDRICH PROCEDURES

- OP1002 Drilling Safety
- OP1003 Utility Clearance
- OP2000 Monitoring Field Explorations
- OP2001 Identification & Description of Soils in the Field Using Visual-Manual Methods
- OP2002 Identification & Description of Rock in the Field Using Visual-Manual Methods
- OP2007 Undisturbed, Fixed-Piston Tube Sampling
- OP2010 Borehole Field Permeability Testing
- OP2011 Field Vane Shear Testing
- OP2017 Rock Coring
- OP2020 Groundwater Monitoring (Observation) Well Installation, Development and Abandonment
- OP3000 General Environmental Field Procedures and Protocol
- OP3001 Preservation and Shipment of Environmental Samples
- OP3002 Headspace Screening Procedure
- OP3006 Procedures for Subsurface Soil Sampling for Chemical Analysis

APPENDIX C
FORMS AND EXAMPLES

C.1 Forms

All Haley & Aldrich field forms are maintained on the server at K:\techproc\sop\Forms. The following is a list of current forms available specifically for use in test boring exploration programs.

- Form 2004 Subcontractor Quantities for Test Borings
- Form 2007 Observation Well Installation Form
- Form 2003 Test Boring Daily Report
- Form 2001 Test Boring Report– USCS
- Form 2002 Core Boring Report

C.2 Examples

The following example of a completed test boring log is intended to provide guidance in soil and bedrock logging. This example is presented as a general reference of the standard test boring logging conventions practiced by H&A.

HALEY & ALDRICH

SUBCONTRACTOR QUANTITIES FOR TEST BORINGS

Form #2005

Project	**File No.**
Location	**Date**
Contractor	**Project Manager**

No.	Description	Unit	Quantity
I	**MOBILIZATION/DEMOBILIZATION**		
1	Mob/Demob of Truck rig w/ OSHA-trained crew within 100 miles of contractor yard*	ea	
2	Mob/Demob of Skid rig with OSHA-trained crew within 100 miles of contractor yard*	ea	
3	Mob/Demob of Bomb/ATV rig with OSHA-trained crew within 100 miles of contractor yard*	ea	
4	Mob/Demob of Geoprobe rig w/ OSHA-trained crew within 100 miles of contractor yard*	ea	
II	**DRILLING - FOOTAGE RATE**		
5	3-in. dia. cased overburden drilling (0-100 ft.) with no sampling	lf	
6	cased overburden drilling (0-100 ft.) with standard 5-ft. interval sampling	lf	
7	cased overburden drilling (0-100 ft.) continuous sampling	lf	
8	4-in. dia. cased overburden drilling (0-100 ft.) with no sampling	lf	
9	cased overburden drilling (0-100 ft.) with standard 5-ft. interval sampling	lf	
10	cased overburden drilling (0-100 ft.) continuous sampling	lf	
11	4-¼ in. dia. hollow stem auger overburden drilling (0-100 ft.) with no sampling	lf	
12	hollow stem auger overburden drilling (0-100 ft.) w/ standard 5-ft. interval sampling	lf	
13	hollow stem auger overburden drilling (0-100 ft.) continuous sampling	lf	
14	NX rock core via double-tube core barrel (includes bit wear)	lf	
15	HX rock core via double-tube core barrel (includes bit wear)	lf	
16	Extra split spoon samples (for footage rates only)	ea	
17	3-in. undisturbed tube samples	ea	
18	Standby Time for rig and crew/Decon of equipment	hr	
III	**DRILLING - DAY RATE**		
19	Truck mounted drill rig with OSHA-trained crew	day	
20	Truck mounted drill rig with OSHA-trained crew (overtime rate)	hr	
21	Skid rig with OSHA-trained crew	day	
22	Skid rig with OSHA-trained crew (overtime rate)	hr	
23	Bomb/ATV drill rig with OSHA-trained crew	day	
24	Bomb/ATV drill rig with OSHA-trained crew (overtime rate)	hr	
25	Geoprobe rig with OSHA-trained crew	day	
26	Geoprobe rig with OSHA-trained crew (overtime rate)	hr	
27	NX rock core via double-tube core barrel (includes bit wear for day rates)	lf	
28	HX rock core via double-tube core barrel (includes bit wear for day rates)	lf	
29	Geoprobe push samples liners (4' section)	ea	
IV	**OBSERVATION WELL INSTALLATION**		
30	1-in. dia. piezometer (Sch 40 PVC) installed	lf	
31	2-in. dia. well (Sch 40 PVC) installed (slotted and screened)	lf	
32	4-in. dia. well (Sch 40 PVC) installed (slotted and screened)	lf	
33	Standard 4-in. dia. roadway box	ea	
34	Standard 8-in. dia. roadway box	ea	
35	5 ft. protective guard pipe with padlock (4-in. diameter)	ea	
V	**ADDITIONAL ITEMS**		
36	Utility Clearance	ea	
37	Permits - Determined on a job to job basis	ls	
38	State Police Detail	hr	
39	Laborer	hr	
40	Chain Saw	day	
41	Steam Cleaner with Generator	day	
42	Upgrade Crew Personnel Protection to Level "C"	hr	
43	55 gal. soil/water drum	ea	
44	Borehole Grouting (4-in. diameter)	lf	
45	Sand	bag	
46	Concrete	bag	
47	Cold Patch	bag	
48			
49			
VI	**COMMENTS**		

Driller Signature ______________________ **Date** ________

Geologist Signature ______________________ **Date** ________

WHITE - FIELD SERVICE MANAGER **CANARY** - CONTRACTOR **PINK** - PROJECT MANAGER

OBSERVATION WELL INSTALLATION REPORT

HALEY & ALDRICH

Well No. ______

Boring No. ______

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE INSTALLED	
DRILLER		WATER LEVEL	

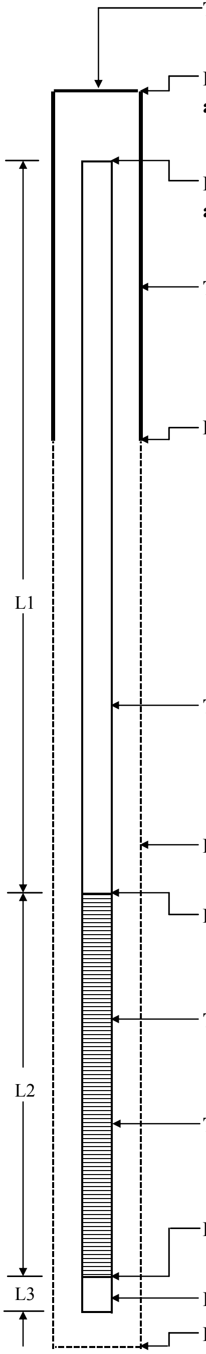
Ground El. ______ ft
El. Datum ______

Location ______

☐ Guard Pipe
☐ Roadway Box

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock ______

Height/Depth of top of guard pipe/roadway box above/below ground surface ______ ft

Height/Depth of top of riser pipe above/below ground surface ______ ft

Type of protective casing: ______
Length ______ ft
Inside Diameter ______ in

Depth of bottom of guard pipe/roadway box ______ ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete		
Bentonite Seal		

Type of riser pipe: ______
Inside diameter of riser pipe ______ in
Type of backfill around riser ______

Diameter of borehole ______ in

Depth to top of well screen ______ ft

Type of screen ______
Screen gauge or size of openings ______ in
Diameter of screen ______ in
Type of backfill around screen ______

Depth of bottom of well screen ______ ft

Bottom of Silt trap ______ ft

Depth of bottom of borehole ______ ft

(Not to Scale)

______ ft + ______ ft + ______ ft = ______ ft
Riser Pay Length (L1) + Length of screen (L2) + Length of silt trap (L3) = Pay length

COMMENTS: ______

Form 2007

TEST BORING DAILY REPORT

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MANAGER	
CLIENT		FIELD REPRESENTATIVE	
CONTRACTOR		DATE	
DRILLER		DFR NUMBER	
TYPE OF RIG(S)		NUMBER OF RIGS	

SUBCONTRACTOR'S TIME ON SITE

Rig Type	Arrived	Left Site	Lunch/Other	Downtime	Standby Time	Total Billable Hours

HALEY & ALDRICH'S TIME ON SITE

Field Representive(s)	Arrived	Left Site	Lunch/Other	Paperwork	Travel Time	Total Billable Hours

WORK PRODUCTION TO DATE

Boring No.	Type of Drilling	Over Burden (lf)	Rock Core (lf)	Obstr. Drilling	Total Footage (lf)	Tubes Samples	Extra Split Spoons*	Misc. (Wells etc.)	Materials Encountered (Type and Depth Range)

STATUS OF TOTAL PRODUCTION

Unsampled	Continuos	Standard	Inside Dia.	Boring Footages					Additional pay Items	Today	Total to Date
				Item	Today	Total to Date	Estimate	% Complete	Observation Wells I.D. (ft)		
									Roadway Boxes (ea)		
				H.S.A.					Guard Pipes (ea)		
				Casing					Steamer and Generator (day)		
				Casing					Grout (lf)		
				Casing					Undisturbed Tube Samples (ea)		
				Uncased					Extra Split Spoons (ea)*		
				Rock Core					55 Gallon Drums (ea)		
				Geoprobe					Police Details (hr)		
									Stand by Time (hr)		

No. of Borings Completed	Remaining	Rig-Days to Date	Remaining

SYMBOLS

B 2-1/2 inch Standard	**A** 4 inch Hollow Stem Auger	**Z** Probes of Soundings	**T** 2 inch Shelby Tube	**Y** Pressure Test
N 3 inch Standard	**W** Water Borings	**C** Rock Core	**V** Vane Shear Test	**S** Observation Well
H 4 inch Standard	**X** Continuous Sampling	**U** 3 inch Piston Tube	**P** Permeability Test	

* Extra split spoon samples are for footage contracts only.

HALEY & ALDRICH

TEST BORING DAILY REPORT

REMARKS

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TEST BORING REPORT

BORING NO.

Page of

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand				Field Test			
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength

NOTES:

FILE NO.

BORING NO.

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

BORING NO.

Page 1 of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation	ft.	Datum	Boring Location				
Item	Casing	Sampler	Core Barrel	Rig Make & Model	Hammer Type	Drilling Mud	Casing Advance
Type				☐ Truck ☐ Tripod ☐ Cat-Head	☐ Safety	☐ Bentonite	Type Method Depth
Inside Diameter (in.)				☐ ATV ☐ Geoprobe ☐ Winch	☐ Doughnut	☐ Polymer	
Hammer Weight (lb.)				☐ Track ☐ Air Track ☐ Roller Bit	☐ Automatic	☐ None	
Hammer Fall (in.)				☐ Skid ☐ ____ ☐ Cutting Head	Drilling Notes:		

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0																	

Water Level Data						Sample ID		Well Diagram	Summary
			Depth in feet to:						
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water	O	Open End Rod	Riser Pipe	
						T	Thin Wall Tube	Screen	Overburden (Linear ft.)
						U	Undisturbed Sample	Filter Sand	Rock Cored (Linear ft.)
						S	Split Spoon Sample	Cuttings	Number of Samples
						G	Geoprobe	Grout	BORING NO.
								Concrete	
								Bentonite Seal	

Field Tests Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

BORING NO.

Page 1 of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft	Datum			Boring Location
Item	Casing	Sampler	Core Barrel	Rig Make & Model
Type				
Inside Diameter (in)				
Hammer Weight (lb)				
Hammer Fall (in)				

Rig: ☐ Truck ☐ ATV ☐ Track ☐ Skid ☐ Tripod ☐ Geoprobe ☐ Air Track ☐ ________ ☐ Cat-Head ☐ Winch ☐ Roller Bit ☐ Cutting Head

Hammer Type: ☐ Safety ☐ Doughnut

Drill Mud: ☐ Bentonite ☐ Polymer ☐ None

Casing: ☐ Driven ☐ Spun

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath-ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks

Water Level Data					
			Depth in feet to:		
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (Linear ft.) ________
Rock Cored (Linear ft.) ________
Number of Samples ________

BORING NO.

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HALEY & ALDRICH

CORE BORING REPORT

BORING NO.

Page of

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weath-ering	Well Diagram	Stratum Change (ft)	Visual Classification and Remarks

FILE NO. BORING NO.

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Form 2002 USCS p.2

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TEST BORING REPORT

BORING NO.	B 7 (OW)
Page	1 of 2

PROJECT	Greenspace Development	H&A FILE NO.	27921-000
LOCATION	18 Riverside Road, Boston Massachusetts	PROJECT MGR.	S.R. Kraemer
CLIENT	Ecologic Investments	FIELD REP.	C.S. Osgood
CONTRACTOR	Guild Drilling Co., Inc.	DATE STARTED	13-Feb-01
DRILLER	Charlie O'Donnel	DATE FINISHED	14-Feb-01

Elevation 23.3 ft. Datum Boston City — Boring Location See sketch on reverse of form.

Item	Casing	Sampler	Core Barrel
Type	NW	S	NV2
Inside Diameter (in.)	3	1.385	2
Hammer Weight (lb.)	300	140	
Hammer Fall (in.)	24	30	

Rig Make & Model: CME 75
- ☑ Truck ☐ Tripod ☑ Cat-Head
- ☐ ATV ☐ Geoprobe ☐ Winch
- ☐ Track ☐ Air Track ☑ Roller Bit
- ☐ Skid ☐ ______ ☐ Cutting Head

Hammer Type: ☑ Safety ☐ Doughnut ☐ Automatic

Drilling Mud: ☑ Bentonite ☐ Polymer ☐ None

Casing Advance — Type Method Depth: NW Driven 29.0 ft.

Drilling Notes: Flushed slurry prior to coring.

Depth (ft.)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Well Diagram	Stratum Change (ft.)	USCS Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0																	
	10		0.0			SP-SM	Medium dense brown poorly graded SAND with silt (SP-SM),				20	70	10				
	12	S1					mps 2 mm, distinctly stratified, fines partially organic, no odor, dry.										
	15	21"															
	20		2.0		2.0		-ALLUVIUM-										
	11		2.0			SP	Dense brown poorly graded SAND (SP), mps 25 mm, no odor, dry.	5	5	20	30	35	5				
	15	S2															
	16	10"															
	17		4.0				-ALLUVIUM-										
					4.5												
5																	
	WOR		5.0				Very soft, dark brown ORGANIC SOILS with sand (OL/OH), trace					25	75	S	M	H	VH
	WOR	S3				OL/OH	seashell fragments and particles, soil mps 0.5 mm, strong										
	WOH	24"					organic odor, moist.										
	WOH		7.0				-ORGANIC DEPOSIT-										
					8.0												
							Note: Drilling fluid returning medium to fine sand from 8.0 ft. to										
							10.0 ft. Drilling fluid color change to yellow red at 8.5 ft.										
							-PROBABLE MARINE DEPOSIT-										
					10.0												
10																	
	3		10.0			CH	Stiff yellow brown fat CLAY (CH), trace fine sand, mps 0.5 mm,						100	N	M	H	
	6	S4					apparently laminated with frequent fine sand partings and										
	6	22"					possible organic fibers, no odor, moist.										
	6		12.0				-MARINE DEPOSIT-										
					13.5												
							Note: Drill action indicates gravel below 13.5 ft.										
15																	
	12		15.0			CL	Very stiff yellow brown to gray sandy lean CLAY with gravel (CL),	5	10	10	10	15	50	S	M	M	
	14	S5					mps 35 mm, distinct disrupted laminae in discrete zones, coarse										
	15	17"					fraction consists of well rounded igneous and igneous and										
	19		17.0				metamorphic lithologies, no odor, moist.										
							-GLACIOMARINE DEPOSIT-										
					18.0												
							Note: Drill action and total loss of drilling fluid indicates gravel										
					19.0		and cobbles from 18.0 ft. to 19.0 ft.										
							Very dense gray silty SAND (SM) , mps 15 mm, very well bonded,										
20																	
	21	S6	20.0			SM	coarse fraction consists partly of platy argillite fragments, no odor, moist.		10	15	20	30	25	R			
	25	10"	21.0		21.0		-GLACIAL TILL-										
	33	S6A	21.0			ML	Very dense gray SILT (ML), mps <0.1 mm, no structure, no odor,						100	R		N	
	34	7"	22.0				dry.										
							-RESIDUAL SOIL-										
							Note: Drilling advanced smoothly from 21.0 ft. to 25.0 ft.										
					25.0		PROBABLE TOP OF DECOMPOSED BEDROCK 25.0 FT.										
25																	
	53		25.0				Very dense gray highly to completely weathered ARGILLITE.										
	28	S7					Possible extremely thin relect bedding subparallel to strong										
	39	5"					low angle foliation. Sample is generally well bonded and consists										
	35		27.0				of very soft angular fragments and particles which are easily										
							crushed with finger pressure.										
							-DECOMPOSED BEDROCK-										
							Note: Drill action indicates stratum change at 28.5 ft.										
					28.5		TOP OF "SOUND" BEDROCK 28.5 FT.										
							SEE SHEET 2 FOR CORE BORING REPORT										
30																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth in feet to: Bottom of Casing	Bottom of Hole	Water
13-Feb-01	15:30	0	29.0	29.0	2.0
14-Feb-01	7:00	15.5	29.0	29.0	6.2
14-Feb-01	15:00	1.0	39.5	39.5	10.4

Sample ID
- O Open End Rod
- T Thin Wall Tube
- U Undisturbed Sample
- S Split Spoon Sample
- G Geoprobe

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (Linear ft.)	29.5
Rock Cored (Linear ft.)	10.0
Number of Samples	S7 C2
BORING NO.	B 7 (OW)

Field Tests Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Meduim H - High V - Very High

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil identifications based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

BORING NO. B 7 (OW)

Page 2 of 2

Depth (ft)	Drilling Rate (min/ft)	Core No. Depth (ft)	Recovery (in)	RQD (%)	Weathering	Stratum Change (ft)	Visual Classification and Remarks
							SEE SHEET 1 TEST BORING REPORT FOR OVERBURDEN DETAILS.
						21.0	TOP OF RESIDUAL SOIL 21.0 FT.
							Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through residual
							soil from 21.0 ft. to 25.0 ft.
					Residual		
					Soil		-RESIDUAL SOIL-
						25.0	TOP OF DECOMPOSED BEDROCK 25.0 FT.
25							
					High		Note: Advanced borehole with rollerbit and splitspoon and drove NW casing through
					to		decomposed bedrock from 25.0 ft. to 28.5 ft.
					Complete		
							-DECOMPOSED BEDROCK-
						28.5	TOP OF "SOUND" BEDROCK 28.5 FT.
							Note: Seated NW casing at 29.0 ft. Advanced borehole with rollerbit to 29.5 ft. without sampling
							prior to coring.
		29.5	56"		Slight		C1: Moderately hard, slightly weathered, gray, aphanitic ARGILLITE. Bedding extremely thin to
30							very thin, generally low angle (30-35 degrees). Foliation low angle, commonly subparallel to
	6						bedding. Cleavage well developed along bedding/foliation planes where coincident.
					Mod.		Cleavage joints very close to close 29.5 -31.0 ft. and close below 32.5 ft. smooth-planar,
	3	C1			High		slightly oxidized, occasionally calcite-infilled, tight. High angle to vertical joints moderately
					Mod.		close, rough-undulatory, pyritized or highly oxidized and decomposed with silt infilling, open.
	5						Soft, moderately to highly weathered zone 31.0-32.5 ft. associated with extremely close,
					Slight		moderately dipping, slickensided-planar shears intersecting bedding plane and high angle features.
	6						Note: Partial water loss below 31.0 ft.
		34.5	24"	40%			Note: Lost core assumed 31.7-32.0 ft.
	6	34.5	60"	100%			C2: Similar to bottom of run C1 except cleavage joints close to moderately close. High angle to
35							vertical joints absent. Occasional thin zone of extremely close, extremely thin, moderately
	7						dipping to high angle (50-60 degrees) calcite stringers. Occasional calcite-healed low angle
							joint.
	6	C2			Slight		-CAMBRIDGE FORMATION-
	6					38.0	
							Lithology change at 38.0 ft. to hard, slightly weathered, dark gray to black, fine grained to
	8						aphanitic DIABASE. Single high angle joint at 38.7 ft. rough-stepped, slightly oxidized, tight.
		39.5	54"	90%			
	8						BOTTOM OF EXPLORATION 39.5 FT.
40							

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FILE NO. 27921-000 **BORING NO.** B 7 (OW)

APPENDIX D
CHECKLISTS

D.1 Test Boring Checklist

D.1.1 Preliminary Preparation

A. Project Briefing
B. Field Project File and Document Assembly
   - Proposal
   - Contract Documents
   - Locus, Site & Utility Plans
   - Exploration Criteria
   - Subcontractor Agreement
   - Site and Project Contacts
   - Forms
     - DFR
     - Subcontractor Quantities
     - Test Boring Report
     - Core Boring Report
     - Observation Well Installation Form
     - Special Testing / Instrumentation Forms
     - COC
     - Equipment Usage and Billing Form
     - Sample Receiving Form
C. H&S Briefing
   - H&S Plan
D. Equipment Request and Assembly

D.1.2 Onsite Duties

- Site Walkover and Subcontractor Utility and Safety Briefing
- Exploration Program Review
  - Exploration Layout
  - Site Conditions Sketch
  - Preliminary Surficial Geologic Map
- Exploration Monitoring
  - Equipment Inventory
  - Exploration Layout & Utility Check
  - Field Logging Soil & Rock
  - Water Level Measurements
  - Production and Budget Quantities
  - Sample Handling & Transport
  - Instrumentation & Testing Records
  - As-Built Sketches & Exploration Locations

D.1.3 Follow Up & Summary

- Proof Logs and Test Reports
- Finalize DFR and Subcontractor Quantities
- Sample Receiving and Disposition
- Equipment Return and Billing
- Exploration Program Summary
- Final Site & Geological Conditions Summary
- Geologic Profiles

OPERATING PROCEDURE: OP2026

EXPLORATORY TEST PITS

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	CSO/ 3-24-03	DMP/ 3-27-03	P.Pope/ 3-27-03	STP/6-1-03	SRK/7-1-03

Total Pages: 27

TABLE OF CONTENTS

LIST OF FIGURES

OPERATING PROCEDURE: OP2026

EXPLORATORY TEST PITS

1. PURPOSE

Exploratory test pits are important sources of subsurface information relating to geologic conditions and site suitability fundamental to environmental site assessment and geotechnical design. The following procedure is an introduction to test pit excavation equipment and techniques and an outline of field staff responsibilities while conducting test pit excavation methods utilized by Haley & Aldrich Inc.

2. EQUIPMENT & SUPPLIES

2.1 Standard Required Equipment

Required		Additional as Required	
1.	Proposal (signed by Client)	20.	First Aid Kit
2.	Site Plan	21.	Cellular Phone
3.	Contract with Subcontractor (pay items)	22.	Health & Safety Plan
4.	Exploration Criteria/Specifications	23.	Respirator & Tyvek Suit
5.	Field Book	24.	Laptop Computer
6.	Clipboard	25.	Camera & Film
7.	Logs & Forms	26.	Field Procedures
8.	Office Supplies (pencils & markers)	27.	Maps and References
9.	Engineer's Scale	28.	Sample Bags & Jars with Labels
10.	6 ft. Ruler	29.	Survey Stakes/Paint/Flagging
11.	100 ft. Measuring Tape	30.	Shovel
12.	Hand Lens, magnifying	31.	Geologist's Pick
13.	Pocket Knife	32.	Flashlight
14.	Hard Hat	33.	Roadway Box Key/Socket Wrench
15.	Safety Glasses	34.	Water Level Indicator
16.	Sound Dampeners	35.	Hand Level
17.	Steel Toe Boots	36.	Brunton Compass
18.	Protective Gloves	37.	Pocket Penetrometer
19.	Rain Gear	38.	Torvane

2.2 Required Environmental Equipment

Test pit excavation programs conducted for environmental purposes will require specific equipment for personal protection, air quality monitoring, headspace screening, sampling, testing and decontamination. A comprehensive list of equipment and materials must be developed for each project in coordination with the Project Manager (PM) and the Health & Safety (H&S) Coordinator prior to the start of the field program.

2.3 Additional Equipment, Specialized Instrumentation, Materials & Company Vehicles

Company-wide, Haley & Aldrich maintains an array of equipment, vehicles and specialized instrumentation for a broad variety of uses in addition to the selected equipment listed above. Additional equipment, vehicles and materials may be rented or purchased as needed with the approval of the project manager. Project equipment needs should be addressed proactively so that interoffice allocation can take place. It is recommended that the field staff familiarize themselves with the use, function and availability of all types of equipment standard to the industry.

2.4 Billing Equipment & Materials

Equipment and materials are billed to the project as used on a daily or per item basis. Completion of equipment usage and billing forms and submission of original receipts for items purchased or rented is required in order to charge the project for reimbursement.

3. PROCEDURE

3.1 Preliminary Preparations

Prior to the beginning of a test pit excavation program field staff must attend a project briefing for the purpose of reviewing the proposal, site and utility plans, contract documents and drawings, applicable regulations, test pit sampling, testing and termination criteria, site restoration, site contacts, phone numbers of team members, and other related documents and references. In addition, certain projects will require the field staff to attend a Health & Safety briefing due to specific occupational safety concerns. The individual nature of these concerns will be addressed by a site specific Health & Safety Plan.

A file folder for the field activities should be created and maintained such that all relevant documents and log forms likely to be useful for the completion of field activities by others are readily available in the event of personnel changes.

3.2 Duties and Responsibilities

3.2.1 General

The principal reason for providing Haley & Aldrich field representation during test pit excavation is to assure that the field data being collected is accurate and of the type necessary to properly evaluate the site geologic conditions for the subsequent engineering analyses and environmental assessment.

3.2.2 Supervision of Test Pit Excavation Programs

Test pit excavation programs are regularly used for surficial geological mapping activities including routine soil identification and sampling. Test pits are particularly useful for delineating overburden thickness in areas of shallow bedrock and for determining the extent of potentially contaminated zones. In addition, test pits may be used to expose existing underground structures for detailed documentation or as a means to establish the soil profile and to excavate to a particular elevation for the purpose of conducting percolation testing.

Proposed test pit locations and depths may be modified throughout the execution of the excavation program as the accumulated geologic data and any test results are interpreted. For this reason it is essential that all records are maintained current and complete and that uncertainties are identified for resolution as they occur. Field staff members are responsible for maintaining communication with the project manager and for logistical coordination of the field effort within the workscope and budgetary limits.

Test pit excavation programs are by nature more destructive than other subsurface exploration methods. H&A field staff should be extremely clear as to the expectations of the client and project manager with regard to site damage and restoration efforts, prior to conducting the test pits.

3.2.3 Verification of Excavation Methods and Services

It is the responsibility of the H&A field staff to verify that test pits and related subsurface sampling and testing methods are in conformance with applicable approved standards and specifications and to document conditions and results. All applicable safety standards must be complied with including establishment of exclusion zones, installation of safety fencing, use of trench boxes, maintenance of proper slopes or benching, and provision of access and egress. The Occupational Safety and Health Administration's (OSHA) Excavation and Trenching standard Title 29 of the Code of Federal Regulation (CFR) Part 1926.650 covers requirements for excavation and trenching standards which may be accessed through their website www.OSHA.gov or from your Health & Safety Administrator. OSHA also provides useful guidance in an easy to read handbook entitled Excavations OSHA 2226 included in Appendix D.

It is the responsibility of the H&A field staff to verify that proper equipment and techniques are employed and to obtain measurements and make observations independently. H&A field staff are responsible for complete field logging of groundwater, soil and bedrock conditions, the maintenance of accurate test records and field exploration location sketches, and ensuring proper sample preservation and handling.

Payment for services rendered on behalf of the client is commonly handled with H&A providing an accurate breakdown of the work activities and itemized costs. Excavation subcontractor pay items and method of payment are defined in their contract. Typically test pits are paid for on an hourly basis with a mobilization fee and a utility clearance fee with additional pay items as needed such as laborers, jack hammers and compressors, chainsaws, surface patching with asphalt or reseeding landscaped areas.

3.2.4 Right of Access

Prior to site entry, Haley & Aldrich staff members must ensure that permission has been gained from the property owner to access the property.

3.2.5 Layout and Utility Clearance

Prior to the start of any subsurface exploration all proposed locations must have utility clearance from all appropriate agencies and utility owners. Utility owners typically do not enter private properties. If there are particular concerns regarding utilities on private property, arrangements can be made with a private utility locating service. Prior to contacting any utility agency or service all proposed exploration locations must first be clearly marked in the field either with white paint or staked and white flagged. Additional colors can be used to highlight the location if the ground is snow covered. Alternate locations should be laid out in areas of suspected utilities. H&A requires the subsurface exploration subcontractor to obtain the utility clearance within the terms of the contract or services agreement. H&A field staff should verify with the driller/test pit contractor that the utilities have been cleared and obtain the clearance number prior to the start of subsurface explorations. Pre-excavation may be necessary in areas of closely spaced utilities either by hand, vacuum, or other means. Additional guidance is provided in OP1003 Utility Clearance.

3.2.6 Site Briefing

At the start of fieldwork H&A field staff should coordinate a site briefing and review the schedule and workscope with all subcontractors involved with the project. This briefing should include a review of the following:

- Excavation requirements including depths, maximum slopes and shoring
- Test pit lay out, criteria and priority
- Testing and sampling specifics
- Pay items
- Site conditions
- Environmental concerns, known or suspected contamination
- H&S information
- Decontamination requirements

- Site restoration and waste disposal issues
- A site walkover and utility check

While it is the subcontractor's responsibility to obtain the utility clearance, the field representative should pay attention to the utility plans as well as surface manifestations of the utilities including, manholes or catch basin grates, and gate or roadway boxes. Distance to overheaad utilities must be verified by the test pit contactor as well.

3.2.7 Test Pit Monitoring

3.2.7.1 General

Test pits are an extremely economical and effective way to rapidly characterize shallow subsurface conditions. Test pits are particularly useful for surficial geologic mapping, determining fill thickness and content, identifying the presence and extent of contamination, contouring shallow bedrock conditions and in determining oversized (cobble and boulder) percentages. Small backhoes with an approximately ¼ cubic yard bucket capacity are capable of excavating test pits up to 12 ft. depth in most materials and can be used with minimal site damage. Larger excavators with an approximately ¾ cubic yard bucket capacity are capable of excavating test pits up to 16 to 20 ft. depth and can be used to construct access for drill rigs on difficult sites. Given sufficient area, excavators can safely enter the excavation and extend the test pit indefinitely. During test pit excavation careful consideration must be given to potential bearing surface disturbance within proposed structures. In addition, care must be taken to minimize other site impacts requiring costly restoration including damage to trees, pavement, curbing, landscaping and utilities.

Haley & Aldrich field staff members are required to become familiar with the technical details and suitability of all excavation equipment and methods as well as with the regulations governing excavation safety. See Figure 1 Hydraulic Excavators and Backhoes.

3.2.7.2 Excavation Safety

Specific regulations and H&A procedures must be consulted for additional details relating to excavation safety. The Occupational Safety and Health Administration's (OSHA) Excavation and Trenching standard Title 29 of the Code of Federal Regulation (CFR) Part 1926.650 covers requirements for excavation and trenching standards which may be accessed through their website www.OSHA.gov or from your Health & Safety Administrator. OSHA also provides useful guidance in an easy to read handbook entitled Excavations OSHA 2226 included in Appendix D. In addition, refer to OP1001 Excavation and Trenching.

3.2.7.3 Logging

Test pit logging standards require thorough documentation and qualification of all natural and man-made materials and structures encountered. This includes detailed descriptions of any fill materials, overburden soils, bedrock, groundwater, contamination and structures encountered including accurate measurements of the depth and extent of each.

Fill materials and overburden soils are described in accordance with OP2001 Identification & Description of Soils in the Field Using Visual-Manual Methods. While the bedrock may not be penetrated to a great extent in a test pit, effort should be made to qualify the competency of the bedrock through excavation rates and to describe the bedrock hardness, type, weathering and fracturing according to OP2002 Identification & Description of Rock in the Field Using Visual-Manual Methods. Accurate distinction and depths of geologic contacts are a primary objective of test pit excavation programs. Stratigraphic contacts between separate geologic units are drawn with a solid line while variations in texture, density, weathering or color occurring within a unit are distinguished with a dashed line.

Groundwater is of fundamental importance to environmental assessment and geotechnical engineering. Careful observation of the points and rates of groundwater inflow within a test pit may help to make the distinction between perched groundwater and the phreatic surface. The seasonal high water level may be discernible through mottling or oxidation. A complete record of observations taken throughout the excavation of a test pit must be maintained.

Meaningful terminology to qualify the degree and extent of each type of contamination found on a particular site may be developed on a site-specific basis in conjunction with the project manager. Criteria may be based upon a combination of obvious physical properties and field testing and instrumentation measurements.

Man-made structures must be documented in detailed scale drawings shown in plan and elevation perspective. Every effort should be made to properly identify the type of structure encountered based upon construction, geometry and any other observation. Distinction between a footing and a grade beam or pile cap can only be made by effectively exposing a sufficient area beneath the structure to make a judgement based upon direct observation of the bearing surface. Qualification must be made wherever possible to document the condition of the structure encountered as well. Notes must be taken to clearly describe such details as the integrity of a buried granite block footing, the degree of decomposition of a poured-concrete foundation wall or the spacing and degree of decay observed in a series of timber piles.

3.2.7.4 Sampling

A. *Bag Samples* – Bulk soil samples are routinely obtained from test pits for the purpose of conducting a number of geotechnical laboratory tests including sieve (gradation), hydrometers, Atterberg limit, unit weight and proctor analysis. It is imperative that a sufficient volume of material is obtained for each sample for the desired test to be performed and for the results to be valid. Generally speaking, a minimum of 50 lbs. of material must be collected for a standard suite of geotechnical tests. ASTM D2488 defines the minimum amount of soil required for identification and description. The minimum amount required is based on the maximum particle size observed in the soil.

Maximum Particle Size		Minimum Specimen Size (estimated in dry weight)		
No. 4	(5 mm)	coarse sand	100 g	(0.25 lb)
3/8 in.	(10 mm)	fine gravel	200 g	(0.5 lb)
¾ in.	(19 mm)	fine gravel	1.0 kg	(2.2 lb)
1.5 in.	(38 mm)	coarse gravel	8.0 kg	(18 lb)
3 in.	(75 mm)	coarse gravel	60.0 kg	(132 lb)

Bulk samples are retained in clean, unused, heavy-duty sample bags that can contain approximately 0.6 cubic feet (5 gallons) or 80 lbs. of soil. Care must be exercised to obtain a representative sample of material. The coarser fraction in the upper portion of a material stockpile tends to roll to the toe or perimeter of the mound, therefore hand excavation into the stockpile some distance is required in order to obtain a truly representative sample. Grab samples are obtained at a discrete point while composites may be obtained from several points or along a linear trend. Sampling may occur within or across stratification. It is critical to the analysis to recognize the inherent bias in the technique prior to the sampling event. All samples must be thoroughly documented in the field prior to transport off site. Bag sample tags must be affixed to the twist-tie with the following information.

- Project Name
- File Number
- Date
- Sampled By
- Exploration No.
- Sample No.
- Depth
- Remarks (sample source, general description, possible tests to assign, project manager to contact)

B. *Jar Samples* – Representative soil samples from each stratigraphic unit are routinely obtained from test pits for quick reference by the project manager. These may be retained in clean, unused, 8 oz. glass jars that have been clearly labeled with the following sample information.

- File Number
- Exploration Number
- Sample Number
- Depth
- Stratigraphic unit or geologic interpretation

Soil samples should be carefully selected and placed in sample jars as nearly intact and undisturbed as possible. Original soil structure, including bonding, foliation and stratification, are critical to the geological interpretation and understanding the engineering properties of soils. Careless handling of samples may destroy soil structure making any geologic interpretation of soils during the review process impossible.

Transportation of samples from the site should be addressed by the project manager in advance of the sampling. Commonly samples will be taken at the site by H&A field staff and entered into the sample receiving storage and tracking database. Company owned vehicles may be scheduled for periodic pick-up of contaminated samples or on projects with particularly large sample volume requirements or difficult site access.

3.2.7.5 Percolation Testing

Many state and local agencies require percolation testing to be performed at shallow depths in naturally deposited, undisturbed soils on sites in order to determine infiltration and recharge rates for construction dewatering or for septic system design. Test pits are routinely used to quickly categorize soils for potential siting of such systems by providing broad and easy access to soils at a range of depths for description, percolation testing and determination of the depth to groundwater. Complete details for the performance of percolation testing are found in OP2027 Field Percolation Testing.

3.2.7.6 Restoration

Test pit excavation programs are by nature more destructive than other subsurface exploration methods. H&A field staff should be extremely clear as to the expectations of the client and project manager with regard to site damage and restoration efforts. Typically on undeveloped sites the test pit may be accessed with a minimum of damage to the ground surface and surrounding vegetation and the test pit can be backfilled upon completion with a degree of care to ensure that a relatively smooth surface remains. Limited clearing using a chainsaw is preferable to the vegetation damage resulting from attempting to overrun or sweep vegetation with the excavation equipment. The degree of destruction increases proportionally with the size of the excavation equipment selected, the number of oversized components or obstructions encountered as well as with the ultimate dimension and depth of the excavation. Landscaped areas may incur widespread damage in traveled zones in addition to the actual areas of excavation. Use of plywood to “raft” the excavation equipment over short distances may not be successful especially during wet conditions and hand grading, raking and reseeding is typically necessary to restore the landscaping. Paved areas should be pre-cut with saws or a jackhammer prior to excavation after which, they should be backfilled and compacted in lifts that have had oversized components segregated and removed. Later a paving crew can place and compact hot-mix asphalt to complete the restoration. Restoration efforts commonly exceed the excavation efforts in time and cost.

3.2.7.7 Environmental Sampling and Monitoring

Environmental sampling combined with discrete field screening of soil for contaminants is routinely conducted during the performance of test pit explorations. In addition, continuous monitoring of air quality within the work zone or at the project site may be required to address H&S concerns. Potential contaminants and sources may be identified in the initial stage of project planning and prior arrangements made for PPE, monitoring, sampling and laboratory analysis.

To minimize the risk of cross-contamination typical environmental sampling programs work from known or suspected clean areas toward areas of known or suspected contamination. Contamination encountered unexpectedly may present serious exposure risks to field personnel without proper PPE and monitoring instrumentation, particularly if the contamination is gross or unidentified. In the event unexpected contamination is encountered, all fieldwork should be suspended and the area evacuated immediately until the Project Manager and the Health & Safety Coordinator can be contacted so that H&S and sampling guidelines can be developed.

A. *Decontamination Procedures and Waste Management* - Standard equipment decontamination practices may include the establishment of a decontamination area such that decontamination fluids are collected and properly stored for disposal. Typically a location within the site is chosen away from sensitive or occupied zones and a decontamination pad is created within a bermed area using polyethylene sheeting. A high-pressure steam cleaner is used to wash all equipment prior to each exploration and wastewater is pumped into adjacent drums. Excavation and hand sampling tools are scrubbed between samples at the exploration location using a detergent (water and alconox) solution rinsed with control (tap) water followed by a solvent (methanol) rinse, wiped with a paper towel and rinsed with deionized water before being allowed to air dry. Hexane may be needed for removal of heavy petroleum, grease and coal tar. Decontamination waste, sample residue and excess excavation spoils are typically drummed, labeled and staged onsite for proper disposal.

B. *Environmental Soil Sampling* - Environmental soil samples obtained for chemical analyses are collected in test pits with special attention given to the rationale behind determining the precise zone to sample, the specifics of the method of soil extraction and the requisite decontamination procedures. Preservation, handling and glassware for environmental soil samples varies considerably depending upon several factors including the type and degree of contamination, the analytical method to be conducted, the analytical laboratory being used and the governing regulations. In addition, the depth and location of samples may be strictly controlled under agency guidelines. Documentation of volatile organic compounds (VOC) in the soil through headspace screening is required in order to provide real-time guidance in the field to direct the sampling. Clean 8 oz. jars are partially filled with newly obtained soils and covered with aluminum foil and allowed to stabilized prior to screening with a photoionization detector (PID). The presence of metals in soils is not associated with odors, while coal tar, fuels and solvents are often easily distinguished. Particular attention is given to discoloration or odors noted, however, it is company policy to avoid fumes and odors at all times. Soils collected from a discrete zone should be homogenized and a representative portion placed into laboratory glassware and labeled. Analytical samples are kept in a cooler with ice blocks and a Chain of Custody form is maintained until transfer to the analytical laboratory. Applicable environmental sampling protocols must be followed as given in OP3000 General Environmental Field Procedures and Protocol, OP3001 Preservation and Shipment of Environmental Samples, OP3002 Headspace Screening Procedure, OP3003 Surficial Soil Sampling, OP3004 Stream Sediment and Wetland Soils Sampling, OP3005 Field Procedure for Logging MGP Residuals, and OP3006 Procedures for Subsurface Soil Sampling for Chemical Analysis.

C. *Environmental Water Sampling* – Sampling of groundwater encountered in test pits is not a recommended practice due to a variety of potential impacts resulting from the excavation equipment and activity. Visual or olfactory evidence of groundwater contamination should be carefully detailed in order to help direct potential subsequent groundwater sampling through acceptable means.

3.2.7.8 Documentation

Thorough field documentation is the primary responsibility of H&A field staff throughout the execution of any test pit program. Site conditions, soil and rock logging, sample identification and tracking, test and data collection, sketches, photographs, pay item quantities, events, personnel onsite, incidents, discussions and issues must be recorded in the appropriate manner in order to comply with contractual agreements, regulatory requirements and recommended loss prevention practices.

All field documentation must be duplicated, photocopied or reproduced as soon as is practical in order to guard against loss. In no case should originals be mailed, transferred or removed from the author's custody until a back up copy is made. Copies of field documentation should be delivered to the project manager in a timely fashion as the project warrants. Originals may be issued to word processing or data entry personnel directly upon completion of a short term test pit program or periodically throughout longer term projects.

Documentation related to environmental sampling, testing and chemical analysis is covered in detail in specific procedures developed for the particular sampling practice, medium, compound and applicable regulations.

A. *Field Book* - The field book is a first line repository of anything observed or discussed onsite without regard to potential use or merit. While the type of information in the field book may in some cases be informal or general in nature, the field book is a legal document and is the property of H&A. Long after a project is completed and the file is closed the field notes may provide an invaluable record of details that may not have been recorded elsewhere. The standard format of the daily field book entry typically includes the following:

- File Number
- Project & Location
- Date
- Weather
- Personnel Onsite
- Equipment Onsite
- Activities
- Observations
- Conversations
- Data
- Issues
- Incidents
- Other items not recorded elsewhere

B. *Photographs* - Photographic documentation of site conditions, activities and incidents are very useful for conveying a visual perspective to what may be difficult to describe otherwise. The fundamentals of good photography must be applied for the images to be of use including:

- Lighting (adequate but not excessive)
- Composition (frame the subject properly)
- Perspective (include a scale)

In addition, subject identification within the photograph by means of a white board and use of the camera date/time feature (if so equipped) renders ease to later captioning as does indicating on a site plan during shooting the approximate location and direction of the shot by frame number.

C. *Test Pit Logs* - Test pit logs must be completed entirely and without omission to stand alone as documentation of the subsurface conditions at a given point. (See Form 2006 Test Pit Logs.) To guard against loss, test pit logs should be proofed in the field and photocopied or faxed as soon as is practical. Protocols for electronic logging using a PDA or laptop computer require periodic file back-up and memory card replacement as well as daily transmission to the H&A server.

Each test pit log contains a header to identify the project, client and test pit designation and to document the test pit location, the ground surface elevation, contractor and equipment used, H&A Project Manager, Field Representative, date, weather conditions and groundwater entry. Within the body of the test pit log each sampling event is recorded in a column by including sample type, designation and depth. Separate columns are used for USCS group symbol and the USCS identification and description. A column for indicating PID (photoionization detector) readings is included in the Environmental Test Pit Log. In the test pit log footer standing groundwater observations noted during the execution of the excavation are carefully recorded in relation to the excavation activity in order to assist in the interpretation of the reading. Boulder counts and test pit dimensions are also recorded in the footer. Guidelines for overburden logging are detailed in OP2001 Identification & Description of Soils in the Field Using Visual-Manual Methods.

D. *Special Testing and Instrumentation* - Forms for documenting specific field sampling procedures, special testing and instrumentation installations are available for use as appropriate. A complete index of forms may be accessed at K:\techproc\sop\Forms\Form Number Index.xls. In addition, new forms may be created as the need arises from a template located within the same directory. Specific guidelines for documenting special testing and instrumentation installations may be given within established procedures. In the absence of documentation standards for a particular procedure the general standards of scope, precision, accuracy and completeness from related procedures should be referred to until specific guidelines are developed.

E. *Subcontractor Quantities for Test Pits* - Test pit pay items are recorded on Form 2004 Subcontractor Quantities for Test Pits which is used to summarize the pay item totals as defined in the contract or agreement with the subcontractor. This form must be reviewed and signed by the subcontractor's representative upon completion of the subsurface exploration program. Carbon copies are distributed to the subcontractor's representative, the project file and the Field Services Manager.

F. *As-Built Test Pit Locations and Elevations* - An accurate sketch showing the actual (as-built) location of completed test pits must accompany the test pit logs. In addition, the estimated elevation of the ground surface or excavation reference elevation must also be included. Locations and elevations should be measured with 0.1 ft. precision from known or permanent features whenever possible, however, establishment of a temporary baseline and/or series of benchmarks may be necessary in open or virgin sites. An existing site plan with location and elevation data may have been provided for use during the test pit program. In such cases the scale and elevation datum should be verified and the accuracy of the horizontal and vertical data should be checked. All excavation and field references should be painted or staked in the field as appropriate for future field survey.

G. *Geologic Profiles* - Simple geologic columns of individual excavations may be quickly sketched in the field and combined as needed in order to produce a two-dimensional stratigraphic cross-section or geologic profile. This exercise may be useful in the development and support of the geologic interpretation of the stratigraphy and in the identification of data gaps during the test pit program.

3.2.7.9 Final Review and Summary

The final complete package of field data must include copies of all first draft field logs, test reports, raw data, field book entries, photographs, plans and sketches, daily field reports, subcontractor quantities and any additional notes. All field data must be reviewed for discrepancies, errors and omissions as well as for the identification of factors of critical importance and any areas of uncertainty.

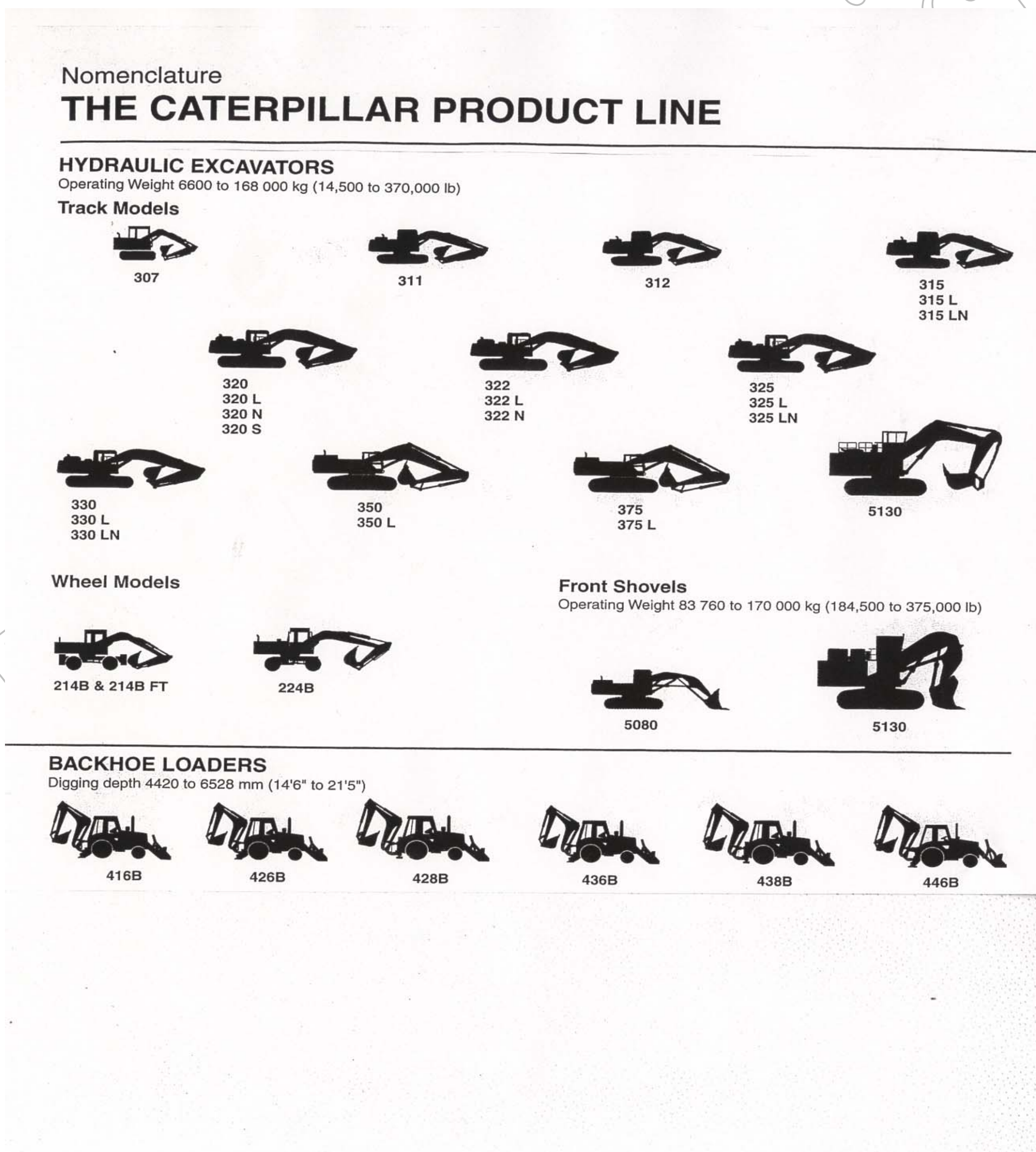
In addition to the field generated data, all relevant research, correspondence, contracts, drawings, test pit rationale and criteria, sample receiving forms, environmental regulations and health and safety protocols assembled for the test pit program should be included in the final package to the file.

A summary of the test pit program should be prepared including the subcontractor and equipment, dates of execution, the total number of excavations, sampling types and quantities, excavation depths, stratigraphy and depth to bedrock.

The site features and geologic conditions should be described incorporating the synthesized data from the test pit program and all available published literature or research. The geologic summary should present the reasoning behind the interpretation and any supporting documentation including geologic profiles developed for the site and related references.

FIGURES

Figure 1 - Hydraulic Excavators and Backhoes



APPENDIX A
REFERENCES

A.1 References

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D420-98, “Standard Guide to Site Characterization for Engineering Design and Construction Purposes.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D653-01, “Standard Terminology Relating to Soil, Rock and Contained Fluids.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D2488-93, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D4220-95, “Standard Practices for Preserving and Transporting Soil Samples.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5434-97, “Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock.”

- American Society of Civil Engineers, 1976," Subsurface Investigations for Design and Construction of Foundations of Buildings", Manual and Report on Engineering Practice, No. 56, 61 p.

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5088-90, “Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5730-98, “Standard Guide for Site Characteristics for Environmental Purposes with Emphasis on Soil, Rock, the Vadose Zone and Ground Water.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.09, D6169-98, “Standard Guide for Selection of Soil and Rock Sampling Devices for Environmental Investigations.”

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.11.04, E1527-00, “Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.”

A.2 Related Haley & Aldrich Field Procedures

- OP1001 Excavation and Trenching Safety
- OP1003 Utility Clearance
- OP2001 Identification & Description of Soils in the Field Using Visual-Manual Methods
- OP2002 Identification & Description of Rock in the Field Using Visual-Manual Methods
- OP2003 Surficial Geologic Mapping
- OP2027 Field Percolation Testing
- OP3000 General Environmental Field Procedures and Protocol
- OP3001 Preservation and Shipment of Environmental Samples
- OP3002 Headspace Screening Procedure
- OP3003 Surficial Soil Sampling
- OP3004 Stream Sediment and Wetland Soils Sampling
- OP3005 Field Procedure for Logging MGP Residuals
- OP3006 Procedures for Subsurface Soil Sampling for Chemical Analysis

APPENDIX B
FORMS AND EXAMPLES

B.1 Forms

All Haley & Aldrich field forms are maintained on the server at K:\techproc\sop\Forms. The following is a list of current forms available specifically for use in test pit exploration programs.

- Form 2004 Subcontractor Quantities for Test Pits
- Form 2006 Test Pit Logs

B.2 Examples

The following examples of completed test pit logs are presented as a general reference of the standard test pit logging conventions practiced by H&A.

HALEY & ALDRICH

SUBCONTRACTOR QUANTITIES FOR TEST BORINGS

Form #2005

Project	**File No.**
Location	**Date**
Contractor	**Project Manager**

No.	Description	Unit	Quantity
I	**MOBILIZATION/DEMOBILIZATION**		
1	Mob/Demob of Truck rig w/ OSHA-trained crew within 100 miles of contractor yard*	ea	
2	Mob/Demob of Skid rig with OSHA-trained crew within 100 miles of contractor yard*	ea	
3	Mob/Demob of Bomb/ATV rig with OSHA-trained crew within 100 miles of contractor yard*	ea	
4	Mob/Demob of Geoprobe rig w/ OSHA-trained crew within 100 miles of contractor yard*	ea	
II	**DRILLING - FOOTAGE RATE**		
5	3-in. dia. cased overburden drilling (0-100 ft.) with no sampling	lf	
6	cased overburden drilling (0-100 ft.) with standard 5-ft. interval sampling	lf	
7	cased overburden drilling (0-100 ft.) continuous sampling	lf	
8	4-in. dia. cased overburden drilling (0-100 ft.) with no sampling	lf	
9	cased overburden drilling (0-100 ft.) with standard 5-ft. interval sampling	lf	
10	cased overburden drilling (0-100 ft.) continuous sampling	lf	
11	4-¼ in. dia. hollow stem auger overburden drilling (0-100 ft.) with no sampling	lf	
12	hollow stem auger overburden drilling (0-100 ft.) w/ standard 5-ft. interval sampling	lf	
13	hollow stem auger overburden drilling (0-100 ft.) continuous sampling	lf	
14	NX rock core via double-tube core barrel (includes bit wear)	lf	
15	HX rock core via double-tube core barrel (includes bit wear)	lf	
16	Extra split spoon samples (for footage rates only)	ea	
17	3-in. undisturbed tube samples	ea	
18	Standby Time for rig and crew/Decon of equipment	hr	
III	**DRILLING - DAY RATE**		
19	Truck mounted drill rig with OSHA-trained crew	day	
20	Truck mounted drill rig with OSHA-trained crew (overtime rate)	hr	
21	Skid rig with OSHA-trained crew	day	
22	Skid rig with OSHA-trained crew (overtime rate)	hr	
23	Bomb/ATV drill rig with OSHA-trained crew	day	
24	Bomb/ATV drill rig with OSHA-trained crew (overtime rate)	hr	
25	Geoprobe rig with OSHA-trained crew	day	
26	Geoprobe rig with OSHA-trained crew (overtime rate)	hr	
27	NX rock core via double-tube core barrel (includes bit wear for day rates)	lf	
28	HX rock core via double-tube core barrel (includes bit wear for day rates)	lf	
29	Geoprobe push samples liners (4' section)	ea	
IV	**OBSERVATION WELL INSTALLATION**		
30	1-in. dia. piezometer (Sch 40 PVC) installed	lf	
31	2-in. dia. well (Sch 40 PVC) installed (slotted and screened)	lf	
32	4-in. dia. well (Sch 40 PVC) installed (slotted and screened)	lf	
33	Standard 4-in. dia. roadway box	ea	
34	Standard 8-in. dia. roadway box	ea	
35	5 ft. protective guard pipe with padlock (4-in. diameter)	ea	
V	**ADDITIONAL ITEMS**		
36	Utility Clearance	ea	
37	Permits - Determined on a job to job basis	ls	
38	State Police Detail	hr	
39	Laborer	hr	
40	Chain Saw	day	
41	Steam Cleaner with Generator	day	
42	Upgrade Crew Personnel Protection to Level "C"	hr	
43	55 gal. soil/water drum	ea	
44	Borehole Grouting (4-in. diameter)	lf	
45	Sand	bag	
46	Concrete	bag	
47	Cold Patch	bag	
48			
49			
VI	**COMMENTS**		

Driller Signature ______________________ **Date** ________

Geologist Signature ______________________ **Date** ________

WHITE - FIELD SERVICE MANAGER **CANARY** - CONTRACTOR **PINK** - PROJECT MANAGER

HALEY & ALDRICH

TEST PIT LOG

Test Pit No.

Page 1 of

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	
EQUIPMENT		WEATHER	

Ground El. ft.
El. Datum

Location

Groundwater depths/entry rates (in./min.):

Depth (ft.)	Sample ID	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength

Obstructions:

Remarks:

Field Tests	
Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:
at depth ft.
measured after hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24		=	
over 24		=	

Test Pit Dimensions (ft.):
Pit Depth
Pit Length X Width

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

J:\forms\final\Frm 3708

HALEY & ALDRICH

ENVIRONMENTAL TEST PIT LOG

Test Pit No.

Page ___ of ___

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	
EQUIPMENT		WEATHER	

Ground El. ___ ft. Location ___ Groundwater depths/entry rates (in./min.):

El. Datum ___

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (Color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel		Sand				Field Test			
						% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength

Obstructions:

Remarks:

Bucket Decontamination Method:

Field Tests	
Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:

at depth ___ ft.

measured after ___ hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24		=	
over 24		=	

Test Pit Dimensions (ft.):

Pit Depth ___

Pit Length X Width ___

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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HALEY & ALDRICH

TEST PIT LOG

Test Pit No.	TP-1
Page	1 of 1

PROJECT	New England Hospital	**H&A FILE NO.**	10715-205
LOCATION	Boston, Massachusetts	**PROJECT MGR.**	M.X. Haley
CLIENT	PFT Associates	**FIELD REP**	C. S. Osgood
CONTRACTOR	J. Marchese & Sons Const.	**DATE**	07-Jan-02
EQUIPMENT	CAT 416 Rubber Tire Extendahoe 0.24 cu.yd. bucket capacity	**WEATHER**	Mostly Clear 20s

Ground El.	36.3 ft.	**Location**	West of Pedestrian Tunnel
El. Datum	NGVD	**Groundwater depths/entry rates (in./min.):**	7.8 ft. Steadily

Depth (ft.)	Sample ID	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (density/consistency, color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				Dark brown silty SAND (SM), mps 5 mm, organic odor, moist.		5	5	10	45	40	R			
	0.5		SM	Fines largely organic.										
				-LOAM FILL-										
		1.3												
2	S3			Yellow brown to olive brown sandy fat CLAY (CH), trace roots, clinker fragments,	5	5	5	10	15	60	N	M	H	
			CH	cinder particles and fragments, clay pipe fragments, metal wire, asphalt fragments.										
				10% cobbles, <5% boulders, mps 30 in., no odor, moist.										
				-FILL-										
4	4.0			Note: Poured concrete foundation wall on east side of test pit from 0.0 -4.4 ft.										
	4.0													
				Note: Poured concrete foooting 4.4-5.4 ft.										
6	S2													
8	8.0	8.0												
	8.0			Yellow brown fat CLAY (CH), trace fine sand. mps 0.5 mm, no odor, dry.					5	95	N	M	H	
	S1		CH	Appartantly laminated with frequent fine sand partings and possible organic fibers.										
	9.0			-MARINE DEPOSIT-										
10														
		11.0												
				Yellow brown to gray sandy lean CLAY (CL) with gravel. mps 35 mm,	5	10	10	10	15	50	S	M	L	
			CL	Distinct disrupted laminae in discrete zones. Coarse fraction consists of well-rounded										
				igneous and metemorphic lithologies.										
12	12.0	12.0		-GLACIOMARINE DEPOSIT-										
				Note: Possible stratum change to gray lean CLAY with sand (CL) below 12.0 ft.										
				Coarse fraction apparantly less abundent.										
				-MARINE DEPOSIT-										
				BOTTOM OF EXPLORATION 13.5 FT.										
14														

Obstructions:

Remarks:
Note: Bag samples S1-S3 obtained for potential mechanical analysis from depths indicated.

Field Tests	
Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:

at depth	13.2	ft.
measured after	0.1	hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	1	=	1.8
over 24	1	=	8.2

Test Pit Dimensions (ft.):

Pit Depth	13.5
Pit Length X Width	9.0 x 6.0

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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Form #3008

HALEY & ALDRICH

ENVIRONMENTAL TEST PIT LOG

Test Pit No. **TP 214**

PROJECT	Mirror Lake Watershed Study	**H&A FILE NO.**	28675-309
LOCATION	Essex, Massachusetts	**PROJECT MGR.**	D.H. Gevalt
CLIENT	Citizens Advisory Partnership	**FIELD REP**	C.S. Osgood
CONTRACTOR	Stanley Lynde Const. Co., Inc.	**DATE**	19-Jul-02
EQUIPMENT	Case 580 rubber tire backhoe - 1/4 cu. yd. bucket	**WEATHER**	Thunderstorms 90's

Ground El. 74.5 ft.	**Location**	N 2,089,041.101	**Groundwater depths/entry rates (in./min.):**	
El. Datum NGVD		E 801,444.238	None	

Depth (ft.)	Sample ID	PID Reading (ppm.)	Stratum Change Depth (ft.)	USCS Symbol	Visual Identification (density/consistency, color, GROUP NAME & SYMBOL, % oversized, maximum particle size, structure, odor, moisture, optional descriptions,	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
					Note: Ground surface strewn with boulders. Numerous depressions indicating										
					subsurface voids noted.										
	1.5				15% coarse to fine sand, 15% cinder fragments and particles, 10% unidentifiable, white										
					ash-like material, 10% fines (largely organic), 10% coarse to fine gravel, 10% wood										
2					(manufactured and treated), 5% glass fragments, 5% metal strips and wire, 5% charcoal										
	S2	15.9			5% plastic sheeting (possibly polyethelene bags), 5% brick particles, 5% clay pipe										
					fragments. Matrix generally dark brown to gray in color with pockets of white and red.										
					15% boulders, 15 % cobbles. Maximum particle size 36 inches.										
	2.5				Distinct decomposed gasoline odor, possible faint napthalene odor. Visible irridescent										
					sheen on moist solids 4.6 to 5.2 ft.										
					-FILL-										
4															
	4.6														
	S1	140			Note: Bedrock surface smooth and flat, consisting of very hard to hard, slightly										
	5.2		5.2		weathered, light gray to pink, coarse to fine grained granite. Single high angle joint noted.										
					REFUSAL ON BEDROCK 5.2 FT.										
6															
8															

Obstructions:

Remarks:
Note: Sample S1 submitted for laboratory chemical analysis.
Note: Field monitoring of breathing zone and headspace screening conducted using an hNU 11.7 ev. PID.

Bucket Decontamination Method: Steam cleaned

Field Tests

Dilatancy:	R - Rapid S - Slow N- None
Toughness:	L - Low M - Medium H - High
Plasticity:	N - Nonplastic L - Low M - Medium H - High
Dry Strength:	N - None L - Low M - Medium H - High V - Very High

Standing water in completed pit:

at depth	NE	ft.
measured after	0.75	hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	6.0	=	18.0
over 24	1.0	=	33.0

Test Pit Dimensions (ft.):

Pit Depth	5.2
Pit Length X Width	10.5 x 4.3

NOTE: Soil identifications based on visual/manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

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Form #3008

APPENDIX C
CHECKLISTS

C.1 Test Pit Checklist

C.1.1 Preliminary Preparation

A. Project Briefing
B. Field Project File and Document Assembly
   - Proposal
   - Contract Documents
   - Locus, Site & Utility Plans
   - Exploration Criteria
   - Subcontractor Agreement
   - Site and Project Contacts
   - Forms
     - Subcontractor Quantities
     - Test Pit Log
     - Special Testing / Instrumentation Forms
     - COC
     - Equipment Usage and Billing Form
     - Sample Receiving Form
C. H&S Briefing
   - H&S Plan
D. Equipment Request and Assembly

C.1.2 Onsite Duties

- Site Walkover and Subcontractor Utility and Safety Briefing
- Exploration Program Review
  - Exploration Layout
  - Site Conditions Sketch
  - Preliminary Surficial Geologic Map
- Exploration Monitoring
  - Equipment Inventory
  - Exploration Layout & Utility Check
  - Field Logging
  - Water Level Measurements
  - Sample Handling & Transport
  - Instrumentation & Testing Records
  - As-Built Sketches & Exploration Locations
  - Production and Budget Quantities

C.1.3 Follow Up & Summary

- Proof Logs and Test Reports
- Finalize Subcontractor Quantities
- Sample Receiving and Disposition
- Equipment Return and Billing
- Exploration Program Summary
- Final Site & Geological Conditions Summary
- Geologic Maps & Profiles

APPENDIX D
OSHA HANDBOOK 2226 – EXCAVATIONS

OPERATING PROCEDURE: OP3001

PRESERVATION AND SHIPMENT OF ENVIRONMENTAL SAMPLES

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver 0.0	AKM/6-03	KLR/6-03			JAK/ September 2003

Total Pages: 17

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OPERATING PROCEDURE: OP3001

PRESERVATION AND SHIPMENT OF ENVIRONMENTAL SAMPLES

1. PURPOSE

This operating procedure (OP) has been established to maintain consistency in preservation and shipment of environmental samples to protect the integrity of the samples prior to analysis. This OP may be modified to suit the needs of an individual site and to comply with specific regulatory programs (i.e. state, CERCLA, RCRA).

The objectives of this OP are to maintain the physical form and chemical composition of the sample and to prevent changes in contaminant concentration. To meet these objectives, there must be a measure of control over all sample handling procedures beginning with sample container cleaning procedures and ending with laboratory analysis. This OP deals with the first half of the control process: the procedures leading up to and ending with sample packaging and transport to the laboratory. The information provided herein will make it possible to choose the minimum number of sample handling and preservation practices necessary to ensure the integrity of a sample designated for analysis.

Refer to OP3000 for General Environmental Field Procedures and Protocol, including procedures for decontamination of sampling equipment and/or containers. Refer to OP3026 for Operating Procedures on completing a Chain of Custody.

2. EQUIPMENT & SUPPLIES

- Prepackaged or decontaminated sampling device
- Laboratory supplied sample containers
- Preservatives, as applicable
- Disposable gloves
- Litmus/pH paper, as applicable
- Labels
- Permanent/indelible marker
- Cooler
- Ice
- Bubble wrap
- Packing tape
- Chain of Custody

3. PROCEDURE

There are four basic steps necessary to obtain meaningful analytical data: preparation of the sample container, sampling, sample preservation, and analysis. The amount of sample to be collected, and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest. In order to obtain meaningful analytical data, sample preservation techniques must be effective from the time of sample collection to the time of analysis.

3.1 Selection of Sampling Parameters

The selection of sampling parameters is dependent on the specific work objectives for a Site. When choosing preservatives for your sampling and analysis program, verify that the preservatives or lab techniques used do not contain chemicals that are also constituents of concern at the Site.

In addition, it is important to recognize acetone, as a high purity solvent rinse in sampling equipment decontamination procedures, is included as an analyte on the Target Compound List (TCL) and SW-846, but not on the Priority Pollutant List (PPL).

3.2 Sampling Equipment and Container Selection

Proper selection of sampling equipment and containers for sample collection is an important means of protecting the integrity of the sample. When selecting sampling equipment and containers, verify that the materials that come into direct contact with the sample are compatible with the chemical or physical properties of the contaminant(s) of concern. The type of sample containers to be used in a sampling event should be determined during sampling event planning and documented in the sampling and analysis plan.

As a general rule when obtaining soil samples using core barrel samplers, samples obtained for semivolatile organic compound (SVOC) analysis can be obtained within a core barrel or core barrel liner that is composed of stainless steel, steel, or brass. When only inorganic constituents are of concern, a plastic core barrel liner would be more appropriate. All of these materials are suitable for volatile organic compounds (VOCs) as long as the contact time is minimized. Often all of the above samples (SVOCs, inorganic, and VOCs) are obtained from a single soil core. In this situation, soils should be taken from the interior of the soil core to avoid potential interferences between the contaminants of concern and the surface of the core barrel that is in direct contact with the sample.

For sediment sampling, the analytical sediment sample is arbitrarily defined as that which passes a 10-mesh (approximately 2-mm openings) sieve. The purpose of this is to provide a basis for discrimination of sediment and foreign objects or materials. Stainless steel or nylon sieves may be used when inorganic constituents are to be determined. (For inorganic analyses, stainless steel sieves are acceptable provided the mesh is not soldered or welded to the frame.) Stainless steel or brass sieves are suitable for use when organic substances are to be determined. (For organic analyses, organic materials such as rubber or plastics should not be used in the storage or handling of samples.)

For water sampling, specifications on container design, including shape, volume, gas tightness, materials of construction, and use of cap liners, are defined for specific parameters or suites of parameters (for example, amber glass containers protect photosensitive analytes, such as polychlorinated biphenyls (PCBs) from chemical alteration). Specifications for sample container selection are documented in parameter-specific analytical methods (for example, ASTM, U.S. EPA SW846, AWWA Standard Methods) as well as in Federal (40 CFR Part 136), state, and local regulatory guidelines on groundwater sample collection and preservation. Table 1 provides examples of common container materials, colors and volumes.

3.2.1 Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because the potential exists for contaminants to adsorb to the surface of the plastic or for the plasticizers to leach into the sample.

In some instances, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass. Because some metals species will adhere to the sides of glass containers in an aqueous matrix, plastic bottles must be used for samples collected for metals analysis. In the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compound creating adsorptive sites on the container surface.

3.2.2 Volume of the Container

The volume of sample to be collected will be dictated by the analytical method and the sample matrix. The laboratory must supply bottles of sufficient volume to perform the required analysis. Table 1 indicates the container volumes required for the various parameters. In most cases, the methodology dictates the volume of sample material required to complete the analysis. However, individual labs may provide larger volume containers for various analytes to ensure sufficient quantities for replicates or other quality control checks.

3.2.3 Color of Container

Whenever possible, amber glass containers should be used to prevent photodegeneration of the sample, except when samples are being collected for metals analysis. If amber containers are not available, containers holding samples should be protected from light. However, 40-milliliter (ml) clear glass vials are often provided by laboratories for aqueous VOC analysis and are acceptable for use.

3.2.4 Container Closures

Container closures should form a leak-proof seal (i.e., screw caps or ground glass stoppers). Closures must be constructed of a material which is inert with respect to the sampled material, such as Polytetrafluoroethylene (PTFE) (e.g., Teflon®). Alternately, the closure may be separated from the sample by a closure liner that is inert to the sample material such as PTFE liner or septum.

3.2.5 Decontamination of Sample Containers

Sample containers must be laboratory cleaned, preferably by the laboratory performing the analysis. The cleaning procedure is dictated by the specific analysis to be performed on the sample.

When sampling for organic compounds, if your sample containers are not provided by the analytical laboratory, care should be taken to ensure that the containers are properly cleaned and prepared. Refer to ASTM Standard D3694-96 *Standard Practices for Preparation of Sample Containers and for Preservation of Organic Constituents* for guidance.

After the sample containers are cleaned, they can be pre-preserved or preserved in the field. Information on sample preservation is given in Section 3.4. Sample containers provided by a commercial analytical laboratory are cleaned and in many cases pre-preserved by the laboratory. The sample bottles should be prepared for shipment accompanied by a chain-of-custody and the cooler containing them should be sealed. The chain-of-custody must also accompany the bottles during transportation to the field, sample collection, transportation back to the lab, during analysis and final disposal of the sample container.

3.3 Sample Labels

Sample labels may be in the form of adhesive labels or tags, or both. Tags have the advantage of being removable to become part of the record keeping process, although their inadvertent loss or inappropriate removal may leave the sample without documentation. Labels should be made of waterproof paper and indelible ink should be used to make entries. Alternatively, sample information may be written directly on the sample container, as long as the writing can be done indelibly. Containers should be free from other labels and other writing to prevent any confusion. If both tags and labels are used, care should be taken to ensure that the information on both is identical.

Labels or tags should be filled out just before or immediately after sample collection. Labels should contain spaces for the following information:

- Project identification code.
- Sample identifying name
- Sampling location ID, sampling point ID.
- Sampling date and time.
- Analyses desired.
- Company name.

3.4 Sample Presevation

The need for sample preservation for specific analytes should be defined prior to the sampling event and documented in the site-specific sampling and analysis plan. Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity. Unless the analysis is accomplished within 2 hours after sampling, preservation is preferred and usually required.

Preservatives are generally added to the sampling bottles by the laboratory prior to shipment into the field. If the sample bottles are not pre-preserved by the laboratory, preservatives may be added in the field immediately after the samples are collected. Many laboratories provide pre-preserved bottles as a matter of convenience and to help ensure that samples will be preserved immediately upon collection. A problem associated with this method arises if not enough sample is collected, resulting in too much preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles.

3.4.1 Soil

3.4.1.1 Composite Samples

When composite samples are collected, the appropriate preservation reagents must be added to the compositing vessel prior to collection. If the preservation requirements call for refrigeration, the sample must be refrigerated during the collection. The collection time for a single composite sample should not exceed 24 hours. If longer sampling periods are necessary, a series of composite sample should be collected.

3.4.1.2 Grab Samples

In the absence of specific instructions, storage at a temperature of 4°C or lower for a period of time not to exceed 1 week is recommended.

3.4.1.3 Sediment Samples

Sediment samples intended for both organic and inorganic compound analysis may undergo changes in composition during storage. The analytical method should specify the conditions necessary to assure requisite stability. In the absence of specific instructions, storage at a temperature of 4°C or lower for a period of time not to exceed 1 week is recommended, although it is known that microbiological activity does not cease under these conditions.

3.4.2 Water

3.4.2.1 Groundwater Samples

Groundwater samples are subject to chemical, physical, and biological change at the ground surface relative to in-situ conditions as a result of exposure to ambient conditions during sample collection.

Groundwater sample preservation procedures are grouped into two general categories: (1) physical preservation and (2) chemical preservation. Groundwater samples should be preserved in the field at the time of sample collection using physical means to prevent sample container breakage or temperature increases, and chemical means to minimize changes in groundwater sample chemistry prior to laboratory analysis.

Physical groundwater sample preservation methods include: (*1*) use of appropriate sample collection containers for each parameter being analyzed, *(2)* use of appropriate sample collection procedures (i.e. making sure there are no air bubbles in VOA vials) (*3*) use of appropriate packing of sample containers for shipment to prevent sample container breakage and potential cross-contamination of samples during shipment, and (*4*) temperature control.

Samples are cooled to reduce biological activity on the organic chemicals. Cool the sample to 4°C immediately after sampling using a wet ice water bath. During storage or shipment, or both, maintain the sample at 4°C. A temperature blank should be used with each shipping container of samples to determine actual sample temperatures at the time the sample shipment is received by the laboratory.

Chemical preservation of groundwater samples involves the addition of one or more chemicals (reagent-grade or better) on a parameter-specific basis to protect sample integrity. Table 1 provides examples of common analyte-specific chemical preservation methods. Chemical preservation is specified in numerous analytical methods as well as in various regulatory guidance documents such as 40 CFR Part 136.3. Chemicals can be used to adjust sample pH or inhibit microbial activity to prevent chemical alteration of samples. In most cases the samples containers will be pre-preserved by the analytical laboratory. In the case that the sample containers are not pre-preserved, refer to *ASTM D 6517-00 Standard Guide for Field Preservation of Ground-Water Samples* for guidance.

After the sample container is filled and preserved, it should be securely capped and gently inverted to ensure uniform distribution of the preservative throughout the sample.

Preservation must take place <u>immediately</u> upon sample collection <u>except</u> when samples are to be filtered. Samples requiring filtration must be processed immediately after collection. Filtered samples are then preserved <u>immediately following</u> the filtration process.

Samples must be placed into a cooler and maintained at 4°C immediately upon collection and preservation.

When collecting samples in pre-preserved containers, care must be taken not to pre-rinse the container with the sample and to avoid overfilling the container to prevent loss of chemical preservative. It may be necessary to establish site-specific protocol to address acceptable periods for storage and storage conditions for pre-preserved sample containers due to the potential for chemical reactions to occur between the chemical preservative and the empty sample container

Records should be kept for all forms of sample preservation used for groundwater samples. The following should be reported:

- Type of sample container(s) used for each parameter being analyzed (volume, materials of construction, type of cap, etc.);
- Packaging method(s) used to prevent sample bottle breakage during sample storage and shipment;
- How groundwater samples were cooled to 4°C, if required for physical preservation;
- Chemical preservative(s) used on a parameter-specific basis;

- Description of appearance of unpreserved and preserved samples, specifically noting any chemical reactions which may occur upon addition of chemical preservative (for example, effervescence, formation of precipitates, change in color).

3.5 Chain-Of-Custody

The purpose of a chain-of-custody is to provide accountability for and documentation of sample integrity from the time the samples are collected until sample disposal. A chain-of-custody is intended to be a legal form documenting sample possession during collection, shipment, storage and the process of analysis. Chain-of-custody procedures are necessary in a program to assure the ability to support data and conclusions adequately in a legal or regulatory situation. Refer to OP3026 for Operating Procedures on completing a Chain of Custody.

A single field sampling person should be assigned responsibility for custody of samples. An alternate custodian should also be assigned to cover the prime custodian's absence. As few people as possible should handle samples. The assigned field sampler should be personally responsible for the care and custody of the samples collected until they are properly transferred. While samples are in their custody, field personnel should be able to testify that no one was able to tamper with the samples without their knowledge.

A standard chain-of-custody form included in Appendix A has been designed for recording custody information related to field sample handling. The following information should be on the form:

- Sample identifying name.
- Sampling location ID, sampling point ID.
- Sampling date and time.
- Sampling interval.
- Signatures of sampling personnel and signatures of all personnel handling and receiving the samples.
- Project identification code.
- Preservation (to alert lab personnel): amount and type.
- Number of containers. Indicate number of replicates if there are multiple containers of the same type.
- Field notes.
- Analyses desired.
- Sample type: grab, composite, etc.

When transferring the possession of samples, the individuals relinquishing and the individuals receiving the samples should sign, date, and note the time on the custody record. Provisions should be made for receipt of samples at nonstandard hours, such as nights and weekends by non-laboratory personnel. Shipping documents, with noted time of receipt and receipt by whom, should be made part of the custody record.

3.6 Sample Sealing

Sample custody seals of waterproof adhesive paper may be used to detect unauthorized tampering with samples prior to receipt by the lab. When seals are used, they should be applied so that it is necessary to break them in order to open the sample cooler. It is helpful to cover the custody seal with clear packing tape to ensure the security of the cooler.

3.7 Holding Times

Table 1 lists maximum holding times cited in the U.S. EPA "Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act". Sample containers should be shipped and received by the laboratory and as soon as possible to allow sufficient time for the laboratory to perform the requested analyses within the holding time defined by the applicable laboratory analytical method for each parameter.

3.8 Sample Storage and Transport

Field personnel should package and ship samples in compliance with all applicable regulations including the Department of Transportation (for example, Title 49 Code of Federal Regulations, Part 172) and the International Air Transportation Association (IATA). Samples should be placed in a cooler to be maintained at 4°C. Special care should be taken when packaging glass (i.e., using bubble wrap). Sample containers should be shipped in a manner that will ensure the samples are received intact by the laboratory, at the appropriate temperature, and as soon as possible to allow sufficient time for the laboratory to perform the requested analyses within the holding time. Samples should be shipped well before the holding time is up and ideally should be shipped within 24 hours of sample collection.

TABLE 1 - Required Containers, Preservation Techniques, and Holding Times

Using USEPA-Contract Lab Program Methodologies for Aqueous and Nonaqueous Samples

Parameter	Sample Container (1)	Container Volume	Preservation	Maximum Holding Time
Volatile Organics	Aqueous-G, black phenolic plastic screw cap, teflon-lined septum	Aqueous 40 ml	Cool, 4 deg C, dark, 0.08% $Na_2S_2O_3$ if residual Cl_2	10 days
	Nonaqueous-G, polypropylene cap, white teflon liner	Nonaqueous 120 ml		10 days
Total Organic Carbon	G - Preferred, P - If determined that there is no contributing organic contamination	100 ml	Cool, 4 deg C, dark, HCl or H_2SO_4 to pH<2 if analysis can't be done within 2 hrs	2 Hrs - unpreserved 28 days - preserved
Base Neutral/Acid Extractable (Semivolatile) Organics	Amber Glass, Teflon lined cap	1 liter	Cool, 4 deg C, dark	Extraction Aqueous continuous liquid-liquid extraction must be <u>started</u> within 5 days Non-aqueous - <u>10 days</u> Analysis 40 days from validated time of sample receipt at the lab.
Total Petroleum Hydrocarbons	G	1 liter	Cool, 4 deg C	Aqueous 7 days
		4 oz		Non-Aqueous 28 days Gasoline in soil 7 days
Pesticide/PCBs	Amber G, Teflon lined cap	1 liter	Cool, 4 deg C, dark	Extraction Aqueous continuous liquid-liquid extraction must be <u>started</u> within 5 days Non-aqueous - <u>10 days</u> Analysis 40 days from validated time of sample receipt at the lab.
Metals except Mercury	Aqueous-P bottle, P cap, P liner	Aqueous - 1000 ml	Aqueous - HNO_3 to pH<2	180 days
	Nonaqueous-Flint G bottle, black phenolic cap, polyethylene liner	Nonaqueous 4, 8, 16, or 32 oz	Nonaqueous - 4 deg C until analysis	
Hexavalent Chromium	P, G	400 ml	Cool, 4 deg C	24 hrs
Mercury	Aqueous-P bottle, P cap, P liner	Aqueous - 1000 ml	Aqueous - HNO_3 to pH<2	26 days
	Nonaqueous-Flint G bottle, black phenolic cap, polyethylene liner	Nonaqueous 4, 8, 16, or 32 oz	Nonaqueous - 4 deg C until analysis	
Phenols	G Only	1 liter	Cool, 4 deg C, H_2SO_4 to pH<2	28 days

TABLE 1 - Required Containers, Preservation Techniques, and Holding Times (CONTINUED)

Parameter	Sample Container (1)	Container Volume	Preservation	Maximum Holding Time
Cyanide	Aqueous-P bottle, P cap, P liner	Aqueous - 1000 ml	Aqueous - 0.6g ascorbic acid if residual Cl_2, NaOH to pH>12, cool, 4 deg C until analyzed $CaCO_3$ in presence of sulfide	12 days
	Nonaqueous-Flint Glass bottle, black phenolic cap, polyethylene liner	Nonaqueous 4, 8, 16, or 32 oz	Nonaqueous Cool, 4 deg C until analyzed	
Sulfates	P, G	100 ml	Cool, 4 deg C	28 days
Sulfides	P, G	1 liter	Cool, 4 deg C, add 4 drops zinc acetate per 100 ml sample, NaOH to pH>9	7 days
Chloride	P, G	1 liter	Cool, 4 deg C	28 days
Total Nitrogen	Aqeous - P bottle, P cap, P liner	Aqueous - 1000 ml	H_2SO_4 to pH<2	12 days
Nitrate	P, G	1 liter	Cool, 4 deg C,	24 hrs - Unpreserved
			H_2SO_4 to pH<2, (2 ml/L)	28 days - preserved
Fluoride	Aqeous - P bottle, P cap, P liner	Aqueous - 1000 ml	4 deg C until analysis	26 days

Excerpt from Appendix 2-1 (NJDEP Field Sampling Procedures Manual, May 1992) which is based on 40 CFR part 136.3

P - Plastic, hard or soft

G - Glass

$Na_2S_2O_3$ - Sodium thiosulfate

HCl - Hydrochloric acid

Cl_2 - Chlorine

H_2SO_4 - Sulfuric acid

HNO_3 - Nitric Acid

NaOH - Sodium hydroxide

$CaCO_3$ - Calcium carbonates

APPENDIX A
REFERENCES

A.1 Reference Procedure

- American Society for Testing and Materials International, Standard Guide for Field Preservation of Groundwater Samples, ASTM D 6517-00, April 2000.

- American Society for Testing and Materials International, Standard Guide for Sample Chain-of-Custody Procedures, ASTM D 4840-99, January 2000.

- American Society for Testing and Materials International, Standard Practice for Collection and Handling of Soils Obtained in Core Barrel Samplers for Environmental Investigations, ASTM D 6640-01, April 2001.

- American Society for Testing and Materials International, Standard Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents, ASTM D 4841-88, October 1985.

- American Society for Testing and Materials International, Standard Practice for Preparation of Sediment Samples for Chemical Analysis, ASTM D 3 976-92, December 1992.

- American Society for Testing and Materials International, Standard Practices for Preparation of Sample Containers and for Preservation of Organic Constituents, ASTM D 3694-96, March 1997.

A.2 Other References

- New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, May 1992.

- United States Environmental Protection Agency Environmental Response Team, Groundwater Well Sampling SOP #: 2007, 26 January 1995.

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1004 Operation/Calibration of PID Photoionization Detector
- OP1007 Field Monitoring for Volatile Organics (breathing space-work zone)
- OP1009 Medical Surveillance Program
- OP1010 Health and Safety Plans
- OP1022 Health and Safety Manual
- OP3000 General Environmental Field Procedures and Protocols
- OP3006 Procedures for Subsurface Soil Sampling and Chemical Analysis
- OP3008 Manual Water Level Measurement Procedure
- OP3009 Monitoring Well Development Procedure
- OP3010 Groundwater Quality Sampling Procedure
- OP3012 Low Stress/Low Flow Groundwater Sample Collection Procedure
- OP3014 NAPL Monitoring and Sampling
- OP3026 Chain of Custody

APPENDIX C
FORMS

Form 3001	Sampling Labels (Environmental)
Form 3003	Chain of Custody Record (Field)
Form 3005	Groundwater Sampling Record
Form 3006	Monitoring Well Devel Rpt
Form 3010	Low Flow Field Sampling Form

APPENDIX D
GLOSSARY

Chemical preservation - the addition of acidic, alkaline or biologically toxic compounds, or combination thereof, to a groundwater sample to prevent changes in chemical properties of the sample that may occur after collection.

Custody - physical possession or control. A sample is under custody if it is in possession or under control so as to prevent tampering or alteration of its characteristics.

Holding time - the maximum amount of time that may transpire from the moment a sample container is filled to the time the sample is extracted or analyzed. Holding times are parameter-specific, variable in length, and defined by laboratory analytical methods.

Physical preservation - methods that are implemented to protect the physical integrity of a groundwater sample from the time the sample is collected until the sample is analyzed.

Temperature blank - a laboratory quality control sample that is transported with samples and is used by the laboratory performing sample analyses to verify that temperature-sensitive samples have been adequately cooled to 4°C for shipment to and arrival at the laboratory.

APPENDIX E
CHAIN OF CUSTODY RECORD

See three-piece form in Forms cabinet.

OPERATING PROCEDURE: OP3003

SURFICIAL SOIL SAMPLING

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	JML: June 2003	CSO July 2003			DHS Sept 2003

Total Pages: 21

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OPERATING PROCEDURE: OP3003

SURFICIAL SOIL SAMPLING

1. PURPOSE

The purpose of this Operating Procedure (OP) is to describe the procedures for the collection of representative samples of surficial soil. The procedures are intended specifically to minimize alteration of samples during collection. Surficial soil samples as referenced herein mean soils or soil-like material located less than 6 feet below ground surface which may contain quantities of contaminants.

Refer to OP3000 for General Environmental Field Procedures and Protocol, including procedures for decontamination of sampling equipment and/or containers. Refer to OP3001 for Operating Procedures on Preservation and Shipment of Environmental Samples.

Refer to OP3004 for Operating Procedures on Stream Sediment and Wetlands Soil Sampling. Refer to OP3006 for Operating Procedures on Subsurface Soil Sampling for Chemical Analysis.

Haley & Aldrich (H&A) personnel are to use the techniques in OP3003 to collect surficial soil samples. These operating procedures may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the actual procedures used should be documented and described in an appropriate site report.

2. EQUIPMENT & SUPPLIES

Required:
1. Site map(s)/plan(s)
2. Safety equipment, as specified in the site-specific Health and Safety Plan
3. Field Log book
4. Stainless steel, plastic, or other appropriate homogenization bucket, bowl or pan
5. Plastic or stainless steel spoons and/or wooden tongue depressors
6. Appropriate size sample containers
7. Plastic zip lock bags
8. Sample Labels
9. Chain of Custody records and custody seals
10. Sampling Record Form (H&A Form 3004)
11. Cooler(s)
12. Ice
13. Decontamination supplies/equipment

Sampling equipment may include one or more of the following:

1. Stainless steel trowel(s) or scoop(s)
2. Stainless steel spade or shovel
3. Bucket auger
4. Bit auger
5. Continuous flight (screw) auger
6. Post-hole auger
7. Extension/drill rods
8. T-handle
9. Core sampler
10. Sampling trier
11. Thin wall tube sampler
12. Split spoons
13. Vehimeyer soil sampler outfit
14. Tubes
15. Points
16. Drive head
17. Drop hammer
18. Puller jack and grip
19. Backhoe
20. Telescopic mechanical sampling arm (aluminum poles)
21. Stainless steel sampling beaker

Optional:

1. Tape measure
2. Survey equipment or global positioning system (GPS) to locate sampling points
3. Survey stakes or flags
4. Camera and film
5. Plastic sheeting or cover

3. PROCEDURE

3.1 Preparation

- Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.

- Obtain necessary sampling and monitoring equipment.

- Decontaminate or pre-clean equipment, and ensure that it is in working order.

- Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.
- Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
- Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations should be utility-cleared by the property owner or the On-Scene-Coordinator prior to soil sampling, and utility clearance should always be confirmed before beginning work.

3.2 Presampling Observations, Notes and Required Entries

The information listed below will be recorded in a project Field Log book and a Sampling Record Form. The Sampling Record Form is referenced in Appendix C. The following list of measurements and observations represent a minimum requirement for soil samples:

- Sampling Location Number
- Time
- Date Collected
- Samplers (names of individuals who actually collected samples)
- Sample Destination (Analytical Laboratory) to receive samples
- Description of Sample Location with Sketch or Map
- Sample Depth (i.e., distance in feet from ground surface)
- Photograph Number and Roll Used (if applicable).
- Observable Physical Characteristics
  - Odor
  - Color
  - Density, Consistency, etc.
  - Layering
  - Other
- Evidence of Stressed Vegetation or Wild Life in Area where Sample was taken

- Ambient Weather Conditions during Sampling
  - Air Temperature
  - Sky Condition
  - Recent Precipitation or Drought

- Samples Collected (enter all sample numbers collected at this location)

3.3 Sampling Procedures

- After entries are completed, label and number required sample bottles. Fill out the label in indelible ink and carefully and clearly address all categories and parameters.

- Sample analyses will be specified by the Project Coordinator and Site Manager. A list of these analyses and required containers and handling procedures is presented in a Site work plan or related document.

- Sampling instructions have been provided for seven sampling devices most often used to collect surficial soil samples. Select the appropriate sampling device.

- Refer to Operation Procedure OP2001 - Identification and Description of Soils in the Field Using Visual-Manual Methods, if observations of surficial soils are to be recorded.

- Decontaminate sampling device and/or container prior to use according to Operation Procedure OP3000 - General Environmental Field Procedures and Protocol.

- Sample containers (glass jars and vials) should be filled to the top. Refer to a Site work plan or related document for sample volume size and appropriate containers for given analyses. Sample containers should contain laboratory-provided preservatives, if necessary. Care should be taken to prevent the presence of air bubbles in VOA vials. All container caps will include an inner teflon septa or lining and must be tightly secured to contain the sample. All samples will be stored and shipped at 4°C. Refer to OP3001 for operating procedures on sample handling and preservatives.

- Check for appropriate liner in cap and secure cap tightly. Store the samples with ice in a cooler, following these sealing and packing procedures:

  - Ice will be placed in plastic zip-lock bags to contain ice water. Sample containers will be adequately layered in bubble wrap to prevent breakage. Samples will be positioned upright in the cooler to prevent breakage, and samples will be stored and shipped at 4°C.

  - All 40-milliliter VOA vials will be sealed in thick or heavy duty plastic zip lock bags.

  - Check to make sure all appropriate information is in Field Log Book or Sampling Record form and Chain-of-Custody form using indelible ink.

- If samples are to be shipped to a laboratory for analysis, a Chain-of-Custody record, custody seals, fragile markers, and reinforced nylon tape will all be properly affixed to or on the sample cooler. If samples are to be delivered to the laboratory directly by Haley & Aldrich, then only the Chain-of-Custody record is required.
  - Chain-of-Custody Form - enclose in large plastic zip lock bag and tape to inside top of cooler lid.
  - Custody Seals - place custody seal over cooler gasket separating the cooler lid from the cooler bottom at all sides except hinged location.
  - Nylon Tape - tape completely around cooler at two locations. Tape reinforcing will prevent cooler from opening if the lid locking mechanism fails.
  - Fragile Markers - fragile markers and upright stickers will be affixed to each side of the cooler.

3.4 Sampling Device Instructions

The specific procedures and equipment for surficial soil sampling will be defined in a Site work plan or related document. The following presents a description of seven sampling devices commonly used to collect surficial soil samples within 6 feet of ground surface. The split spoon sampler, when used with drilling equipment, can also collect subsurface soil samples to much greater depths. The most appropriate device for a specific sampling program as described in a Site work plan or related document has been selected based on site conditions (accessibility, type of soil, desired depth of samples, etc.) and on climate conditions (e.g. frozen ground in winter).

The selected devices for each sampling task are described in detail in a Site work plan or related document. Any changes to procedures outlined in a Site work plan or related document will be specified by the Site Manager.

3.4.1 Hand Scoops, Trowels, Spades and Shovels

This method is probably the simplest, most expeditious, direct method for making soil samples accessible. Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. These devices are easy to operate, decontaminate and work well for sampling most surficial soils. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample. This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member.

Hand scoops and trowels consist of the usual garden type trowel or scoop usually constructed of stainless steel. A stainless steel laboratory scoop is a preferred scoop device due to its non-corrosive nature. Scoops or trowels work well in collecting grab samples of surficial soils or sludges. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required. A typical shovel or spade constructed of stainless steel can be used to collect representative soil samples near the surface. Devices plated with chrome or other exterior coatings that may chemically alter the sample should not be used. Plating is particularly common with garden implements such as potting trowels.

Procedures for Use

1. Carefully remove the top layer of soil to the desired sample depth with a cleaned, stainless steel spade, shovel, trowel, or scoop. In the case of sludges exposed to air, it may be desirable to remove the first 1-2 centimeters of material prior to collecting sample.

2. Using a cleaned, stainless steel scoop or trowel, collect the desired quantity of soil.

3. If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, new wooden tongue depressor or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

3.4.2 Bucket and Bit Augers with Thin-Wall Tube Attachment

This system consists of a bucket or bit auger, or a thin-wall tube sampler, a series of extensions/drill rods, and a "T" handle (Figure 1). A cleaned bucket or bit auger is used to bore a hole to the desired sampling depth and then is withdrawn. When using the bucket auger, the soil sample must be removed from the bucket with a cleaned, stainless steel spoon or trowel. The bucket auger can collect a large soil sample (up to 24 ounces) but is limited in penetrating depth to approximately 2 feet under ideal conditions. Bucket augers are useful for direct sample recovery, because they provide a large volume of sample in a short time. The bit auger has greater penetrating depth (up to 6 feet) but collects a small soil sample. The bit auger tip is removed from the auger when the desired sampling depth is reached and replaced with the thin wall tube attachment. The system is then lowered down the cored hole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

Other types of augers include continuous flight (screw) and post-hole augers. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of approximately three feet.

This equipment can be used in a wide variety of soil conditions. The presence of rock layers and collapsing of the borehole usually prohibit sampling at depths greater than 3 to 6 feet. The equipment is inexpensive, easy to operate, and generally works well to sample most soils.

Procedures for Use

1. Attach the cleaned auger bucket or bit to a drill rod extension and further attach the "T" handle to the drill rod.

2. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 3 to 6 inches of surface soil for an area approximately 6 inches in radius around the drilling location.

3. Begin augering by rotation of the "T" handle, periodically removing accumulated soils onto a plastic sheet spread near the hole. This prevents accidentally brushing loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the hole.

5. If a bucket auger is used, remove the soil sample with a cleaned, stainless steel spoon or trowel.

6. If a bit auger is used, remove the auger tip from the extension rods and replace with a cleaned, thin-wall tube sampler. Install the proper cutting tip.

7. Carefully lower the tube sampler down the borehole. Gradually press the tube sampler into the soil. Take care to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring, as the vibrations may cause the boring walls to collapse.

8. Remove the tube sampler and unscrew the drill rods.

9. Remove the cutting tip, and remove the core from the device.

10. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.

11. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, wooden tongue depressor or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval

into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

12. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and repeat previous steps, making sure to decontaminate the auger and tube sampler between samples.

13. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

3.4.3 Hand Held Corer

The device consists of a "T" handle and cylindrical core tube (Figure 2). The device is equipped with a check valve at the top to prevent washout during retrieval through an overlying water layer, if applicable, and a nosepiece at the bottom to help contain the sample. This device can be used in a wide variety of soil conditions. Hand corers can also be fitted with brass or polycarbonate plastic liners.

<u>Procedures for Use</u>

1. Inspect the corer for proper pre-cleaning.

2. Press the corer in with a smooth continuous motion.

3. Twist the corer, and then withdraw the corer in a single smooth motion.

4. Remove the nosepiece and withdraw the sample into a stainless steel, plastic or other appropriate homogenization container.

5. Transfer the sample into an appropriate sample container with a stainless steel spoon, wooden tongue depressor or equivalent.

3.4.4 Thin Tube Hand Held Sampling Trier

The system consists of a trier, a long hollow cylindrical tube with a slot trending almost its entire vertical length, and a "T" handle (Figure 3). The trier is driven into the soil to be sampled and used to extract a core sample from the appropriate depth. The tip and edges of the tube are sharp to allow the trier to cut a core by rotation of the "T" handle once it is completely pushed-down or manually driven to the depth of collection. Triers range from approximately 20 to 60 inches in length and from approximately 0.5 to 1 inch in diameter.

Procedures for Use

1. Insert the cleaned trier into the soil or sludge material at a 0 to 45° angle from horizontal. This orientation minimizes the spillage of sample from the sampler. Extraction of samples might require tilting of the containers.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure the slot is facing upward.

4. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, wooden tongue depressor or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

3.4.5 Split Spoon Sampler

Split spoon sampling is generally used to collect undisturbed soil cores of 18 or 24 inches in length. A split spoon sampler consists of a cylindrical hollow steel or stainless steel sampler usually 24 inches long and 2 or 3 inches in outside diameter. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. Split spoon samplers collect in-situ soil samples that permit stratigraphic logging. To remove the split spoon sampler and collect a soil sample, remove the sampler from the driving rods and unscrew the tapered nosepiece and top piece from the sampler. The spoon will then split into two longitudinal sections. It may be necessary to use a pipe wrench to unlock the threaded nosepieces. This sampling device is almost always used in conjunction with a drilling rig and as such is an equipment intensive effort. However, the split spoon may be used with a hand-held drop hammer for collection of shallow soil samples (less than 6 feet below ground surface).

Refer to Operation Procedures OP2005 - Test Borings, Sampling, Standard Penetration Testing and Borehole Abandonment, and OP3006 - Procedures for Subsurface Soil Sampling for Chemical Analysis, which describe the use of this sampler in greater detail.

<u>Procedures for Use</u>

1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.

2. Place the sampler in a position perpendicular to the sample material.

3. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.

4. Record in the Field Log book or test boring log the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.

5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 1/2 inch diameters. A larger barrel may be necessary to obtain the required sample volume.

6. Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.

3.4.6 Test Pit/Trench Excavation

A backhoe can be used to remove sections of soil, when detailed examination of soil characteristics are required. This is a relatively expensive sampling method because of the cost of backhoe operation. Refer to Operation Procedure OP2026 - Exploratory Test Pits for more information on test pit excavations.

<u>Procedures for Use</u>

1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of overhead and buried utilities.

2. Review the site specific Health & Safety plan and ensure that all safety precautions including appropriate monitoring equipment are installed as required.

3. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location, or as specified in a Site work plan or related document. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.

4. A shovel may be used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.

5. Record in the Field Log book or test pit log the depth intervals from which the samples are being collected.

6. Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket. A telescopic mechanical arm (see next sampling device) and stainless steel sampling beaker may be used to collect samples.

7. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, wooden tongue depressor or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

8. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material. The test pit/excavation should be backfilled in accordance with a Site work plan or related document.

3.4.7 Telescopic Mechanical Sampling Arm

The device consists of an aluminum pole approximately 1 to 2 inches in diameter divided into three, 4-foot sections. Attached to the end of the pole is a stainless steel sampling beaker (usually with an 18-ounce capacity). The pole is capable of telescoping from 4 to 12 feet. This mechanical sampling arm is used to collect soil samples from test pits or other excavations. It allows a sample to be collected from a location that would otherwise be difficult to access.

Procedures for Use

1. Attach the cleaned, stainless steel beaker to the end of the pole either by tightening a clamp or wing nuts.

2. Make sure your feet are safely and securely positioned.

3. Telescope the pole to the required length.

4. Lower the pole end into the test pit or other excavation.

5. Collect the sample.

6. Remove the sample from the beaker with a cleaned, stainless steel scoop, trowel or new wooden tongue depressor.

3.5 Sample Containers

The samples for each analysis will be collected in the appropriate containers and handled in accordance with the procedures described in a Site work plan or related document.

3.6 Chain-of-Custody Forms

All samples submitted to the contract analytical laboratory for analyses, will be accompanied by a Chain-of-Custody form. Appropriate Chain-of-Custody procedures will be followed at all times during a sampling event and subsequent transport to the contract analytical laboratory. Refer to OP3026 for operation procedures on completing a Chain-of-Custody form and Chain-of-Custody procedures.

3.7 Decontamination

Soil sampling equipment will be cleaned prior to and between each use according to Operation Procedure OP3000 – General Environmental Field Procedures and Protocol. After decontamination, the equipment will be wrapped in aluminum foil and placed on clean racks off the ground until it is used.

3.8 Quality Assurance/Quality Control

There are no specific quality assurance (QA) activities that apply to the implementation of these operating procedures. However, the following QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.

- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in a Site work plan or related document. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

3.9 Health and Safety

When working with potentially hazardous materials, follow H&A health and safety procedures, in addition to the procedures specified in the site specific Health & Safety Plan.

FIGURES

Figure 1. Sampling Augers

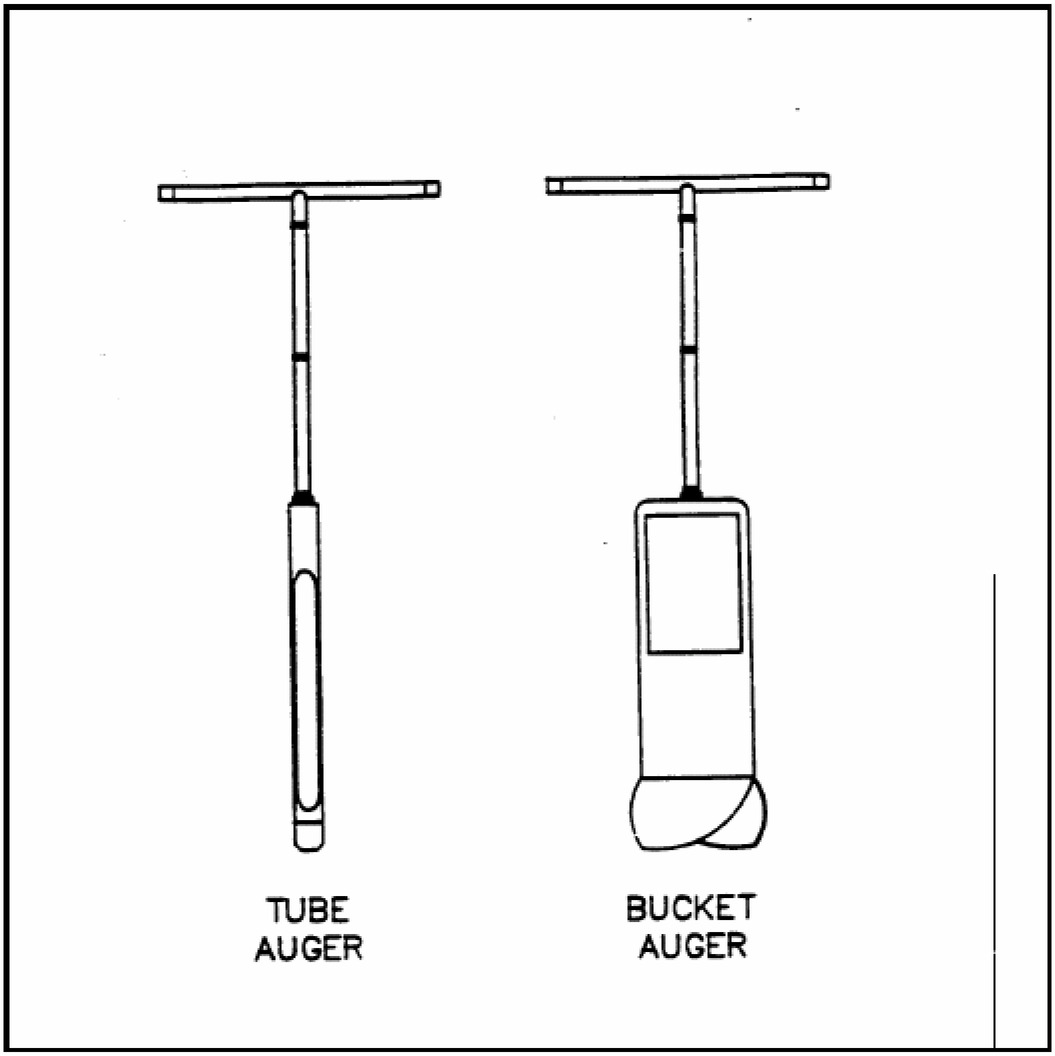


Figure 2. Sample Coring Device

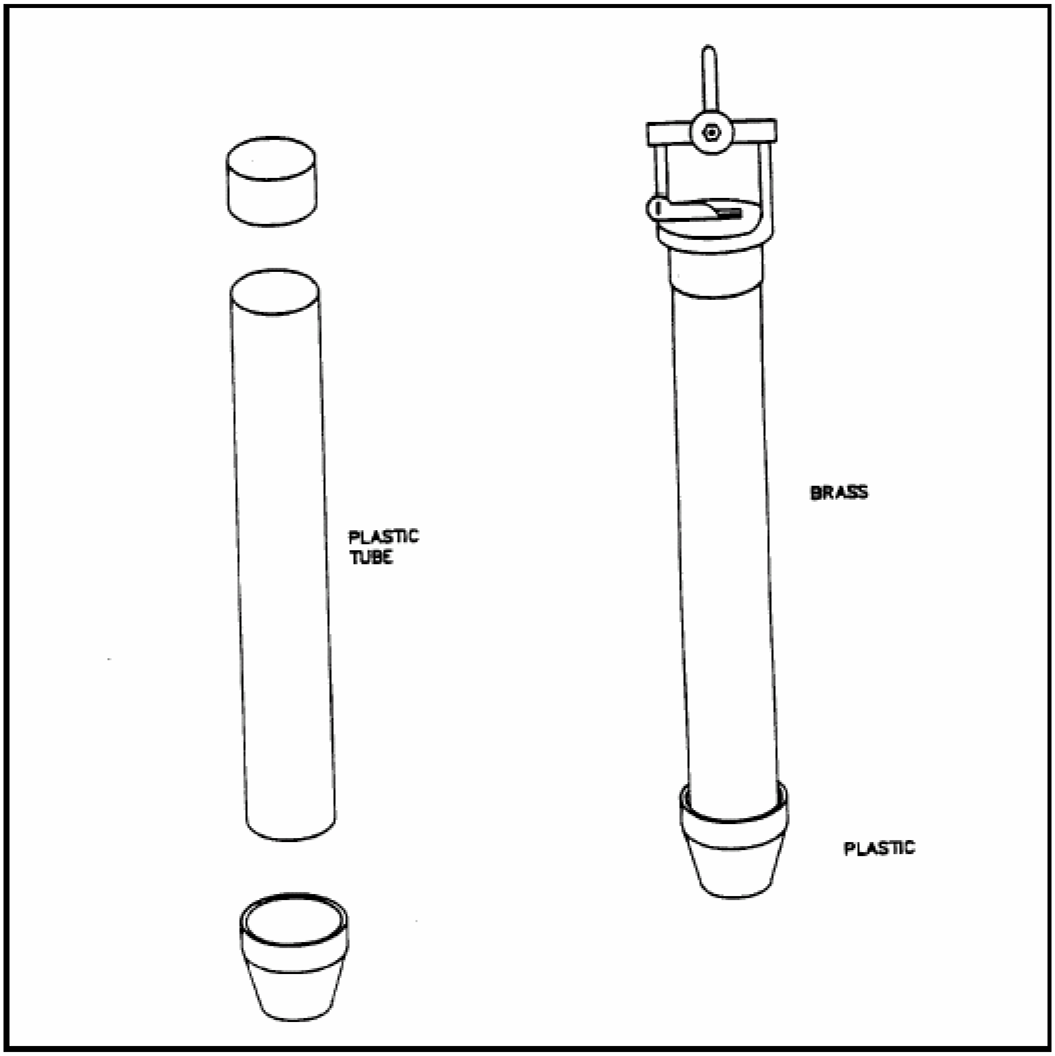
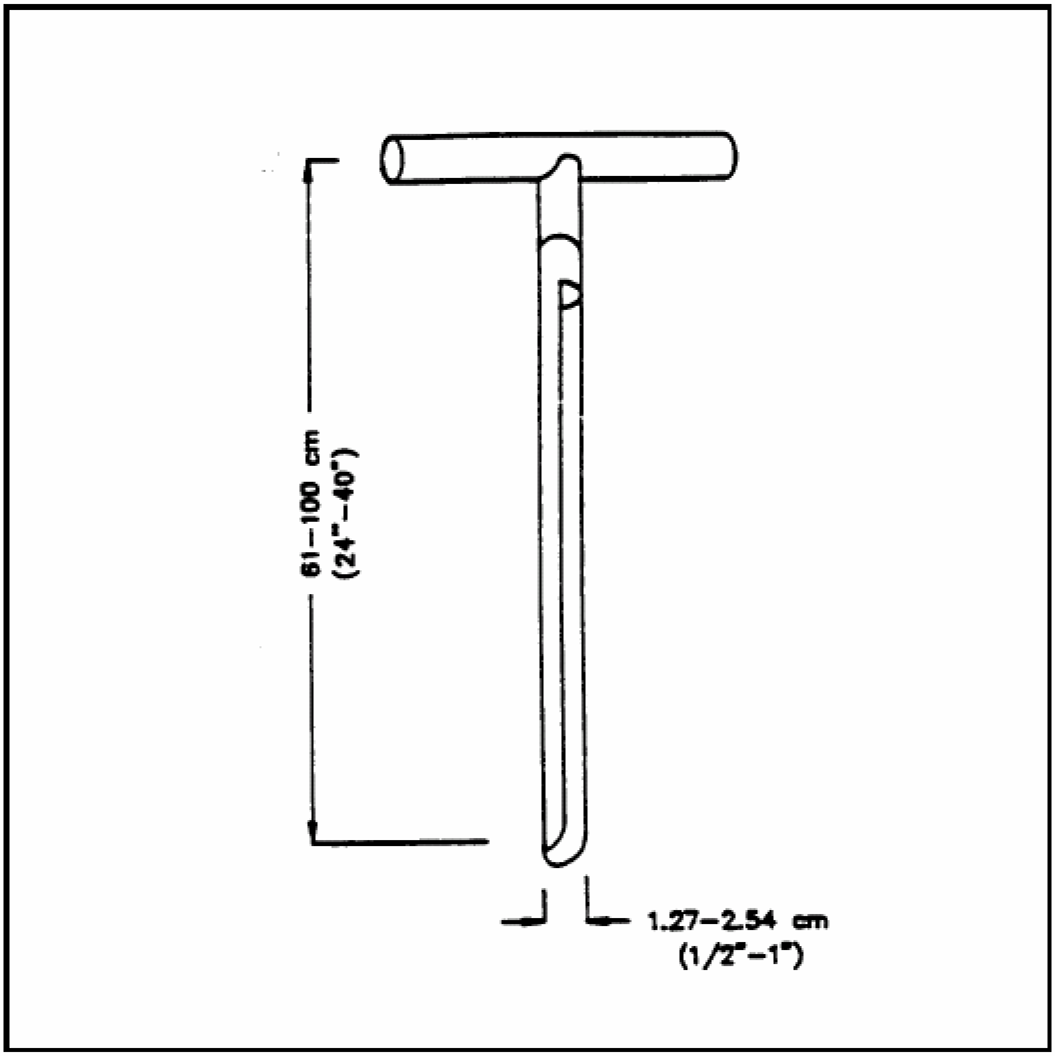


Figure 3. Sampling Trier



APPENDIX A
REFERENCES

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APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1009 Medical Surveillance Program
- OP1010 Health and Safety Plans
- OP2001 Identification and Description of Soils in the Field Using Visual-Manual Methods
- OP2005 Test Borings, Sampling, Standard Penetration Testing and Borehole Abandonment
- OP2026 Exploratory Test Pits
- OP3000 General Environmental Field Procedures and Protocol
- OP3001 Preservation and Shipment of Environmental Samples
- OP3004 Stream Sediment and Wetlands Soil Sampling
- OP3006 Procedures for Subsurface Soil Sampling for Chemical Analysis
- OP3026 Chain of Custody

APPENDIX C
FORMS

- Form 3001 Sampling Labels (Environmental)
- Form 3002 Chain of Custody (Electronic)
- Form 3003 Chain of Custody (Field)
- Form 3004 Sampling Record

APPENDIX D
GLOSSARY

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OPERATING PROCEDURE: OP3009

MONITORING WELL DEVELOPMENT PROCEDURE

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	BAM/ 08-02	JCP/ 08-02	GJM/ 06-03		JAK/ 06-03

Total Pages: 20

HALEY & ALDRICH

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MONITORING WELL DEVELOPMENT PROCEDURE

1. PURPOSE

This procedure provides guidance on methods and techniques for groundwater monitoring well development typically performed after well installation, but prior to groundwater quality sampling, specifically for instrumentation installed in overburden or bedrock for environmental monitoring and geotechnical purposes. Groundwater well development increases the yield of the well by removing fine sediments and particles from within the well and the well filter pack, enhances the hydraulic communication between the well and the screened formation, decreases turbidity, increases precision of hydrologic measurements, and increases representativeness of groundwater quality data. Well development is an integral component of a groundwater sampling program, with the objective of obtaining high quality, reproducible groundwater quality data.

The selected method and duration of groundwater well development will be dependent on a number of factors, including: well construction method and materials, depth to groundwater, anticipated groundwater testing parameters and data quality objectives, presence of contamination (i.e., degree of contamination and presence of free-phase non-aqueous phase liquids), method of borehole advancement, and site physical setting/access.

IMPORTANT NOTES:

It is not necessary to follow all of the methods in this procedure for every monitoring well development performed. The procedures may be adapted to conform to specific local practice, site-specific geologic conditions, or to support local, municipal or state regulatory requirements.

The term “groundwater monitoring well” or “well” in the procedure is used to denote groundwater monitoring wells, groundwater observation wells, piezometers, gas monitoring wells, lysimeters or other devices constructed in similar manner to a well. Certain well constructions (i.e., large-diameter pumping test wells, injection/extraction wells, commercial, residential or industrial water supply wells) may be developed using the information contained in the procedure, but are typically installed using specialized drilling equipment and are typically developed using that equipment by specific methods that are beyond the scope and intent of this field procedure.

2. EQUIPMENT & SUPPLIES

Required

1. Water Level Indicator, Sinco or equivalent
2. Oil/Water Interface Probe
3. Thermometer
4. pH meter and buffering/calibration solutions
5. Conductivity meter and probe
   Dissolved oxygen meter and probe
7. Turbidity meter and probe
8. Oxidation/Reduction Potential meter and probe
9. Salinity meter
10. Pump (Grundfos, peristaltic, whale etc.)
11. Pump accessories (Cables, fittings, tools)
12. ½ in. or 5/8 in. HDPE or Teflon discharge tubing; also silicon tubing for peristaltic pump
13. Power source for pump (generator with fuel; automotive battery, rechargeable battery)
14. Graduated plastic bucket (5-gallon) or flow meter
15. Stopwatch
16. Standard decontamination equipment (water jug, buckets or washtubs, brushes, Alconox, distilled water, tap water, methanol, squeeze bottles)
17. Ruler, engineer's 6 ft. folding
18. Scale, engineer's
19. Graduated tape, 100 ft. length, weighted end
20. Field Logs & Forms/Field Book 6.
21. Site Plan, Maps, Boring and Well Installation Logs
22. Personal protective equipment
23. Calculator
24. Keys to well padlocks/covers
25. Paper towels
26. Trash bags

Optional:

1. Horiba MultiMeter (measures pH, temperature, conductivity, DO, turbidity, and salinity)
2. Horiba U-22 Flow Cell (measures pH, temperature, conductivity, DO, turbidity, ORP and salinity)
3. Inertial Pump Materials: Waterra Foot Valves, HDPE Tubing
4. Bailers; rope, knife

3. PROCEDURE

3.1 Summary of Procedure Purpose and Intent

The primary purpose of developing groundwater quality monitoring wells at sites containing, or potentially containing, solid or hazardous materials or their byproducts, is to create an effective filter pack around the well screen, rectify impact to the formation caused by drilling and the associated drilling fluid, remove fine particles from the formation near the borehole and assist in restoring the natural water quality of the aquifer in the vicinity of the well. The properly developed well ensures the reliable collection of representative ground water samples, of acceptably low turbidity.

Well development induces movement of water in two directions across the well screen and filter pack. This movement removes fines or other foreign materials from within the well, the filter pack, and the surrounding natural formation, creating a stable graded filter yielding water of relatively low turbidity.

3.2 Role of Environmental Professional or Engineer

Groundwater monitoring well development requires evaluation and consideration of a variety of site-specific characteristics, which precludes the use of one single development practice or procedure. The procedure is provided as a guide to aid the environmental professional, geologist or engineer in selecting the technical approach and methodology to effectively complete a well development program.

At the initiation of project planning, the Project Manager, Project Engineer or Scientist, and field personnel, determine any project-specific requirements for groundwater well development. Municipal, state or federal regulations, local practice, client requirements or project requirements may dictate the use of a different or modified well development method.

3.3 General Methods of Monitoring Well Development

There are three general types of well development methods typically employed on small diameter monitoring wells (equal to or less than 4 in. I.D.) installed for environmental purposes:

- Pumping and overpumping
- Bailing
- Surging with a Surge Block

Well development methods that potentially alter the chemical composition of the groundwater are not acceptable. Therefore, methods that introduce fluids (including water pumped from the well) or air, to accomplish development are generally considered unsuitable. This eliminates several methods commonly used to develop large-diameter water supply wells. These methods include backwashing, jetting, airlift pumping or air surging.

The majority of well development for environmental purposes is conducted by mechanical pumping and overpumping, use of inertial lift pumps, inertial lift pumps with surge blocks, bailers, or a combination of these methods.

3.4 Preliminary Procedures

In preparation for well development activities (and subsequent groundwater quality sampling event), the Project Manager and groundwater developer/sampler reviews project-specific requirements and considerations of the well development and groundwater sampling program.

The information reviewed may include site map or plans, drilling methods and records, well construction records, depth to groundwater data, previous groundwater quality data, data trends, earlier sampling records and field procedures used, and preferred well sampling sequence or sampling order. Identify project documentation needs and records of well development execution.

Other information to be reviewed are specific laboratory analyses to be performed on samples to be obtained from each well, sampling glassware, need for field filtration and container preservatives. Related aspects of the procedure include site health & safety plan review, evaluation of the site physical setting, availability of electrical power, property access permission and constraints, and purge water disposal.

Design the well development program to support the data quality objectives of the chemical analyses of the groundwater samples to be obtained. Based on the types of data to be collected in the field, identify the appropriate types of mechanical purging required (by pumps or other specialized equipment), likelihood of the presence of non-aqueous phase liquid (NAPL) and accommodations for measuring NAPL. Generally, a series of wells are developed starting with the least contaminated well working towards the well exhibiting the most significant contamination, if known.

Other considerations are identifying protocol for personnel protective equipment (PPE) use and specialized handling of purged water and decontamination wastewater, as generated. Recently installed monitoring wells should not be developed before well sealant materials (bentonite annular seal, cement/bentonite grout) have set or cured, typically assumed to be approximately one week.

In some cases, groundwater obtained from wells installed and sealed with a column of cement grout has exhibited artificially high pH, due to migration and influence of the calcium carbonate from the cement. The Project Manager and field representative are cautioned of this possibility, manifested during the well development procedure by inconsistent, unstable or high pH readings.

Table I presents common well development equipment, and lists advantages/disadvantages of the equipment.

3.5 Calculate Volume of Standing Water in Well

Calculate the estimated volume of standing water in the well. Some useful formulae for calculating well volumes are provided below:

- $V = L\, r^2 (0.163)$

  Where:

  V = volume of standing water in well, in gallons
  r = internal radius of well, in inches
  L = length of standing water column, in feet
  0.163 = derived constant converting well radius in inches to feet, and cubic feet to gallons

Other useful formulae:

- Gallons per 100 ft. = 4.08 * (D)2

  Where D = Inside well or borehole diameter, in inches

- Cubic feet of water per 100 ft. = 0.55 * (D)2

  Where D = Inside well or borehole diameter, in inches

- 7.48 gallons = 1 cubic foot

- 0.134 cubic feet = 1 gallon

3.6 Field Procedures

3.6.1 Locate Well

Locate the subject well in the field, using site plans, sketches, fixed references or other available documentation. Metal detectors may be useful in locating buried metal well casings; however, non-ferrous (i.e., aluminum or PVC) or missing well casings will not respond to metal detector signals.

Verify well designation, particularly individual wells located in closely spaced well clusters or well nests. If necessary, verify and document the location of the well to be decommissioned, referenced by taped distance to three fixed features, or acquire coordinates using global positioning system (GPS) methods or by instrument survey.

3.6.2 Evaluate Well Integrity and Construction

Evaluate and document condition of protective well casing and surface seal (padlock missing/broken, well cap missing, staining on well riser observed, concrete surface seal cracked, surface runoff entering well etc.). Record well construction material (stainless steel, PVC, fiberglass, galvanized steel, black carbon steel etc.).

Establish/verify monitoring well reference point (i.e., PVC rim, roadway box rim, protective guard pipe casing rim, ground surface).

3.7 Well Development Procedure – Mechanical Pump Method

Mechanical pumps include electrically powered submersible pumps (Grundfos and Whale brands), or suction lift surficial pumps, such as centrifugal or peristaltic types. Pumps may have variable speed controls to regulate discharge rate. Other types of suction lift surface pumps may be driven by internal combustion gasoline engines (not discussed in this procedure).

1. Follow Preliminary Procedures above, including evaluation of well integrity and documentation of well construction details.

2. Don appropriate personnel protective equipment (PPE) as identified in project health & safety plan. Pay particular attention to splash hazards.

3. Decontaminate all downhole development equipment prior to placement within wells, between uses in either the same well, or in other wells. Clean and prepare equipment using an Alconox soapy wash, tap water rinse, methanol rinse, and distilled/deionized water rinse. Containerize decontamination rinseate, if required.

4. If warranted, measure for possible presence of non-aqueous phase liquids (NAPL), using oil/water interface probe. Modify well development program based on findings and discussion with Project Manager, including postponing/canceling well development.

5. Measure well diameter, depth to water (static water level), depth to bottom of well using water level indicator or weighted graduated tape. Calculate standing water volume (see above).

6. Verify information on the respective well record, if available, and note any discrepancies. If well logs are not available, determine screen length and depth, if possible, to determine whether the well construction will provide useful data.

7. Evaluate obstructions present within the well or material accumulated in bottom of well. The presence of substantial quantity of accumulated materials (i.e., silt > 0.5 ft.) in bottom of well may warrant modifying the well development method to remove the sediment (i.e., use of peristaltic pump or hand bailer to remove sediment).

8. Remove any unsuitable dedicated groundwater sampling devices, if present (i.e., Waterra-type inertial pumps and discharge tubing, bailers, SoakEase absorbent material). Retain and discard as solid waste.

9. Groundwater purged from the borehole may or may not require containment or may be discharged on the ground in vicinity of well head, depending on groundwater quality, site setting, regulatory considerations and project requirements. Resolve with Project Manager prior to entering field.

10. Cut a clean piece of discharge tubing for selected pump (typically ½ in. or 5/8 in. high density polyethylene (HDPE) or Teflon tubing) of sufficient length to fully penetrate the well to its screened depth and to accommodate measuring purge volumes and inorganic parameters at ground surface. Cut tubing should not fall or drop into the well.

11. For submersible pumps, attached tubing and lower pump intake into well, suspending pump intake at the approximate midpoint of the saturated zone for water table wells, or at the screen midpoint for deeper wells. Connect power cables and controller box, and operate the pump according to manufacturer's instructions.

12. Initially operate pump at a discharge rate approximately equal to well recharge rate, using graduated bucket or flow meter and stopwatch to estimate flow, and adjust until drawdown of approximately 0.3 ft. is obtained. At the start of purging, obtain inorganic field parameters of the discharge, in the following order: pH, temperature, specific conductance (conductivity), oxidation-reduction potential (ORP), dissolved oxygen (DO) and turbidity, and record on field forms or in logbook.

13. Well development continues until representative groundwater, free from drilling fluids, drill cuttings, accumulated sediment or other materials introduced during the well construction is obtained.

    Unless determined by project specific requirements, remove approximately 3 to 5 well volumes, measuring and recording inorganic field parameters for each well volume removed. If, during removal of 3 to 5 well volumes, field parameters have stabilized within 10% for two successive readings, and turbidity has been reduced to 5 nephelometric turbidity units (NTU) or less, then well development is considered complete. Based on discussion with the Project Manager or environmental professional, consider the applicability of Step 14 below, and complete if warranted.

    In certain circumstances and based on project objectives, well development may consist of removing a fixed volume of water from the well that is predicated on the drilling method used for well installation. For wells installed without the introduction of drilling fluids (i.e., hollow stem augers, driven well points), three (3) well volumes are removed. For wells where drilling fluids were introduced (i.e., cased borings, rock coring, mud rotary methods), ten (10) well volumes are removed. In these cases, inorganic field parameter readings may be obtained for informational purposes.

14. A parallel objective of well development may be to remove drilling fluid lost to the formation(s) that was introduced during the drilling process. This aspect of development is complete when the identified volume of fluid is removed, and stabilized inorganic parameters are achieved.

15. If field parameters have not stabilized after Step 13, increase pumping rate to dislodge fine-grained materials from the filter pack, or remove sediment in suspension. It may be necessary to lower pump intake to accommodate drawdown. Avoid pulling coarse sediment into well intake to prevent pump impeller damage.

16. If slow recharge rate does not allow for continuous operation, shut off pump, allow well to recharge, and resume pumping at slower rate and well evacuation until discharge water clears. Resume measuring field parameters (Step 13) until stabilized.

17. Complete documentation as appropriate.

3.8 Well Development Procedure – Inertial Pump Methods

Inertial pumps use a dedicated pre-cleaned single ball check valve ("foot valve") and HDPE discharge tubing to manually remove water from the well.

1. Follow Preliminary Procedures above, including evaluation of well integrity and documentation of well construction details, and Section 5.7, Steps 1 through 10.

2. Attach foot valve (i.e. Waterra type) to bottom end of HDPE tubing and lower into well. Allow approximately 2 to 4 ft. extra tubing above well casing for controlling discharge of purge water.

3. To remove groundwater from the well, manually lift and lower the HDPE tubing within the well bore by hand, approximately once every three to five seconds, timing the motion to optimize purge water volume removed with each stroke. Clean foot valve if it becomes clogged or obstructed by sediment by carefully removing tubing from well, unthreading the foot valve, and rinsing with distilled water.

4. Monitor inorganic field parameters as in Steps 12 to 14, above.

5. If slow recharge rate does not allow for continuous purging, allow well to recharge, and resume purging and well evacuation until discharge water clears. Resume measuring field parameters until stabilized. HDPE tubing and foot valves are typically dedicated and left in groundwater well following sampling.

6. Complete documentation as appropriate.

3.9 Well Development Procedure - Surge Blocks

Surge blocks can be used in conjunction with pre-cleaned, dedicated inertial pumps (single ball check valve or "foot valve") and HDPE discharge tubing.

1. Follow Preliminary Procedures above, including evaluation of well integrity and documentation of well construction details, and Section 5.7, Steps 1 through 10.

2. Press fit the surge block device securely onto foot valve (i.e. Waterra type), attach foot valve to bottom end of HDPE tubing and lower into well. Allow approximately 2 to 4 ft. extra tubing above well casing for controlling discharge of purge water.

3. To surge the groundwater, lower the surge block into the water column and use as a "plunger" by manually lifting and lowering the HDPE tubing by hand, forcing water to flow into and out of the screened portion of the aquifer. Surge each well for a minimum of 30 minutes to remove the finer material from the aquifer surrounding the borehole, providing a developed zone of uniformly graded sand of higher porosity and higher permeability surrounding the well screen, allowing the water to flow more freely into the well, and reducing potential turbidity.

4. Following the surging portion of the well development, remove the surge block from the foot valve, and purge a minimum of one well volume from the well by removing the fine particles brought into the well during surging.

5. Monitor inorganic field parameters as in Steps 12 to 14, above.

6. If slow recharge rate does not allow for continuous purging, allow well to recharge, and resume purging and well evacuation until discharge water clears. Resume measuring field parameters until stabilized. HDPE tubing and foot valves are typically dedicated and left in well following sampling.

7. Complete documentation as appropriate.

3.10 Well Development Procedure - Bailers

Hollow, cylindrical bailers are a type of grab sampling device, and may be constructed of stainless steel, Teflon, or PTFE, typically with a single ball check valve fixed on the bottom. They are manually lowered into the well using a rope tether, allowed to collect well water, then lifted from the well. The collected water is discharged to a graduated bucket, and the process repeated until the well is deemed adequately developed. Stainless steel bailers are generally simple to decontaminate. Teflon or PTFE bailers are considered dedicated or disposable after one-time use.

In general, the use of bailers are not a preferred well development method, due to the time required to remove potentially large volumes of development water, especially in deep wells. Their use, however, creates agitation and mixing within the water column, which suspends sediment and fines, incrementally aiding in clearing the well and filter pack, thereby reducing turbidity.

PTFE ("clear") bailers are often used to collect NAPL for thickness measurements or product analysis. Although not discussed in this procedure, bailers are generally not recommended for groundwater sampling overall, and not acceptable for low-flow groundwater sampling in particular, especially sampling for volatile organic compounds (VOCs), volatile petroleum hydrocarbons (VPH), dissolved metals or other analytes requiring field filtration.

3.11 Restoration and Cleanup

The area around the well head and ground surface shall be completely cleaned up of any development materials (plastic sheeting, tubing, paper towels, litter, etc.), and the well secured.

3.12 Documentation

A complete record of the well development procedure should be documented and incorporated into the project file. Complete portions of the Groundwater Sampling Record form, recording the following information:

- Project information, date and personnel present
- Well location and designation
- Well condition inventory
- Presence of NAPL

- Diameter, depth of well, screened interval (if known), depth to static groundwater, volume of standing water column in well
- Detailed description of well development equipment and procedure used
- Time(s) development started and ended
- Incremental and total volume of purge water removed
- Inorganic field parameter measurements
- Comments on discharge water quality
- Modifications to procedures
- Decontamination method, and discharge water management method
- Drum count of accumulated discharge water, if applicable

Appendix C contains a blank Sampling Report (Form #3004), Groundwater Sampling Record (Form #3005), Monitoring Well Development Report (Form #3006) and Low Flow Field Sampling Form (Form #3010) for reference.

3.13 Precision and Bias

This procedure provides qualitative information only; therefore, a precision and bias statement is not applicable.

TABLE 1
Common Well Development Equipment

Material	Type	Power Requirement	Positive Attributes	Negative Attributes
Mechanical Pumps:				
Grundfos Pump	Submersible pump (variable speed)	120V A.C. current	-Lift height only constrained by cable length (+/- 150 ft.) -Controllable, variable flow rate from 0.01 to ≈35 L/minute -Stainless steel disassembles for simple decontamination See note 1	-Requires generator if no power source available -Risk of cross contamination of sample glassware or tubing from generator fuel -Heavy/cumbersome -Sediment may clog pump impellers -2.0 in. minimum well diameter See note 2
GeoDurham	Submersible Pump (variable speed)	12V D.C. current (Automotive battery)	-Portable power supply -Lift height only constrained by cable length (+/- 75 ft) -Controllable, variable flow rate -Stainless steel for simple decontamination See note 1	-Limit on lowest pump speed/discharge -Sediment may clog pump impellers -Power supply limits duration of pump use -2.0 in. minimum well diameter See note 2
Whale Pumps	Submersible pump (variable speed)	12V D.C. current (Automotive battery)	-Portable power supply -Lift height only constrained by cable length (+/- 30 ft.) -Disassembles for simple decontamination -1.5 in. minimum well diameter	-Power supply limits duration of pump use See note 2
Peristaltic Pumps	Suction lift surface pump (single speed)	12V D.C. current (Automotive Battery)	-Good for purging sediment from silt trap during development -Dedicated tubing -Easy to operate -0.5 in. minimum well diameter	-Not appropriate for sampling VOCs (agitation) -Lift limited to ≈25 ft. BGS -Pump rate 0.01 L/min.
Manual Methods:				
Inertial Pump	Submersible foot valve with discharge tubing	Manually operated	-Dedicated tubing -Inexpensive -Simple to operate -0.5 in. minimum well diameter	-Depth limited by manual capability to lift tubing (typically 70 to 80 ft.) -Tiring for large volumes of development water -Sediment may clog foot valve
Stainless Steel Bailer	Grab sample device with single check valve	Manually operated	-Disassembles for simple decontamination -Simple to operate	-Not appropriate for groundwater sampling (agitation) -Tiring for large volumes of development water -Splash hazard
Teflon Bailer	Grab sample device with single check valve	Manually operated	-Dedicated -Simple to operate -Inexpensive	-Not appropriate for groundwater sampling (agitation) -Tiring for large volumes of development water -Splash hazard
Clear Bailer	Grab sample device with single check valve	Manually operated	-Dedicated -Simple to operate -Inexpensive -Can collect NAPL for evaluation	-Not appropriate for groundwater sampling (agitation) -Tiring for large volumes of development water -Splash hazard

Notes and References:
1. Appropriate for low flow/low stress groundwater sampling.
2. Not appropriate if DNAPL/LNAPL present in monitoring well.

APPENDIX A
REFERENCES

A.1 Reference Procedures

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5521-94, "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers."

- Puls, R.W., Barcelona, M.J., 1996. "Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures," US EPA Ground Water Issue, US Environmental Protection Agency. Office of Solid Waste, EPA/540/S-95/504, pp. 1 to 12.

- US Environmental Protection Agency, Region I, (30 July 1996). "Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells," SOP # GW 0001, Revision 2.

A.2 Other References

- US Environmental Protection Agency, 1992. Office of Solid Waste," RCRA Groundwater Monitoring: Draft Technical Guidance," EPA/530/R-93/001, NTIS PB 93-139350, November 1992, pp. 6-46 to 6-50.

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D6634-01, "Standard Guide for the Selection of Purging and Sampling Devices for Groundwater Monitoring Wells."

- American Society for Testing and Materials, current edition, "Annual Book of ASTM Standards," Vol.04.08, D5903-96 (Reapproved 2001), "Standard Guide for Planning and Preparing for a Groundwater Sampling Event."

- Massachusetts Department of Environmental Protection, "Standard References For Monitoring Wells," January 1991, document WSC-310-91, Section 4.5 Well Development.

A.3 COMMENTS ON REFERENCE PROCEDURES

The procedures and equipment listed in EFP No. 01a and used by Haley & Aldrich are generally as specified in the ASTM and US EPA Reference Procedures. Deviations of EFP No. 01a from the Reference Procedures are not provided. The procedure described in Section 5 has been developed to assist Haley & Aldrich personnel in performing well development, and in some cases simplifies the Reference Procedures.

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP2020 Groundwater Monitoring (Observation) Well Abandonment
- OP2031 Groundwater Monitoring (Observation) Well Installation
- OP3000 General Environmental Field Procedures and Protocols
- OP3007 Procedures for Surface Water Sampling
- OP3008 Manual Water Level Measurement Procedure
- OP3010 Groundwater Quality Sampling Procedure
- OP3012 Low Stress/Low Flow Groundwater Sample Collection Procedure
- OP3014 NAPL Monitoring and Sampling
- OP3015 Aquifer Parameter Testing Procedure

APPENDIX C
FORMS

- 3004 Sampling Report
- 3005 Groundwater Sampling Record
- 3006 Monitoring Well Development Report
- 3010 Low Flow Field Sampling Form

HALEY & ALDRICH

SAMPLING RECORD

PROJECT ____________________ **H&A FILE NO.** ____________
LOCATION ____________________ **PROJECT MGR.** ____________
CLIENT ____________________ **FIELD REP** ____________
CONTRACTOR ____________________ **DATE** ____________

Weather ____________________ **Temperature** ____________
Ground surface Conditions ☐ Dry ☐ Wet ☐ Damp ☐ Standing Water ☐ Snow (_____in) ☐ Other___________
Comments ____________________

SOIL SAMPLING AND SURFACE WATER SAMPLING INFORMATION

Sample No.	Location	Depth (ft)	Time	Sample Description	Sampling Device	Cleaning Prodedure	Container Type

General Comments: (ie: field filtrations, persons communicated with at site, etc.)

GROUNDWATER SAMPLING RECORD

HALEY & ALDRICH

Page ___ of ___

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP	
CONTRACTOR		DATE	

GROUNDWATER SAMPLING INFORMATION

Well No.							
Water Depth (ft)							
Time							
Product							
Depth Of Well (ft)							
Inside Diameter (in)							
Standing Water Depth (ft) (1)							
Volume Of Water In Well (gal)							
Purging Device							
Volume of Bailer/Pump Capacity							
Cleaning Procedure							
Bails Removed/ Volume Removed							
Time Purging Started							
Time Purging Stopped							
Sampling Device							
Cleaning Procedure							
TIME SAMPLES TAKEN	VOA						
	ABN						
	Metals						
PARAMETERS	Color						
	Odor						
	pH						
	Conductivity						
	Turbidity						
	Dissolved Oxygen						
	Temp, ^{0} C						
	Salinity						

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

1. Standing Water Depth = Depth of Well - Water Depth

Form 3005

HALEY & ALDRICH

MONITORING WELL DEVELOPMENT REPORT

Well No.

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE	
ELEVATION SUBTRAHEND			

Estimated Volume of Water Lost During Drilling: ______________ gallons

Comments:

Depth to Water Before Development: ______________ feet

Comments:

Depth to Well Bottom Before Development: ______________ feet

Comments:

Turubitiy of Water Before Development: ______________ NTU

Comments:

Volume of Water Removed: ______________ gallons

Comments:

Method of Removal (bailing, pumping): ______________

Comments:

Depth to Well Bottom After Development: ______________ feet

Comments:

Depth to Water After Development: ______________ feet

Comments:

Turubitiy of Water After Development: ______________ NTU

Comments:

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LOW FLOW/MNA FIELD SAMPLING FORM

Page ____ of ____

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

Sampling Data:

Well ID:		Well Depth:		ft	Initial Depth To Water:		ft	Purging Device:		
Start time:		Depth To Top Of Screen:		ft	Depth Of Pump Intake:		ft	Tubing Present In Well:	☐ Yes	☐ No
Finish Time:		Depth To Bottom Of Screen		ft				Tubing Type:		

Elapsed Time (24 hour)	Depth To Water From Casing (ft)	Pump Setting (ml/min) or (gal/min)	Purge Rate (ml/min) or (gal/min)	Cumulative Purge Vol. (liters) or (gal)	Temp-erature (^{o}F) or (^{o}C)	pH	Conduct-ivity (us/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP/eH (mv)	Comments

OPERATING PROCEDURE: OP3012

LOW STRESS/LOW FLOW GROUNDWATER SAMPLE COLLECTION PROCEDURE

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	SLB/GMW / 05-02	NVD/ 12-01-02	GJM/ 6-5-02		JAK/ 6-10-03

Total Pages: 22

HALEY & ALDRICH

TABLE OF CONTENTS

OPERATING PROCEDURE: OP3012

LOW STRESS/LOW FLOW GROUNDWATER SAMPLE COLLECTION PROCEDURE

1. PURPOSE

This document describes procedures for collection of groundwater samples for laboratory analysis utilizing the "Low Stress/Low Flow Method". This method should be employed when it is critical to collect groundwater samples not impacted by over-purging, aeration, and sediment/colloid presence. Although the procedures described in this document are generally appropriate for obtaining groundwater samples as part of Monitored Natural Attenuation (MNA) programs, a more complete procedure for MNA programs is described in a separate document (Monitored Natural Attenuation Sample Collection Procedure).

The method described herein is most appropriate for wells that can accept a submersible pump and have a screened interval of ten feet or less. However, the procedure is flexible and can be modified for a variety of well construction and groundwater yield situations. The low-flow purging and sampling method is not appropriate for use in all hydrogeologic regimes, and certain groundwater monitoring well designs may make the method unsuitable (e.g. open hole and long screen monitoring wells in bedrock and stratified sand and clay where the water bearing zones have not been characterized).
This procedure does not address wells that contain Non-Aqueous Phase Liquids (NAPLs).

Note: The methods described in this document are provided for training use and general information. Depending upon regulatory agency and other project specific requirements, appropriate field procedures may differ from those described herein. These procedures should be confirmed with the Haley & Aldrich Project Manager prior to implementation.

1.1 BACKGROUND

Research conducted by Puls et al. (1992), Puls and Powell (1992), and Powell and Puls (1993) has shown that high-volume purging and sampling cause significant turbidity and suspended particulate artifacts that can result in an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Additionally, standard purging procedures can cause pressure changes and bailing can cause aeration that can strip volatile organic compounds from groundwater samples (Pennino, 1988) and provide misrepresentative data on aquifer conditions (such as dissolved oxygen and redox). Overpurging of a well can cause water to cascade down the well screen, causing undesirable aeration and volatilization.

The use of low-flow pumping devices for purging and sampling minimizes both the disturbance of water in well casing and the potential for mobilization of colloidal material (Barcelona et al., 1994). Low-flow purging with maintenance of water level in the well and stabilization of indicator parameters (especially turbidity) allows collection of groundwater samples that are more representative of conditions without filtering (U.S. EPA, 1993; Backhus et al., 1993). In many cases, use of a low-flow pump to purge and sample monitoring wells decreases sampling time, reduces the need to handle large volumes of purge water and lowers the cost associated with its disposal, and may allow collection of samples for without filtering.

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface that can be affected by flow regulators or restriction. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practicable taking into account established site sampling objectives (USEPA, Puls and Barcelona, April 1996).

2. EQUIPMENT & SUPPLIES

1. Adjustable rate, positive displacement pumps (e.g. low flow-rate submersible centrifugal or bladder pumps constructed of stainless steel or Teflon). The pump should be easily adjustable and capable of operating reliably at lower flow rates. An example is QED MicroPurge bladder pump (available for purchase or rental at US Environmental 781-899-6969, among others).

   Under most regulatory programs, peristaltic pumps may be used for collection of inorganic samples only – they are NOT appropriate for collection of VOCs. Bailers are inappropriate for use in this procedure. Waterra tubing purging and sampling is also not recommended for low-flow sampling by the USEPA.

2. Tubing: Tubing used in purging and sampling each well must be dedicated to the individual well. Once properly located, moving the pump in the well should be avoided. Consequently, the same tubing should be used for purging and sampling. The tubing wall thickness should be maximized (3/8 to ½ inch) and the tubing length should be minimized (i.e. do not have excess tubing outside of the well)

   - **Organic analysis**: Teflon or Teflon-lined polyethylene tubing must be used to collect samples.

   - **Inorganic analysis**: Teflon or Teflon lined polyethylene, PVC, Tygon or polyethylene tubing may be used to collect samples.

3. Polyethylene sheeting and sampling gloves.

4. Water level measuring device, 0.01 feet accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

5. Flow measurement supplies (e.g. graduated cylinder and stopwatch).

6. Interface probe, if needed.

7. Power source (e.g. generator, located downwind; nitrogen tank, etc). The generator should not be oversized for the pump.

8. In-line flow-through cell containing purge criteria parameter monitoring instruments for pH, turbidity, specific conductance, temperature, Eh and dissolved oxygen (DO). The in-line device should be bypassed or disconnected during sample collection. An example is the Horiba U-22 which is a flow-through cell that comes with probes capable of measuring pH, dissolved oxygen, conductivity, salinity, TDS, temperature, turbidity and oxidation-reduction potential. Available from Ashtead Technologies, 800.242.3910, www.ashtead-technology.com or Pine Environmental, 800-301-9663, www.pine-environmental.com, among others.

9. Photoionization detector (PID), or flame ionization detector (FID) or equivalent.

10. Nylon stay-ties

11. Decontamination supplies

12. Field book or well sampling form

13. Sample Bottles. It is recommended that preservatives be added to sample bottles prior to field activities to reduce potential error or introduction of contaminants.

14. Sample preservation supplies (as required by the analytical method; see previous item)

15. Sample tags or labels, and chain of custody.

16. Well construction data, location map, field data from last sampling event.

17. Sampling Plan or Work Plan

18. Health & Safety Plan

19. pH meter

20. Conductivity meter

21. Dissolved Oxygen (DO) meter

22. Oxidation -reduction (REDOX) reaction potential (ORP) meter

23. Nephlometer (turbidity)

24. Temperature gauge

25. Field test kits (such as Hach kits for measurement of dissolved iron (Fe^{+2}), carbon dioxide, and alkalinity). See the document "Monitored Natural Attenuation Groundwater Sample Collection Procedure" for specifications and ordering information for these types of kits.

26. Field filtration units (if required)

3. PROCEDURE

3.1 Sampling Preparatory Activities

Prior to entering the field there are several activities that should be conducted. The activities are as follows:

- Obtain and review a copy of the Sampling or Work Plan and Health & Safety Plan.
- Obtain and review previous groundwater sampling data (if available), previous water level measurements and well construction details (total depth and length of well screen).
- Locate a site map denoting the wells to be sampled.
- Obtain well wrenches, well keys and any other equipment needed to access the wells.
- Coordinate site access.
- Coordinate with laboratory to obtain sample bottles and necessary quality assurance samples.
- Perform an inventory of necessary purging, sampling, and field measurement equipment. Certain equipment may need to be purchased or rented for the sampling event. Check field measurement probes for proper calibration and ensure that the probes and kits are complete (i.e., contain calibration and analytical solutions) for the entire sampling event.

3.2 Preliminary Site Activities

Once on site the following activities should be conducted prior to beginning sampling.

- Verify well identification and location using borehole log details and location site map. Check the condition of the well and record any evidence of damage or need for repair in the field book or field sampling form. Following field activities inform the Project Manager of any necessary repair work required.
- Lay out sheet of clean polyethylene around the well for monitoring and sampling equipment.

- Prior to opening the well cap, measure the breathing space above the well casing with a PID or FID to establish baseline levels. Repeat this measurement once the well cap is opened. If either of these measurements exceeds the air quality criteria in the health and safety plan, field personnel should adjust their PPE accordingly.

- If the well does not have a water level reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the field book or sampling form.

- Collect a round of synoptic water level measurements and well depth (in the shortest possible time) before any purging or sampling activities begin. Water levels and well depths should be measured and reported to 0.01 ft. The water levels should be obtained from the denoted reference point on the well.

- Water level and total depth measurements must be obtained to determine the well volume for hydraulic purposes. In some settings it maybe necessary to allow the water level time to equilibrate. This condition exists if a watertight seal exists at the well cap and the water level has fluctuated above the top of screen thereby creating a vacuum or pressurized area in this air space. Three water level checks will verify static water level conditions or changing conditions.

- Check newly constructed wells for the presence of light or dense aqueous phase liquids before sampling.

3.3 Sampling Procedure

It is preferable to sample the wells in order of increasing chemical concentrations (known or anticipated). The following describes the procedure for the low-flow purging and sampling method. Equipment calibration, logbook documentation, sample bottle filling and preservation, and shipping will be conducted in accordance with the site-specific Quality Assurance Project Plan (QAPjP). Personal protective equipment will be donned in accordance with the requirements of the site-specific Health and Safety Plan.

1. Attach and secure the polyethylene tubing to the low-flow pump. See the equipment and materials section for recommended pump types. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties. It is recommended that the pump be placed in the well 12 to (preferably) 48 hours prior to purging/sampling to minimize the effects of turbidity and mixing in the well from introducing the pump.

2. Pump, safety cable, tubing and electrical lines should be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well, or at a location determined to either be a preferential flow path or zone where contamination is present. The pump intake should be kept above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

3. Before starting the pump, measure the water level again with the pump in the well. Start pumping water from the well at a rate of **100 to 500 milliliters per minute (mL/min) which correlates to 0.03**

to 0.13 gallons per minute. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface. The pumping rate should cause little or no water level drawdown in the well (less than 0.2 ft) and the water level should stabilize.

Water level measurements should be made every three to five minutes. Precautions should be taken to avoid pump suction loss or air entrainment. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump intake but the operator should attempt to maintain a steady flow rate with the pump to the extent practicable. Record adjustments made to the pumping rates and water levels immediately after each adjustment.

In low-yielding wells, where 100 mL/min exceeds the entrance rate of groundwater into the well, it is important to avoid dewatering the well screen interval and purging the well dry should be avoided to the extent possible. In these cases, the pump should remain in place and the water level should be allowed to recover repeatedly until there is sufficient volume in the well to permit collection of samples. Under these low-yield conditions, it may become difficult to maintain an adequate water volume in the flow-through cell described in the next step. An alternative means of sample collection may be necessary under these conditions and should be discussed with the Project Manager.

4. While purging the well, measurements of water quality indicator parameters utilizing an in-line flow-through cell (or similar equipment) should be collected every three to five minutes until all of the parameters have stabilized. See the Equipment and Materials section for recommendations. Stabilization is achieved when three successive readings are within the following tolerances noted in the table below.

Parameter	Stabilization Level (3 successive readings within)
Turbidity	+10% and final value between 5 and 10 NTU
Specific conductance	+3%
pH	±0.1
Dissolved oxygen (DO)	±10%
Redox potential (Eh)	±10mv

In general, the order of stabilization is pH, temperature and specific conductance, followed by redox potential, dissolved oxygen, and turbidity (USEPA, 1996). A minimum subset of these parameters that can be used to determine stabilization during purging in this procedure are pH, specific conductivity and turbidity or DO. Turbidity and DO are typically the last parameters to stabilize. If the parameters have stabilized, but the turbidity is not in the range of 10 NTU, then follow step 6. For informational purposes, the following table provides typical ranges of the various field parameters. Field data collected during purging and sampling should be compared against these values and, if substantial differences exist, the accuracy of the meter should be verified to rule out potential operational problems with the equipment.

Parameter	Typical Range of Values
Turbidity	10 – 500 NTU
Specific conductance	50 – 500 mS
pH	6 - 9
Dissolved oxygen (DO)	ND – 9 mg/L
Redox potential (Eh)	-250 - +400 mV

5. Once stabilization has been documented, go to step 8.

6. Should stabilization not be achieved for all field parameters (or turbidity only as described in Step 4), purging is continued until a maximum of 20 well screen volumes have been purged from the well. Since low-flow purging (LFP) likely will not draw groundwater from a significant distance above or below the pump intake, the screen volume is based upon a 5-foot (1.4 m) screen length. After purging 20 well screen volumes, purging is continued if the purge water remains visually turbid and appears to be clearing, or if stabilization parameters are varying slightly outside of the stabilization criteria listed above and appear to be approaching stabilization.

   - If low-turbidity samples are critical to the project goals, purging will be extended until turbidity has been reduced to 5 NTU or less.

   - The pump must not be removed from the well between purging and sampling.

7. If the turbidity measurements do not approach the range of that of natural groundwater (10 NTU), both filtered and unfiltered samples should be collected for analysis of compounds such as metals or hydrophobic compounds[1]. Filtered metal samples are to be collected with an in-line filter. A high capacity, in-line 0.45 micron particulate filter must be pre-rinsed according to the manufacturers recommendations, or with approximately 1 liter of groundwater following purging and prior to sampling. After the sample is filtered it must be preserved immediately.

8. Collect groundwater samples. All sample containers should be filled by allowing the pump discharge to gently flow down inside the container with minimal turbulence. The flow-through cell, or similar equipment, should be bypassed during sampling. As each sample bottle is collected, the bottle should be labeled with the following information then place into a cooler with the proper temperature control.

   - Sample number/ID
   - Date and time
   - Parameters to be analyzed
   - Project Reference ID
   - Samplers initials

[1] Filtering of samples for analysis is a project-specific requirement and should be confirmed with the Project Manager prior to filtration.

After collection of the samples, the tubing from the pump should be properly discarded or dedicated to the well for re-sampling (by hanging the tubing inside the well). Avoid handling the interior of the bottle or bottle cap and don new gloves for each well sampled to avoid contamination of the sample.

VOC and gas sensitive (e.g. Fe^{+2}, CH_4, H_2S/HS) parameter samples should be collected first. Refer the project sampling and analysis plan to determine which analytes will be measured in the field (wellhead) and which will be submitted to a fixed-base laboratory. The order of sample collection is as follows:

1. Volatile organic compounds
2. Gas sensitive parameters (e.g. Fe^{+2}, CH_4, H_2S/HS)
3. Semi-volatile organic compounds
4. Total organic carbon (TOC)
5. Total organic halogens (TOX)
6. Extractable organics
7. Total metals
8. Dissolved metals
9. Phenols
10. Cyanide
11. Sulfate and chloride
12. Nitrate and ammonia
13. Radionuclides

*Note: **The pumping rate used to collect a sample for VOCs should not exceed 100 mL/min.** Samples should be transferred directly to the final container 40 mL glass vials completely full and topped with a Teflon cap. Once capped the vial must be inverted and tapped to check for headspace/air presence (bubbles). If air is present the sample vial will be discarded, and re-collected until free of air. Field filtration will be performed if dictated by the project Work Plan.*

9. Measure and record final water level and well depth.

10. Secure the well (close and lock).

3.4 Decontamination

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed from well between purging and sampling operations. The pump and tubing (including support cable and electrical wires that are in contact with the well) will be decontaminated by one of the procedures listed below.

3.4.1 Procedure 1

Decontamination solutions can be pumped from buckets through the pump, or the pump can be disassembled and flushed with the decontamination solutions. It is recommended that the detergent and isopropyl alcohol be used sparingly in the decontamination process and that water-flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

1. Flush the equipment/pump with potable water.

2. Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

3. Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

4. Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event shows that the level of contamination is low, then this step may be skipped.

5. Flush with distilled/deionized water. The final water rinse must not be recycled.

6. Decontaminate the in-line flow-through cell and other sampling equipment with similar procedures, as appropriate.

3.4.2 Procedure 2

1. Steam clean the outside of the submersible pump.

2. Pump hot potable water from the steam cleaner through the outside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

3. Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

4. Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.
5. Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

6. Decontaminate the in-line flow-through cell and other sampling equipment with appropriate procedures.

3.5 Field Documentation

Field notes must document all the events, equipment used, and measurements collected during the sampling activities. The logbook or sampling form (see Appendix C Forms) should document the following for each well sampled:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Sounded well depth
- Presence of immiscible layers and detection/collection method
- Well yield - high or low
- Purge volume and pumping rate
- Time well purged
- Measured field parameters - record measurements obtained every 3-5 minutes to monitor for stabilization, see attached example record log.
- Purge/sampling device used
- Well sampling sequence
- Sampling appearance
- Sample odors
- Sample volume
- Types of sample containers and sample identification
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and method(s)
- Sample distribution and transporter

- Laboratory shipped to
- Chain of custody number for shipment to laboratory
- Field observations on sampling event
- Name collector(s)
- Climatic conditions including air temperature
- Problems encountered and any deviations made from the established sampling protocol.

3.6 Groundwater/Decontamination Fluid Disposal

Groundwater disposal methods will vary on a case-by-case basis and field personnel should consult the Project Manager for site-specific requirements. Disposal options may include:

- Off-site treatment at private treatment/disposal facilities or public owned treatment facilities.
- On-site treatment at Facility operated facilities.
- Direct discharge to the surrounding ground surface, allowing groundwater infiltration to the underlying subsurface regime.
- Direct discharge to impervious pavement surfaces, allowing evaporation to occur
- Decontamination fluids should be segregated and collected separately from wash waters/groundwater containers. Often small volumes of solvents used during the day can be allowed to evaporate if left in an open pail. In the event evaporation is not possible or practical, off-site disposal arrangements must be made.

APPENDIX A
REFERENCES

- USEPA Low-flow (minimal drawdown) groundwater sampling procedures (EPA/540/S-95/504), April 1996.

- USEPA Ground-Water Sampling-A Workshop Summary, Dallas, Texas, November 30 - December 2, 1993. EPA/600/R-94/205.

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- Barcelona, M.J., H.A. Wehrmann, and M.D. Varljen. 1994. Reproducible Well Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling. Ground Water. V. 32, pp. 12-22.

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- Puls, R.W. and R.M. Powell. 1992. Acquisition of Representative Ground Water Quality Samples for Metals. Ground Water Monitoring Review. V. 12, pp. 167-176.

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- USEPA Region 3. 1997. Recommended Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells. Waste and Chemicals Management Division - Low Flow Sampling. Bulletin No. QAD023.

- USEPA Region 1. 1996. Low Stress (Low Flow) Purging and Sampling for the Collection of Groundwater Samples from Monitoring Wells. SOP #: GW 001. Revision 2. pp.13.

- USEPA Region 2. 1998. Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling. GW Sampling SOP, Final.

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP3000 General Environmental Field Procedures and Protocol
- OP3001 Preservation and Shipment of Environmental Samples
- OP3008 Manual Water Level Measurement Procedure
- OP3009 Monitoring Well Development Procedure
- OP3010 Groundwater Quality Sampling Procedure
- OP3013 Monitored Natural Attenuation Groundwater Sample Collection Procedure
- OP3014 NAPL Monitoring and Sampling Procedure

APPENDIX C
FORMS

- Form 3001 Sampling Labels (Environmental)
- Form 3003 Chain of Custody
- Form 3004 Sampling Record
- Form 3005 Groundwater Sampling Record
- Form 3006 Monitoring Well Development Report

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St., Suite 2200
Boston, MA 02129
Tel: 617-886-7400

Sample ID:	File Number:
Depth:	Project:
Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

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Haley & Aldrich, Inc.
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Boston, MA 02129
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Date:	Analysis:
Time:	Preservative:
Collected By:	Laboratory:
Comments:	

HALEY & ALDRICH

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465 Medford St.,
Suite 2200,
Boston, MA 02129-1400

CHAIN OF CUSTODY RECORD

Phone (617) 886-7400
Fax (617) 886-7600

Page of

H&A FILE NO.		LABORATORY		DELIVERY DATE	
PROJECT NAME		ADDRESS		TURNAROUND TIME	
H&A CONTACT		CONTACT		PROJECT MANAGER	

Sample No.	Date	Time	Depth	Type	Analysis Requested													Number of Containers	Comments (special instructions, precautions, additional method numbers, etc.)
					VOA	ABNs PAH only	Metals RCRA (8) PP(13)	Pesticides PCBs	VPH Full Suite C-ranges only	EPH Full Suite C-ranges only	TPH (specify)	TCLP (specify)	Reactivity Ignitability Corrosivity						

Sampled and Relinquished by	Received by
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time

LIQUID													
													VOA Vial
													Amber Glass
													Plastic Bottle
													Preservative
													Volume
SOLID													
													VOA Vial
													Amber Glass
													Clear Glass
													Preservative
													Volume

PRESERVATION KEY

A Sample chilled	**C** NaOH	**E** H_2SO_4	**G** Methanol
B Sample filtered	**D** HNO_3	**F** HCL	**H** Sodium Bisulfate

Sampling Comments

Evidence samples were tampered with? YES NO

If YES, please explain in section below.

WHITE - Laboratory **CANARY** - Project Manager **PINK** - Haley & Aldrich Laboratory **GOLDENROD** - Haley & Aldrich Contact

Form 3003

WATER AND WASTEWATER METHODS			Solid	Liquid	
Analysis Description	**Method No.**	**Preservative**	**Sample Volume/Container**		**Holding Time**
Alkalinity	310	Cool 4° C	N/A	250 mL HDPE	14 days
Amenable Cyanide	Std. Mth. 412 F.	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
Ammonia	350	pH<2 H2SO4, Cool 4° C	N/A	1 L HDPE	28 days
Base/Neutral & Acid Extractables	625	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Biochemical Oxygen Demand (BOD)	405.1	Cool 4° C	N/A	2 L HDPE	48 hours
Chemical Oxygen Demand (COD)	410	pH<2 H2SO4, Cool 4° C	N/A	125 mL HDPE	28 days
Chloride	300.0, 325	None Required	N/A	125 mL HDPE	28 days
Chromium, Hexavalent	3500D, 218.4/5	None Required	N/A	1 L HDPE	24 hours
Fluoride	300.0, 340	None Required	N/A	500 mL HDPE	28 days
Hardness, Total (as CaCO3)	130	pH<2 H2SO4, Cool 4° C	N/A	250 mL HDPE	6 Months
Nitrate	300.0, 352.1	Cool 4° C	N/A	250 mL HDPE	48 Hours
Nitrite	300.0, 354.1	Cool 4° C	N/A	125 mL HDPE	48 Hours
Orthophosphate	300.0, 365	Filter, Cool 4° C	N/A	125 mL HDPE	48 Hours
PCBs	608	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Pesticides	608	Cool 4° C	N/A	1 L Amber	7 days Ext/40 days Analyze
Physiologically Available Cyanide	MADEP draft	pH>12 NaOH, 4° C	N/A	1 L HDPE	14 days
Priority Pollutant Metals (13 Metals)	200.7/AA, 200 Series	pH<2 HNO3, 4° C	N/A	1 L HDPE	28 days (Hg), 6 mos. (others)
Purgeable Halocarbons & Aromatics	601/602	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
RCRA Metals (8 Metals)	200.7/AA, 200 Series	pH<2 HNO3, 4° C	N/A	1 L HDPE	28 days (Hg), 6 mos. (others)
Sulfate	300.0, 375	Cool 4° C	N/A	250 mL HDPE	28 days
Sulfide	376	pH>9 NaOH, Zn Acetate, Cool 4° C	N/A	1 L HDPE	7 days
Sulfite	377.1	None Required	N/A	125 mL HDPE	Analyze Immediately
Total Cyanide	335	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
Total Dissolved Solids (TDS)	209	Cool 4° C	N/A	250 mL HDPE	7 days
Total Organic Carbon (TOC)	415	pH<2 HCl or H2SO4, Cool 4° C, Dark	N/A	40 mL Amber	28 days
Total Organic Halogen (TOX)	506	pH<2 HNO3, 4° C	N/A	1 L Amber	check with lab
Total Phenolics	420.1	pH<2 H2SO4, Cool 4° C	N/A	1 L Amber	28 days
Total Phosphorus	365	pH<2 H2SO4, Cool 4oC	N/A	125 mL HDPE	28 days
Total Solids (TS)	160.3	Cool 4° C	N/A	250 mL HDPE	7 days
Total Suspended Solids (TSS)	160.2	Cool 4° C	N/A	250 mL HDPE	7 days
Volatile Organics	624	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
Weak and Dissociable Cyanide	Std. Mth. 412 H.	pH>12 NaOH, Cool 4° C	N/A	1 L HDPE	14 days
DRINKING WATER ANALYSIS					
Volatile Organics	502.2 or 524.2	pH 2 HCl, Cool 4° C	N/A	40 mL Glass Vial	14 days
MICROBIOLOGY					
Fecal Coliform	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Standard Plate Count	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Total Coliform	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours
Yeast and Mold	STDMTH	Cool 4o C	N/A	sterile, 125 mL	6 hours

SOIL/SEDIMENTS/WATER		Solids (S) / Liquids (L)	Solid	Liquid	
Analysis Description	**Method No.**	**Preservative**	**Sample Volume/Container**		**Holding Time**
Acid Extractables/Base/Neutral Extractables	8270	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Amenable Cyanide	-	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Chromium, Hexavalent	3060A/7196	S/L: Cool 4° C	8 oz. CWM	1 L HDPE	24 hours
Extractable Hydrocarbons	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Herbicides	8150	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Non-Halogenated Organics	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
PAH (low level)	8310 or GC/MS SIM	S/L: Cool 4° C	8 oz. AWM	1 L Amber	7 days Ext/40 days Analyze
Paint Filter Liquids Test	9095	S: Cool 4° C	8 oz. CWM	1 L Amber	Analyze ASAP
PCBs	8082	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Pesticides	8081	S/L: Cool 4° C	8 oz. CWM	1 L Amber	7 days Ext/40 days Analyze
Physiologically Available Cyanide	MADEP draft	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Priority Pollutant Metals(13 Metals)	6010&7000	S: 4° C / L: pH<2 HNO3, 4° C	8 oz. CWM	1 L Amber	28 days (Hg), 6 mos. (others)
RCRA Metals (8 Metals)	6010&7000	S: 4° C / L: pH<2 HNO3, 4° C	8 oz. CWM	1 L Amber	28 days (Hg), 6 mos. (others)
Total Cyanide	9010	S: 4° C / L: pH>12 NaOH, 4° C	4 oz. CWM	1 L HDPE	14 days
Volatile Hydrocarbons	8015B	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
Volatile Organics	8260B, 8021	S: methanol/$NaHSO_4$, 4° C / L: pH<2 HCl, 4° C	4 oz. CWM	40 mL Glass Vial	14 days
RCRA HAZARDOUS WASTE CHARACTERIZATION					
Corrosivity (pH only)	SW846-7.2	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
Ignitability/Flashpoint	SW846-7.1	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
Reactivity (CN-/S2-)	SW846-7.3	S: Cool 4° C	4 oz. CWM	check with lab	Analyze ASAP
TCLP (RCRA 8) Metals (check for mercury)	1311	S: Cool 4° C	16 oz. CWM	check with lab	6 mos. Ext/6 mos. Analyze
TCLP Pesticides/Herbicides	1311	S: Cool 4° C	16 oz. CWM	check with lab	14 days Ext/40 days Analyze
TCLP Semivolatiles	1311	S: Cool 4° C	16 oz. CWM	check with lab	14 days Ext/40 days Analyze
TCLP Volatiles	1311	S: Cool 4° C	8 oz. CWM	check with lab	14 days Ext/14 days Analyze
HYDROCARBON OIL & GREASE ANALYSIS					
MADEP EPH Method	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
MADEP EPH Method (C-Ranges only)	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
MADEP VPH Method	MADEP REV. 0	S: methanol, 4° C / L: pH<2 HCl, 4° C	40 mL+2 oz. CWM.	40 mL Glass Vial	S: 28 days / L: 14 days
MADEP VPH Method (C-Ranges only)	MADEP REV. 0	S: methanol, 4° C / L: pH<2 HCl, 4° C	40 mL+2 oz. CWM.	40 mL Glass Vial	S: 28 days / L: 14 days
MADEP EPH Method - with selected PAHs (including acenaphthene, naphthalene, 2-methylnaphthalene, and phenanthrene)	MADEP REV. 0	S: Cool 4° C / L: pH<2 HCl, 4° C	4 oz. Amber	1 L Amber	S:7 days Ext / L:14 days Ext
Petroleum Identification	ASTM D3328				
Quantitative (include Chromatograms)		S: Cool 4° C / L: pH<2 H_2SO_4, 4° C	4 oz. CWM	1 L Amber	S: 7 days / L: 28 days
Total Petroleum Hydrocarbons (Infrared)	418.1	S: Cool 4° C / L: pH<2 H_2SO_4, 4° C	4 oz. CWM	1 L Amber	S: 7 days / L: 28 days

AIR METHODS					
Analysis Description	**Method No.**	**Preservative**	**Sample Volume/Container**		**Holding Time**
Volatile Organic Compounds	EPA T01/T02	tubes: 4° C; Tedlar Bags: dark	N/A	N/A	tube: 14 days; bag: 72 hours
Volatile Organic Compounds	EPA T014	check with lab	N/A	N/A	can: 14 days; bag: 72 hours
VPH in air	EPA T01/T02	tubes: 4° C; Tedlar Bags: dark	N/A	N/A	tube: 14 days; bag: 72 hours
VPH in air	EPA T014	check with lab	N/A	N/A	can: 14 days; bag: 72 hours

HALEY & ALDRICH

SAMPLING RECORD

Page   of

PROJECT		**H&A FILE NO.**	
LOCATION		**PROJECT MGR.**	
CLIENT		**FIELD REP**	
CONTRACTOR		**DATE**	

Weather ______________________ **Temperature** ______________________

Ground surface Conditions ☐ Dry ☐ Wet ☐ Damp ☐ Standing Water ☐ Snow (_____in) ☐ Other___________

Comments ______________________

SOIL SAMPLING AND SURFACE WATER SAMPLING INFORMATION

Sample No.	Location	Depth (ft)	Time	Sample Description	Sampling Device	Cleaning Prodedure	Container Type

General Comments: (ie: field filtrations, persons communicated with at site, etc.)

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GROUNDWATER SAMPLING RECORD

PROJECT ______ H&A FILE NO. ______
LOCATION ______ PROJECT MGR. ______
CLIENT ______ FIELD REP ______
CONTRACTOR ______ DATE ______

GROUNDWATER SAMPLING INFORMATION

Well No.							
Water Depth (ft)							
Time							
Product							
Depth Of Well (ft)							
Inside Diameter (in)							
Standing Water Depth (ft) (1)							
Volume Of Water In Well (gal)							
Purging Device							
Volume of Bailer/Pump Capacity							
Cleaning Procedure							
Bails Removed/ Volume Removed							
Time Purging Started							
Time Purging Stopped							
Sampling Device							
Cleaning Procedure							
TIME SAMPLES TAKEN	VOA						
	ABN						
	Metals						
PARAMETERS	Color						
	Odor						
	pH						
	Conductivity						
	Turbidity						
	Dissolved Oxygen						
	Temp, ^{0} C						
	Salinity						

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

1. Standing Water Depth = Depth of Well - Water Depth

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MONITORING WELL DEVELOPMENT REPORT

Well No.

Page 1 of 1

PROJECT		H&A FILE NO.	
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE	
ELEVATION SUBTRAHEND			

Estimated Volume of Water Lost During Drilling: ____________ gallons

Comments: ____________

Depth to Water Before Development: ____________ feet

Comments: ____________

Depth to Well Bottom Before Development: ____________ feet

Comments: ____________

Turubitiy of Water Before Development: ____________ NTU

Comments: ____________

Volume of Water Removed: ____________ gallons

Comments: ____________

Method of Removal (bailing, pumping): ____________

Comments: ____________

Depth to Well Bottom After Development: ____________ feet

Comments: ____________

Depth to Water After Development: ____________ feet

Comments: ____________

Turubitiy of Water After Development: ____________ NTU

Comments: ____________

QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
187 FALL STREET
SENECA FALLS, NEW YORK

by

Haley & Aldrich of New York
Rochester, New York

for

New York State Electric & Gas Corporation
Binghamton, New York

File No. 34507-001
10 July 2007
Revised 11 September 2007

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1. INTRODUCTION

1.1 Project Organization

Investigations performed as part of the Preliminary Site Assessment (PSA) for the Seneca Falls Former MGP Site, located at 187 Fall Street, Seneca Falls, Seneca County, New York, will require integration of personnel from the organizations identified below, collectively referred to as the "project team." A detailed description of the responsibilities of each member of the project team is presented below.

1.1.1 Overall Project Management

On behalf of New York State Electric & Gas Corporation (NYSEG), Haley & Aldrich of New York (Haley & Aldrich) will have overall responsibility for the PSA activities. Haley & Aldrich will perform related sampling activities, evaluate data, and prepare the deliverables as specified in the PSA Work Plan. Project direction will be provided by NYSEG, with oversight by the New York State Department of Environmental Conservation (NYSDEC). A list of key project management personnel conceptualized for this project is provided below.

Company/Organization	Title	Name	Phone Number
NYSDEC	Project Manager		
NYSEG	Project Manager	Tracy Blazicek	607-762-8839
Haley & Aldrich of New York	Project Officer	Colin Sweeney	973-658-3920
	Project Manager	Doug Allen	603-391-3320
	Field Manager	Kristina Gross	
	Quality Assurance Coordinator	TBD	
Laboratory	Project Manager	TBD	
	Quality Assurance Manager	TBD	

1.1.2 Task Managers

The staff performing the investigations and site activities will be directed by representatives of the project team. The personnel responsible for each of the Site activities are listed below.

Company/Organization	Title	Name	Phone Number
Haley & Aldrich of New York	Field Task Manager	Kristina Gross	
	Health and Safety Officer	Chip Osgood	
	Database Administrator	Michelle Toner	
	Data Validator	TBD	

1.2 Team Member Responsibilities

The responsibilities of the various team members are summarized below by organization.

1.2.1 New York State Gas & Electric Company

<u>**Project Manager**</u>

Responsibilities and duties include:

- Providing overall direction of site actions;
- Directing Haley & Aldrich; and

- Reviewing Haley & Aldrich's work products, including data, memoranda, letters, reports, and other documents transmitted to the NYSDEC.

1.2.2 Haley & Aldrich

Project Officer

Responsibilities and duties include:

- Overseeing work products; and
- Providing the approval for major project deliverables.

Project Manager

Responsibilities and duties include:

- Managing and coordinating the project as defined in the PSA Work Plan, with an emphasis on adhering to the objectives of the Site activities;
- Developing and reviewing documents; and
- Ensuring that corrective actions are taken for deficiencies cited during any audits of site activities.

Task Managers

The PSA components will be managed by various Task Managers, as set forth in Section 1.1.2. Duties of each Task Manager include, as appropriate:

- managing relevant day-to-day activities;
- developing, establishing, and maintaining files on relevant activities;
- reviewing data reductions from the relevant site activities;
- performing final data review of field data reductions and reports on relevant site activities;
- ensuring that corrective actions are taken for deficiencies cited during audits of relevant site activities;
- performing overall quality assurance/quality control (QA/QC) of the relevant portions of the Site activities;
- reviewing relevant field records and logs;
- instructing personnel working of relevant site activities;
- coordinating field and laboratory schedules pertaining to relevant site activities;
- requesting sample bottles from laboratory;
- reviewing field instrumentation, maintenance, and calibration to meet quality objectives;
- preparing reports pertaining to relevant site activities; and
- maintaining field and laboratory files of notebooks/logs, data reductions, and calculations and transmit originals to the Project Manager.

Field Personnel

Responsibilities and duties include:

- performing field procedures associated with the investigations as set forth in the PSA Work Plan;
- performing field analyses and collect quality assurance samples;

- calibrating, operating, and maintaining field equipment;
- reducing field data;
- maintaining sample custody; and
- preparing field records and logs.

Quality Assurance Coordinator (QAC)

Responsibilities and duties include:

- reviewing laboratory data packages;
- overseeing and interfacing with the analytical laboratory;
- coordinating field QA/QC procedures with Task Managers (including audits of field activities), concentrating on field analytical measurements and practices to meet data quality objectives (DQOs);
- reviewing field reports;
- performing and reviewing audit reports;
- preparing interim QA/QC compliance reports; and
- preparing a QA/QC report in accordance with United States Environmental Protection (USEPA) Region II guidelines, which includes an evaluation of field and laboratory data and data usability reports.

1.2.3 Analytical Laboratories

General responsibilities and duties of the analytical laboratories include:

- performing sample analyses and associated laboratory QA/QC procedures;
- supplying sampling containers and shipping cartons;
- maintaining laboratory custody of sample; and
- strictly adhering to protocols in the QAPP.

Project Manager

Responsibilities and duties include:

- serving as primary communication link between Haley & Aldrich and laboratory technical staff;
- monitoring workloads and ensure availability of resources;
- overseeing preparation of analytical reports; and
- supervising in-house chain-of-custody (COC).

Quality Assurance Manager

Responsibilities and duties include:

- supervising personnel reviewing and inspecting project-related laboratory activities; and
- conducting audits of laboratory activities.

1.2.4 NYSDEC

Project Manager

Responsibilities and duties include:

- providing NYSDEC review and approval of the PSA Work Plan, supporting documents, and future deliverables;
- ensuring that activities are performed in compliance with applicable federal, state, and regional requirements; and
- monitoring progress of site activities.

2. PROJECT BACKGROUND

2.1 Site Location and Description

The footprint of the Seneca Falls former MGP site is believed to be located at 187 Fall Street, Seneca Falls, Seneca County, New York. The Site is located adjacent to the Seneca River and Canal, which flows east towards Cayuga Lake. The site consists of an approximately 1.2 acre parcel currently owned by NYSEG and located in a mixed residential/commercial area. The site is bordered by Fall Street to the north, residential properties to the east, and a Sunoco gas station to the west.

The parcel located at 187 Fall Street is physically defined by upland and lowland areas, separated by a steep slope running east-west, located in the approximate center of the parcel. The upland area of the parcel is occupied by a building currently leased to Pick-A-Flick Video, a movie rental business. A paved parking lot is located immediately west of the building. The steep slope and lowland area of the parcel are wooded. The upland area of the site is generally flat with an elevation of approximately 456 feet above sea level, steeply sloping south to the lowland area of the site. The lowland area of the site gently slopes south to the Seneca River and Canal, with elevations from approximately 430 to 433 feet above sea level. Surface drainage (at a macro scale) is believed to be to the south toward the Seneca River and Canal.

2.2 Site History and Summary of Activities

The Seneca Falls MGP was established in approximately 1856, and produced manufactured gas using coal carbonization processes until plant closure circa 1903. A narrative history of Seneca County indicates in 1871 the gas plant included twenty (20) retorts, four (4) purifiers and a large condenser. The report is reported to be near the river in the narrative, however according to Sanborn Maps, the retort is located along Fall Street. It is unknown if an additional retort house existed near the river at the site. The gas holder at the site had a capacity of 25,000 cubic feet (cf). The Seneca Falls MGP supplied both the towns of Seneca Falls and Waterloo, where a separate gas holder was located. Annual gas production was 8,000,000 cf in 1889 and 7,000,000 cf in 1899. The 1904 Sanborn Map indicates that the plant is no longer in operation. The Seneca Falls MGP ceased operations between 1988 and 1904. Demolition of the retorts occurred between 1911 and 1916. The remainder of the gas plant was demolished between 1925 and 1944. Historical operation features of the Seneca Falls MGP are shown on Figure 2. (Atlantic Environmental Services, 1991)

2.3 Current Status

NYSEG has entered into the Multi-Site Consent Order (Index # D0-0002-9309, 30 March 1994) with the NYSDEC. The PSA will be performed to evaluate potential environmental impacts that may hinder the redevelopment and /or reuse of the property.

3. PROJECT DESCRIPTION

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

- Soil investigation; and
- Groundwater investigation.

Sampling protocols to be followed during the investigation activities are detailed in the FSP. Samples collected during the investigation will be analyzed in accordance with USEPA SW-846 Test Methods for Evaluating Solid Waste, with NYSDEC Analytical Services Protocol (ASP) Revision 2000. Table 2 presents a list of the constituents that will be analyzed for samples collected as part of the PSA. Health and safety protocols to be followed by field personnel during the completion of the investigation activities will be discussed in the Health and Safety Plan (HASP) that will be prepared and submitted to the Department prior to commencing field activities by Haley & Aldrich.

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

3.1 Soil Investigation

The objectives of the soil investigation are to:

- determine if MGP-related and/or non-MGP-related chemical constituents are present in soil at the Site by collecting, visually characterizing, and analyzing surface and subsurface soil samples;

- identify the potential presence of MGP-related and non-MGP-related by-product residuals, (such as coal tar, non-aqueous phase liquid (NAPL), purifier wastes, petroleum, solvents, etc.) in soil; and

- obtain sufficient information to evaluate the necessity for further action.

In addition to the objectives outlined above, the subsurface information collected as part of this investigation will be used to characterize the distribution and saturated thickness of underlying materials. This information is important in understanding how shallow groundwater is moving and whether there are areas where DNAPL, if present, could preferentially collect or migrate.

3.2 Groundwater Investigation

The objectives of the groundwater investigation are to:

- determine groundwater flow and hydraulic characteristics beneath the Site;

- evaluate, to the extent practicable, whether groundwater flow may be a pathway for offsite migration of identified chemical constituents (if present);

- gather sufficient analytical data to evaluate the necessity for further action;
- determine if MGP-related and/or non-MGP-related chemical constituents are present in groundwater beneath the Site by collecting and analyzing groundwater samples; and

- determine the potential presence of free-phase NAPL in subsurface materials, and, if present, quantify relevant physical properties of the NAPL.

3.3 Approach

The PSA will consist of a soil and groundwater investigation to address the PSA objectives. Samples collected during the investigation will be analyzed in accordance with the methods presented in this QAPP.

3.4 Project Schedule

A conceptual project duration schedule is presented in the PSA Work Plan.

4. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The DQO process, as described in the USEPA EPA QA/G-4 QAPP instructions document, is intended to provide a "logical framework" for planning field investigations. The following section addresses, in turn, each of the seven sequential steps in the EPA QA/G-4 QAPP DQO process.

Step 1: Problem Statement

The PSA will be conducted at the NYSEG Seneca Falls Former MGP Site to evaluate if MGP and/or non-MGP constituents of concern are present at the Site. The sampling and analysis program is intended to generate data to initiate a site database that may potentially support further investigations.

Step 2: Decision Identification

The initial use of the data is descriptive (distribution and concentration) and there is no decision point for this descriptive application. Subsequent to review of the descriptive information, an evaluation will be performed based on the findings of the Site investigation. The decision in this case is to determine if MGP and/or non-MGP constituents of concern are present at the Site and to evaluate potential exposure pathways and concentrations if constituents are discovered.

Step 3: Identifying Decision Inputs

Decision inputs incorporate both concentration and distribution. A fundamental basis for decision-making is that a sufficient number of data points of acceptable quality are available from the investigation to support the decision. Thus, the necessary inputs for the decision are: 1) the proportion of non-rejected (usable) data points; and 2) the quantity of data needed to thoroughly evaluate whether constituents of concern are present at the Site.

The data will be evaluated for completeness, general conformance with requirements of this QAPP, and consistency among data sets as appropriate.

Step 4: Defining the Study Boundaries

The former MGP site (the Site) is believed to be located at 187 Fall Street, Seneca Falls, Seneca County, New York. The Site is located adjacent to the Seneca River and Canal, which flows east towards Cayuga Lake. The site consists of an approximately 1.2 acre parcel currently owned by NYSEG and located in a mixed residential/commercial area. The site is bordered by Fall Street to the north, residential properties to the east, and Sunoco gas station to the west.

Step 5: Developing a Decision Rule

The decision on whether data can be used in the Site evaluation will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions noted. The sampling plan has been devised so that the loss of any single data point will not hinder description of the distribution of constituents of concern (if discovered) or the evaluation of further investigation activity. Given this, a reasonable decision rule would be that 90% of the data points not be rejected and deemed unusable for evaluation purposes. Applicable actions would be evaluated, if needed based on the results of the PSA.

Step 6: Limits on Decision Errors

Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability; and 2) understanding the representative nature of the sampling design. This QAPP has been designed to meet both specifications for this step. The sampling and analysis program has been developed based on a review of historical information and knowledge of present Site conditions. The representative nature of the sampling design has been developed by discussions among professionals familiar with the Site.

Step 7: Design Optimization

The overall quality assurance objective is to develop and implement procedures for field sampling; COC, laboratory analysis, and reporting that will provide results to support the evaluation of the Site data generally consistent with National Contingency Plan (NCP) requirements. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, data reporting, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

The sampling plan involves a phased approach to both sampling and analysis. This provides the opportunity to evaluate and focus each data collection step to optimize the overall data collection process.

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

4.1 Data Categories

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

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

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

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

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

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

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

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

Level 3 – Full Reporting: Full "CLP-type" reporting is used for those analyses that, based on intended data use, require full documentation. This reporting level would include ASP Superfund and Category B reporting. The analytical methods to be used during the PSA will be USEPA SW-846 methods with NYSDEC ASP Revision 2000, QA/QC requirement, and Category B reporting deliverables.

4.2 Field Investigations

As part of the PSA, field investigations will be conducted to support the DQOs. Details of the field sampling investigations are described in the PSA Work Plan.

5. SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

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

6. DOCUMENTATION AND RECORDS

6.1 General

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

6.2 Sample Designation System

6.2.1 Sample Codes

Samples will be identified with a unique designation system that will facilitate sample tracking. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events and conditions. An alpha-numeric system is considered appropriate and will be used by field personnel to assign each sample with a unique sample identification number. The sample identification number will begin with a two-letter prefix indicating the sample type, two digits indicating the year of sample collection, and two digits indicating the sequential sample number collected from the location.

The samples types will be designated using the following codes:

- Surface Soil – “SS;”
- Soil Boring – “SB;”
- Groundwater – “GW;”
- Trip Blank – “TB;” and
- Equipment Blank – “EB.”

Following sample type designation, all samples will be followed by two-digits indicating year of sampling. The two-digit sample number beginning with “01” will be assigned in the field and incremented by one as samples are collected from one to the next.

- Where necessary, the code system will be supplemented to accommodate additional sample identification information. For example, the code for soil samples will include a qualifier to identify the section increment (e.g., 0 to 0.5 feet).

Additional sample volumes collected for matrix spike (MS) and matrix spike duplicate (MSD) analysis will be noted on the COC forms, and the associated additional sample containers will be labeled with the appropriate suffix (MS or MSD). Rinse blanks will use to same coding scheme noted above, substituting the location code with the prefix “RB” (e.g., the first rinse blank associated with soil collection would be named RBSB01). Field duplicates will be labeled as ordinary field samples with a unique identification number (e.g., the first field duplicate associated with soil collection would be named DUPSB01). Duplicate samples will not be identified and the laboratory will analyze them as “blind” quality control samples.

6.2.2 Field Documentation

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

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

- Daily Production Documentation - A field notebook consisting of a waterproof, bound notebook that will contain a record of activities performed at the Site.

- Sampling Information - Detailed notes will be made as to the exact sampling location, physical observations, and weather conditions (as appropriate).

- Sample COC - COC forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by Haley & Aldrich field personnel designated to be responsible for sample custody. In the event the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample COC form is included in Appendix E-1.

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

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

6.3 Laboratory Documentation Files

6.3.1 Laboratory Project Files

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

6.3.2 Laboratory Logbooks

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

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

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

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

6.3.3 Computer Tape and Hard Copy Storage

Electronic files and deliverables will be retained by the laboratory for not less than 5 years; hard copy data packages (or electronic copies) will also be retained for not less than 5 years.

6.4 Data Reporting Requirements

Data will be reported both in the field and by the analytical laboratory, as described below.

6.4.1 Field Data Reporting

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

If applicable, field data forms and calculations will be processed and included in appendices to the appropriate reports (when generated). The original field logs, documents, and data reductions will be kept in the project file at the Haley & Aldrich Manchester, New Hampshire office.

6.4.2 Laboratory Data Reporting

The laboratory is responsible for preparing ASP Category B data packages for VOC, SVOC, metals, and total cyanide data reduced data packages, and case narratives for other analyses. Data reports for parameters will include, at a minimum, the following items:

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

- Laboratory name and address;
- Date of sample receipt;
- Cross-reference of laboratory identification number to contractor sample identification;
- Analytical methods used;
- Deviations from specified protocol; and
- Corrective actions taken.

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

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

- Sample ID;
- Laboratory ID;
- Date of collection;
- Date of receipt;
- Date of extraction;
- Date of analysis; and
- Detection limits.

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

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

6.5 Project File

Project documentation will be placed in project files according to Haley & Aldrich's requirements for document management. Project files typically consist of the following components:

1. Agreements/Proposals (filed chronologically);
2. Change Orders/Purchase Orders (filed chronologically);
3. Invoices (filed chronologically);
4. Project Management (filed by topic);
5. Correspondence (filed chronologically);
6. Notes and Data (filed by topic);
7. Public Relations Information (filed by topic);
8. Regulatory Documents (filed chronologically);
9. Marketing Documents (filed chronologically);
10. Final Reports/Presentations (filed chronologically);
11. Draft Reports/Presentations (filed chronologically); and
12. Documents Prepared by Others (filed chronologically).

7. SAMPLING PROCESS DESIGN

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

8. SAMPLING METHOD REQUIREMENTS

Groundwater and soil samples will be collected as described in the PSA Work Plan and the FSP. The FSP also contains procedures that will be followed to drill and sample soil borings; install and develop monitoring wells; measure water levels; collect groundwater samples; perform field measurements; and handle, package, and ship collected samples.

9. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

9.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for PSA samples are shown in Table 4.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned according to USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate). Sample labeling procedures are discussed in Section 9.2.2.

9.2 Field Custody Procedures

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

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

9.2.1 Field Logbooks

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

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

- Person to whom the logbook is assigned;
- Logbook number;
- Project name;
- Project start date; and
- End date.

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

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

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

9.2.2 Sample Labeling

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

- Project;
- Date collected;
- Time collected;
- Location;
- Sampler;
- Analysis to be performed;
- Preservative; and
- Sample number.

9.2.3 Field COC Forms

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

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

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

9.3 Management of Investigation Derived Materials and Wastes

Management of investigation-derived materials and wastes will be performed consistent with the USEPA guidance Guide to Management of Investigation – Derived Wastes, 9345.3-03FS, dated January 1992. Disposable equipment (including personal protective equipment) and debris will be containerized and appropriately labeled during the sampling events, and will be disposed of accordingly. Purged groundwater and water generated during equipment decontamination will be containerized and temporally staged onsite in a 55-gallon drum, and will be disposed of appropriately based on analytical results. Equipment will be decontaminated, as appropriate, as discussed in FSP. Soil cuttings associated with drilling of soil borings will also be collected and temporally stored onsite in a 55-gallon drum(s), and disposed of properly following receipt of analytical results.

9.4 Packing, Handling, and Shipping Requirements

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

Samples will be packaged for shipment as outlined below:

- Ensure that sample containers have the sample labels securely affixed to the container with clear packing tape.
- Check the caps on the sample containers to ensure that they are properly sealed.
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- Complete the COC form with the required sampling information and ensure that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer.
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place COC forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock, and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the following information: shipping address, return address, “Fragile”labels, and arrows indicating “this side up.” Cover the labels with clear plastic tape. Place a signed custody seal over the sample cooler lid.

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

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

Additional procedures for packing, handling, and shipping environmental samples are presented in FSP.

9.5 Laboratory Custody Procedures

9.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field COC form will accompany all samples requiring laboratory analysis. The laboratory will use COC guidelines described in the USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. Laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

9.5.2 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the cooler seal, open the cooler, and compare the contents against the field COC. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, Haley & Aldrich will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

9.5.3 Sample Analysis

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

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

9.5.4 Sample Storage Following Analysis

Samples will be maintained by the laboratory for at least one month after the final report is delivered to Haley & Aldrich. The laboratory will be responsible for the eventual and appropriate disposal of the samples. The analytical laboratory will inform the Haley & Aldrich before any samples are disposed. Unused portions of the samples, sample extracts and associated wastes will be disposed of by the laboratory in accordance with applicable rules and regulations as specified in their SOP for waste disposal.

10. ANALYTICAL METHOD REQUIREMENTS

10.1 Field Parameters and Methods

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

10.2 Laboratory Parameters and Methods

The methods listed below include the range of analyses expected to be performed. The associated laboratory SOPs can be found in Appendix E-2.

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

10.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 1	Environmental and Quality Control Sampling Analyses
Table 2	Parameters, Methods, and Quantification Limits
Table 4	Sample Containers, Preservation Methods, and Holding Times Requirements

10.2.2 PSA Sample Matrices

10.2.2.1 Groundwater

Analyses will be performed following the methods listed in Table 1. Analytical results for analyses will be reported in units identified in Table 3.

10.2.2.2 Soil

Analyses in this category will relate to soil samples. Analyses will be performed following the methods listed in Table 1. Results will be reported as dry weight, in units presented in Table 3. Moisture content will be reported separately.

10.2.3 Analytical Requirements

The primary sources to describe the analytical methods to be used during the investigation are provided in USEPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition, and USEPA Methods for Chemical Analysis of Water and Waste with NYSDEC ASP 2000 Revision, QA/QC, and reporting deliverables requirements. Detailed information regarding QA/QC is provided in NYSDEC ASP 2000 Revision, Exhibit E.

11. QUALITY CONTROL REQUIREMENTS

11.1 Quality Assurance Indictors

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

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

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

Each parameter is defined below. Specific objectives for the Site actions are set forth in other sections of this QAPP as referenced below.

11.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the Site. The actions have been designed to assess the presence of the chemical constituents at the time of sampling. The PSA Work Plan presents the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

11.1.2 Comparability

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

11.1.3 Completeness

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

11.1.4 Precision

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

11.1.5 Accuracy

Accuracy is the deviation of a measurement from the true value of a known standard. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MSs, blank spikes, and surrogates (system monitoring compounds) will be used to assess the accuracy of the laboratory analytical data. Further discussion of these quality control samples is provided in Section 11.5.

11.2 Field Quality Control Checks

11.2.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for field measurements. A duplicate measurement will involve obtaining measurements a second time at the same sampling location.

11.2.2 Sample Containers

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

11.2.3 Field Duplicates

Field duplicates will be collected from the different site materials to verify the reproducibility of the sampling methods. Field duplicates will be prepared by placing well homogenized aliquots (except samples for VOC analysis) from the same sample location into individual sample containers, which are submitted blind to the laboratory. Field duplicate water samples and soil samples for VOC analysis will constitute co-located samples rather than homogenized aliquots. In general, field duplicates will be analyzed at a 5% frequency (every 20 samples) for the chemical constituents. Table 1 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix.

11.2.4 Rinse Blanks

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

11.2.5 Trip Blanks

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

11.3 Analytical Laboratory Quality Control Checks

11.3.1 General

Internal laboratory quality control checks will be used to monitor data integrity. These checks will include method blanks, MS/MSDs, spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Project quality control limits for duplicates and MSs are identified in Table 2. Laboratory control charts will be used to determine long-term instrument trends.

11.3.2 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources which could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

11.3.3 MS/MSDs

MS/MSDs will be used to measure the accuracy of analyte recovery from the sample matrices and will be site specific. MS/MSD pairs will be analyzed at a 5% frequency (every 20 samples or once every week, whichever comes first).

When MS recoveries are outside quality control limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results. Table 1 presents an estimated number of MS and MSD analyses for each applicable parameter.

11.3.4 Surrogate Spikes

Surrogates are compounds which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) and gas chromatography (GC) methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified quality control limits, the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and reanalysis of the samples with additional control may be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

11.3.5 Laboratory Duplicates

For inorganics, laboratory duplicates will be analyzed to assess laboratory precision. Laboratory duplicates are defined as a separate aliquot of an individual sample that is analyzed as a separate sample. Table 1 presents an estimated number of laboratory duplicates for each applicable parameter.

11.3.6 Calibration Standards

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

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

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

11.3.7 Internal Standards

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

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

11.3.8 Reference Standards/Control Samples

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

11.4 Data Precision Assessment Procedures

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

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

The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

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

Where:

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

Precision objectives for MSD and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2000 and contained in Table 2.

11.5 Data Accuracy Assessment Procedures

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

Laboratory accuracy will be assessed via the use of MSs, surrogate spikes, internal standards, and reference standards. Where available and appropriate, quality assurance Performance Standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

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

Where:

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

This formula is derived under the assumption of constant accuracy over the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for MS recoveries and surrogate recovery objectives are identified in the NYSDEC ASP 2000 Revision and contained in Table2.

11.6 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90%. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

12. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

12.1 General

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

12.2 Field Instruments and Equipment

Prior to field sampling, each piece of field equipment will be inspected to ensure that it is operational. If the equipment is not operational, it will be serviced prior to its use. Meters which require charging or batteries will be fully charged and have fresh batteries. If instrument servicing is required, it is the responsibility of the appropriate Task Manager or field personnel to follow the maintenance schedule and arrange for timely service.

Field instruments will be maintained according to the manufacturers' instructions. Logbooks will be kept for each field instrument. Each logbook will contain records of operation, maintenance, calibration, and any problems and repairs. Logbooks for each piece of equipment shall be maintained in project records. The Task Managers will review calibration and maintenance logs.

12.2.1 Equipment Maintenance

Measuring and test equipment to be used in support of the PSA activities that directly affect the quality of the analytical data shall be subject to preventative maintenance measures that minimize equipment downtime. Equipment will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual to ensure that maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to ensure that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out.

Field equipment returned from a site will be inspected to confirm that it is in working order. The inspection will be recorded in the logbook or field notebooks, as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook. Non-operational field equipment will either be repaired or replaced. Appropriate spare parts will be made available for field meters.

Haley & Aldrich and subcontractor-owned or leased equipment maintenance shall be in accordance with the manufacturer's instructions.

12.3 Laboratory Instruments and Equipment

12.3.1 General

Laboratory instrument and equipment documentation procedures include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair).

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

12.3.2 Instrument Maintenance

Maintenance schedules for laboratory equipment adhere to the manufacturer's recommendations. Records reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures are performed through service contracts with manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventative maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the Laboratory Systems Manager.

Major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

12.3.3 Equipment Monitoring

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

13. INSTRUMENT CALIBRATION AND FREQUENCY

13.1 Field Instruments and Equipment

The calibration of field instruments is governed by specific SOPs documented in the FSP for the applicable field analysis method, and such procedures take precedence over the following discussion.

Field personnel are responsible for ensuring that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. Where applicable, each log will include, at a minimum, the following information:

- Name of device and/or instrument calibrated;
- Device/instrument serial/identification numbers;
- Calibration method;
- Tolerance;
- Calibration standard used;
- Frequency of calibration;
- Date(s) of calibration(s); and
- Name of person(s) performing calibration(s).

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated at the intervals specified by the manufacturer or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service. Equipment found to be out of tolerance during the period of use shall be removed from the field and measuring and testing activities performed using the equipment shall be addressed via the corrective action system described in Section 17.4 of this QAPP.

13.2 Laboratory Instrument and Equipment

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

VOCs

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

SVOCs

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

Metals and Cyanide (total)

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

14. INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Supplies to be used in the field and laboratory will be available when needed. They will be free of target chemicals and interferences. Reagents will be tested prior to use with site samples. Standards will be verified against a second source standard. The laboratory will follow a “first in first out” procedure for the storage and use of consumables to minimize the risk of contamination and degradation. The various supplies and consumables required onsite are noted in the various field SOPs included FSP.

15. DATA ACQUISITION REQUIREMENTS FOR NON-DIRECT MEASUREMENTS

At this point in time, NYSEG has not conducted a comprehensive investigation of the site. There is limited existing data generated in connection with the Site, associated with the Site Screening Report (September 1991), and the November 2002 surface soil sampling at the 185 Fall Street property. These data, in conjunction with historical background information concerning the activities at the Site will be used as guidance in determining sampling locations for the PSA.

16. DATA MANAGEMENT

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

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

The data management plan has five elements: 1) sample designation system; 2) field activities; 3) sample tracking and management; 4) data management system; and 5) document control and inventory.

16.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sampled collected, as outlined in Section 6.2.1.

16.2 Field Activities

Field activities designed to gather the information necessary to make decisions during the PSA process require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and quality assurance. These procedures are described in further detail in the following subsections.

16.2.1 Field Documentation

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

- Field logs; and
- COC forms.

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

Field Logs

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

COC Forms

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the field office. Field personnel will be briefed on the proper use of the COC procedure. COC procedures and a sample form are included in FSP.

Instrument Calibration Records

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

- Calibration date and time;
- Type and identification number of equipment;
- Calibration frequency and acceptable tolerances;
- Identification of individual(s) performing calibration;
- Reference standards used;
- Calibration data; and
- Information on calibration success or failure.

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

16.2.2 Data Security

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

16.3 Sample Management and Tracking

A record of field documentation will be maintained to ensure the validity of data used in the Site analysis. To effectively execute such documentation, specific sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms as summarized in Section 9.2.3. The completed COC forms associated with samples collected will be faxed to the QAC. Copies of completed COC forms will be maintained in the field office. The laboratory shall verify receipt of the samples electronically (via email) on the following day.

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

16.4 Document Control and Inventory

Project files will be maintained by Haley & Aldrich. The types of files to be retained consist of, but are not limited to, the following:

1. Agreements/Proposals (filed chronologically);
2. Change Orders/Purchase Orders (filed chronologically);
3. Invoices (filed chronologically);
4. Project Management (filed by topic);
5. Correspondence (filed chronologically);
6. Notes and Data (filed by topic);
7. Public Relations Information (filed by topic);
8. Regulatory Documents (filed chronologically);
9. Marketing Documents (filed chronologically);
10. Final Reports/Presentations (filed chronologically);
11. Draft Reports/Presentations (filed chronologically); and
12. Documents Prepared by Others (filed chronologically).

17. ASSESSMENT AND RESPONSE ACTIONS

17.1 General

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

17.2 Field Audits

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

The appropriate Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field activities to verify that activities are performed according to established protocols. The QAC will review field reports and communicate concerns to Haley & Aldrich's Project Manager and/or Task Managers, as appropriate. In addition, Haley & Aldrich's QAC will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures. In addition, systems audits comparing scheduled QA/QC activities from this document with actual QA/QC activities completed will be performed. The appropriate Task Manager and QAC will periodically confirm that work is being performed consistent with this QAPP, the PSA Work Plan, and FSP.

17.3 Laboratory Audits

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

Internal laboratory audits are conducted by the laboratory QAC. As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory quality assurance manual and SOPs. The results of the audits are summarized and issued to each department supervisor, the Laboratory Manager, and the Laboratory Director. A systems audit of each laboratory is also performed by the QAC to determine if the procedures implemented by each laboratory are in compliance with the quality assurance manual and SOPs.

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

Haley & Aldrich reserves the right to conduct an onsite audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

17.4 Corrective Action

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

17.4.1 Field Procedures

When conducting the field work, if a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented by the Field Manager or a designee, will be documented on a Corrective Action Form and reported to the appropriate Haley & Aldrich Task Manager, QAC, and Project Manager.

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

- Protocols as defined by the QAPP, PSA Work Plan, and FSP have not been followed;
- Equipment is not in proper working order or is not properly calibrated;
- QC requirements have not been met; or
- Issues resulting from performance or systems audits have not been resolved.

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

17.4.2 Laboratory Procedures

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

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

- Specific laboratory analytical protocols have not been followed;
- Protocols as defined by this QAPP have not been followed;
- Predetermined data acceptance standards are not obtained;
- Equipment is not in proper working order or calibrated;
- Sample and test results are not completely traceable;
- QC requirements have not been met; or
- Issues resulting from performance or systems audits have not been resolved.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities. Corrective action is initiated at a point were the problem has been identified. At whatever level his occurs (analyst, supervisor, data review, or quality control); it is brought to the attention of the laboratory AC and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director.

Any corrective action deemed necessary based on system or performance audits or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, re-analysis, cleanup, dilutions, matrix modifications, or other activities.

18. REPORTS TO MANAGEMENT

18.1 Internal Reporting

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

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

18.2 PSA Reporting

Upon sample transport to the laboratory, a copy of the chain-of-custody will be forwarded to Haley & Aldrich's Project Manager. Upon receipt of the ASP - Category B Data Package from the laboratory, Haley & Aldrich's Quality Assurance Manager will determine if the data package has met the required data quality objectives. The analytical data package will be submitted to the Haley & Aldrich Project Manager. The analytical data will be incorporated into the PSA Report in a tabulated format and the full data package will be submitted to the NYSDEC as an electronic appendix to the report.

19. DATA REDUCTION AND REVIEW

19.1 General

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

1. Reduction, or manipulation mathematically, or otherwise into meaningful and useful forms;
2. Review;
3. Organization, interpretation, and reporting; and
4. Data validation.

19.2 Field Data Reduction and Review

19.2.1 Field Data Reduction

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

19.2.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QAC. Logs and documents will be checked for:

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

19.3 Laboratory Data Reduction and Review

19.3.1 Laboratory Data Reduction

The calculations used for data reduction will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered are sufficient to document factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards.

Inorganic analyses will be based on regression analysis. Regression analysis is used to fit a curve through the calibration standard data. The sample concentrations will be calculated using the resulting regression equations. Non-aqueous values will be reported on a dry-weight basis. Unless otherwise specified, values will be reported uncorrected for blank contamination.

19.3.2 Laboratory Data Review

Data will be subject to multi-level review by the laboratory. The group leader will review data reports prior to release for final data report generation. The QAC will review the final data reports, and the Laboratory Director will review a cross-section of the final data reports prior to shipment to Haley & Aldrich.

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

19.3.3 Data Validation and Verification

Data generated for health and safety and engineering design/control purposes will be subjected to the data validation and verification procedures outlined in Section 20. Data generated for disposal purposes will not be reviewed.

20. DATA VALIDATION AND VERIFICATION

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

Haley & Aldrich will validate data generated producing a NYSDEC data usability summary report (DUSR) for each individual SDG using the most recent versions of the USEPA's Function Guidelines (USEPA, 1999; 2002) and USEPA Region II SOPs for data validation available at the time of project initiation, where appropriate. These procedures and criteria may be modified as necessary to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Deviations from the analytical method or any special reporting requirements apart from that specified in this QAPP will be detailed on COC forms.

- Upon receipt of laboratory data, the following procedures will be executed by the data validator:
- Evaluate completeness of data package;
- Verify that field COC forms were completed and that samples were handled properly;
- Verify that holding times were met for each parameter. Holding time exceedances, should they occur, will be documented. Data for samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis;
- Verify that parameters were analyzed according to the methods specified;
- Review QA/QC data (i.e., make sure duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method; verify that duplicate and MS recoveries are acceptable);
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate; and
- If data appears suspect, investigate the specific data of concern. Calculations will be traced back to raw data; if calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics as applicable to each method:

- Assessment of the data package;
- Description of any protocol deviations;
- Failures to reconcile reported and/or raw data;
- Assessment of any compromised data;
- Overall appraisal of the analytical data; and
- Table of site name, sample quantities, matrix, and fractions analyzed.

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean producing data without quality control qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by Haley & Aldrich's QAC at this point.

Data validation reports will be kept in the project file at Haley & Aldrich's Manchester, New Hampshire office.

21. RECONCILIATION WITH USER REQUIREMENTS

The data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results or inconsistent data, may include any or all of the following:

- Retrieval of missing information;
- Request for additional explanation or clarification;
- Reanalysis of sample from extract (when appropriate); and
- Recalculation or reinterpretation of results by the laboratory.

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

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

- Extrapolation of missing data from existing data points;
- Use of historical information; and
- Evaluation of the critical/non-critical nature of the sample.

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

- Additional sample collection and analysis.

REFERENCES

1. United States Environmental Protection Agency (USEPA). *Interim Guidance and Specifications for Preparing Quality Assurance Project Plans*. QAMS-005/80. Office of Research and Development. (December 1980).

2. USEPA. *NEIC Policies and Procedures Manual*. EPA-330/9-78-001R. National Enforcement Investigations Center. (May 1978, Revised August 1991).

3. USEPA. *Guide to Management of Investigation-Derived Wastes*. 9345.3-03FS (January, 1992). United States Environmental Protection Agency. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA-540/R-94-013. (February 1994a).

4. USEPA. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA-540/R-99-008 (October 1999).

5. USEPA. *EPA Requirements for Quality Assurance Project Plans for Environmental Operations*. EPA-QA/R-5. Office of Environmental Information. (March, 2001).

6. USEPA. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA-540/R-01-008 (July 2002).

7. USEPA. *Guidance for Quality Assurance Project Plans*. EPA-QA/G-5. Office of Environmental Information. (December, 2002).

8. USEPA. *Test Methods for Evaluating Solid Waste*. SW-846 3rd Edition, Update 3. Office of Solid Waste (December 1996).

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TABLE I
SAMPLE QUANTITIES AND QUALITY CONTROL FREQUENCIES
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Parameter	Estimated Environmental Sample Quality	Field QC Analyses						Laboratory QC Sample				Total
		Trip Blank		Rinse Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Soil												
Volatile Organic Compounds (SW-846 8260- TCL)	9 to 16	1/cooler	NA	1/day	2 to 3	1/20	1	1/20	1	1/20	1	14 to 22
Semivolatile Organic Compounds (SW-846 8270- TCL)	9 to 16	NA	NA	1/day	2 to 3	1/20	1	1/20	1	1/20	1	14 to 22
TAL Metals (SW-846 6010/7470/7471/9010)	9 to 16	NA	NA	1/day	2 to 3	1/20	1	1/20	1	1/20	1	14 to 22
Water												
Volatile Organic Compounds (SW-846 8260- TCL)	5	NA	1	1/day	1	NA	1	1/20	1	1/20	1	10
Semivolatile Organic Compounds (SW-846 8270- TCL)	5	NA	NA	1/day	1	NA	1	1/20	1	1/20	1	9
TAL Metals (SW-846 6010/7470/7471/9010)	5	NA	NA	1/day	1	NA	1	1/20	1	1/20	1	9

Notes:
Sample counts are an approximation; the final number of samples will be determined in the field pursuant to discussion and agreement with NYSDEC.
1/day One rinse blank per day or one per 20 samples, whichever is more frequent. Rinse blanks not required when dedicated sampling equipment is used.
Freq Frequency
NA Not Applicable
No. Number
QC Quality Control

TABLE II
ANALYTICAL QUALITY CONTROL LIMITS[1]
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Parameter	Accuracy - % Recovery			Precision - RPD		
	Surrogate	**MS/MSD**	**LCS**	**MS/MSD**	**Lab Duplicate**	**Field Duplicate**
Soil						
Volatile Organics	60-140	60-140	70-140	25	--	50
Semivolatile Organics	20-140	20-140	40-120	40	--	50
Metals	--	80-120	80-120	--	20	50
Groundwater						
Volatile Organics	75-115	60-145	70-140	20	--	30
Semivolatile Organics	20-140	20-130	40-120	40	--	30
Metals	--	80-120	80-120	--	30	30

Note:
1 The listed QC limits are based on SW-846 guidance and are advisory. The actual limits are determined based on laboratory performance. Frequent failure to meet the QC limits; however, warrants investigation of the laboratory.

TABLE III
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Analyte	Water (ug/L)			Soil/Sediment[2] (ug/kg)		
	NYS GW STD./G.V.[3]	Laboratory MDL	Laboratory RL	TAGM G.V.[4]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260[1]						
1,1,1-Trichloroethane	5	0.61	5	800	0.63	5
1,1,2,2-Tetrachloroethane	5	0.55	5	600	0.56	5
1,1,2-Trichloro-1,2,2-trifluouroethane	5	0.35	5	6,000	1.40	5
1,1,2-Trichloroethane	1	0.99	5	--	0.35	5
1,1-Dichloroethane	5	0.56	5	200	0.47	5
1,1-Dichloroethane	5	0.75	5	400	0.75	5
1,2,4-Trichlorobenzene	5	0.61	5	3,400	1.70	5
1,2-Dibromo-3-chloropropane	0.04	0.89	5	--	1.00	5
1,2-Dibromoethane	0.0006	0.48	5	--	0.23	5
1,2-Dichlorobenzene	3	0.54	5	7,900	0.90	5
1,2-Dichloroethane	0.6	0.65	5	100	0.50	5
1,2-Dichloropropane	1	0.56	5	--	0.64	5
1,3-Dichlorobenzene	3	0.24	5	1,600	0.97	5
1,4-Dichlorobenzene	3	0.33	5	8,500	1.00	5
2-Butanone	50	1.80	10	300	2.00	10
2-Hexanone	50	1.60	10	--	1.40	10
4-Methyl-2-pentanone	--	1.60	10	1,000	0.85	10
Acetone	50	3.90	20	200	2.50	20
Benzene	1	0.52	5	60	0.30	5
Bromodichloromethane	50	0.55	5	--	0.19	5
Bromoform	50	0.56	5	--	0.58	5
Bromomethane	5	1.30	5	--	0.98	5
Carbon disulfide	60	0.96	10	2,700	0.61	10
Carbon tetrachloride	5	0.62	5	600	0.30	5
Chlorobenzene	5	0.22	5	1,700	0.59	5
Chloroethane	5	0.85	5	1,900	2.00	5
Chloroform	7	0.55	5	300	0.39	5
Chloromethane	5	0.71	5	--	0.65	5
cis-1,2-Dichloroethene	5	0.77	5	--	0.83	5
cis-1,3-Dicloropropene	0.4	0.40	5	--	0.27	5
Cyclohexane	--	0.89	10	--	0.25	10
Dibromochloromethane	50	0.46	5	--	0.25	5
Dichlorodifluoromethane	5	0.82	5	--	0.66	5
Ethylbenzene	5	0.52	5	5,500	0.81	5
Isopropylbenzene	5	0.39	5	--	0.93	5
Methyl acetate	--	1.70	10	--	4.5	10
Methyl t-butyl ether (MTBE)	10	0.47	5	--	0.19	5
Methylcyclohexane	--	0.59	10	--	0.14	10
Methylene chloride	5	0.73	5	100	0.62	5
Styrene	5	0.28	5	--	0.90	5
Tetrachloroethene	5	0.56	5	1,400	0.62	5
Toluene	5	0.41	5	1,500	0.40	5
trans-1,2-Dichloroethene	5	0.88	5	300	0.75	5

See Notes on Page 4.

TABLE III
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Analyte	Water (ug/L)			Soil/Sediment[2] (ug/kg)		
	NYS GW STD./G.V.[3]	Laboratory MDL	Laboratory RL	TAGM G.V.[4]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260[1]	**(Cont'd.)**					
trans-1,3-Dichloropropene	0.4	0.66	5	--	0.54	5
Trichloroethene	5	0.73	5	700	0.44	5
Trichlorofluoromethane	5	0.82	5	--	0.62	5
Vinyl chloride	2	0.94	5	200	0.43	5
Xylenes (total)	5			1,200		
Semivolatile Organic Compounds 8270[2]						
1,1'-Biphenyl	5	0.96	10	--	33	330
2,2'-oxybis(1-Chloropropane)	5	0.68	10	--	49	330
2,4,5-Trichlorophenol	--	0.69	10	100	30	330
2,4,6-Trichlorophenol	--	0.73	10	--	33	330
2,4-Dichlorophenol	50	0.52	10	400	26	330
2,4-Dimethylphenol	50	1.40	10	--	42	330
2,4-Dinitrophenol	10	12.00	50	800	280	1700
2,4-Dinitrotoluene	5	0.74	10	--	42	330
2,6-Dinitrotoluene	5	0.56	10	1,000	40	330
2-Chloronaphthalene	10	0.75	10	--	27	330
2-Chlorophenol	--	0.46	10	800	26	330
2-Methylnaphthalene	--	0.67	10	36,400	27	330
2-Methylphenol	--	0.43	10	330	27	330
2-Nitroaniline	5	0.67	50	800	22	1700
2-Nitrophenol	--	1.00	10	330	29	330
3,3'-Dichlorobenzidine	5	0.98	10	--	42	330
3-Nitroaniline	5	0.75	50	800	56	1700
4,6-Dinitro-2-methylphenol	--	0.68	50	--	33	1700
4-Bromophenyl-phenylether	--	0.48	10	--	38	330
4-Chloro-3-methylphenol	--	0.47	10	330	31	330
4-Chloroaniline	5	0.50	10	330	56	330
4-Chlorophenyl-phenylether	--	0.65	10	--	34	330
4-Methylphenol	--	0.86	10	900	61	330
4-Nitroaniline	5	0.72	50	--	66	1700
4-Nitrophenol	--	7.00	50	800	38	1700
Acenaphthene	20	0.58	10	50,000	31	330
Acenaphthylene	--	0.63	10	41,000	27	330
Acetophenone	--	0.81	10	--	41	330
Anthracene	50	0.31	10	50,000	35	330
Atrazine	7.5	0.77	10	--	47	330
Benzaldehyde	--	1.13	10	--	84	330
Benzo(a)anthracene	0.002	0.35	10	330	35	330
Benzo(a)pyrene	ND	0.30	10	330	34	330
Benzo(b)fluoranthene	0.002	0.37	10	1,100	38	330
Benzo(g,h,i)perylene	--	0.36	10	50,000	34	330
Benzo(k)fluoranthene	0.002	0.40	10	1,100	44	330

See Notes on Page 4.

TABLE III
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

	Water (ug/L)			Soil/Sediment[2] (ug/kg)		
Analyte	NYS GW STD./G.V.[3]	Laboratory MDL	Laboratory RL	TAGM G.V.[4]	Laboratory MDL	Laboratory RL
Semivolatile Organic Compounds 8270[2]	**(Cont'd.)**					
bis(2-Chloroethoxy)methane	5	0.74	10	--	30	330
bis(2-Chloroisopropyl)ether	--	0.65	10	--	31	330
bis(2-Ethylhexyl)phthalate	5	0.86	10	50,000	34	330
Butylbenzylphthalate	50	0.56	10	50,000	32	330
Caprolactam	--	4.89	50	--	240	1700
Carbazole	--	0.39	10	--	45	330
Chrysene	0.002	0.44	10	400	40	330
Dibenz(a,h)anthracene	--	0.42	10	330	39	330
Dibenzofuran	--	0.56	10	6,200	33	330
Diethylphthalate	50	0.48	10	7,100	39	330
Dimethylphthalate	50	0.40	10	2,000	33	330
Di-n-butyl phthalate	50	1.30	10	8,100	42	330
Di-n-octyl phthalate	50	0.98	10	50,000	28	330
Fluoranthene	50	0.41	10	50,000	39	330
Fluorene	50	0.52	10	50,000	30	330
Hexachlorobenzene	0.04	0.52	10	410	37	330
Hexachlorobutadiene	0.5	0.76	10	--	26	330
Hexachlorocyclopentadiene	5	0.69	10	--	23	330
Hexachloroethane	5	1.00	10	--	35	330
Indeno(1,2,3-cd)pyrene	0.002	0.43	10	3,200	34	330
Isophorone	50	0.38	10	4,400	42	330
Naphthalene	10	0.66	10	13,000	29	330
Nitrobenzene	0.4	0.78	10	330	27	330
N-Nitrosodiphenylamine	50	0.85	10	--	34	330
N-Nitrosos-di-n-propylamine	50	0.31	10	--	35	330
Pentachlorophenol	1	10.00	50	1,000	34	330
Phenanthrene	50	0.34	10	50,000	41	330
Phenol	1	0.35	10	330	22	330
Pyrene	50	0.57	10	50,000	34	330
Inorganics 6010[1]						
Aluminum	--	40	100	--	6,000	10,000
Antimony	3	6	60	--	500	6,000
Arsenic	25	6	10	7,500	700	1,000
Barium	1,000	4	20	300,000	200	2,000
Beryllium	3	0.8	5	160	10	500
Cadmium	5	2	5	1,000	100	500
Calcium	--	78	500	--	7,000	50,000
Chromium	50	3	10	10,000	100	1,000
Cobalt	--	3	50	30,000	100	5,000
Copper	200	4	20	25,000	400	2,000
Iron	300	14	100	2,000,000	2,000	10,000
Lead	25	2	3	--	200	500

See Notes on Page 4.

TABLE III
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Analyte	Water (ug/L)			Soil/Sediment[2] (ug/kg)		
	NYS GW STD./G.V.[3]	Laboratory MDL	Laboratory RL	TAGM G.V.[4]	Laboratory MDL	Laboratory RL
Inorganics 6010[1] (Cont'd.)						
Magnesium	35,000	230	5,000	--	4,000	50,000
Manganese	300	2	15	--	200	1,000
Nickel	100	5	40	13,000	100	4,000
Potassium	--	1300	5,000	--	200,000	200,000
Selenium	10	3	5	2,000	500	500
Silver	50	4	10	--	100	1,000
Sodium	20,000	160	5,000	--	30,000	50,000
Thallium	0.5	2	10	--	500	1,000
Vanadium	--	13	50	150,000	500	5,000
Zinc	2,000	7	20	20,000	700	2,000
Inorganics 7470/7471[1]						
Mercury	0.7	0.02	0.3	100	0.02	0.5
Inorganics 9010[1]						
Cyanide	200	5.39	10	--	224	1,000

Notes:

1. USEPA. Office of Solid Waster and Emergency Response. *Test Methods for Evaluating Solid Waste SW-846 3rd ed., Washington, D. C. 1996.*
2. The target reporting limits are based on wet weight. The actual reporting limits will vary based on sample weight and moisture content.
3. Water guidance values (GV) are as presented in the NYSDEC, Division of Water, Technical and Operation Guidance Series document titled, *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (TOGS) 1.1.1) , dated June 1998, last revised April 2000.
4. Soil/Sediment guidance values (GV) are as presented in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) titled, *Determination of Soil Cleanup Objectives and Cleanup Levels*, HWR-94-4046 (TAGM 4046) dated January 24, 1994.

TABLE IV
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Parameter	Method[1]	Bottle Type	Preservation	Holding Time[2]
Soil				
Volatile Organic Compounds	8260	2 – 40 ml glass vials with Teflon® – lined lid	Cool to 4°C	10 days to analysis
Semivolatile Organic Compounds	8270	1- 8 oz glass jar with Teflon® – lined lid	Cool to 4°C	5 days to extraction
Metals (except mercury)	6010	1 – 4 oz wide mouth glass jar	Cool to 4°C	180 days to analysis
Mercury	7471			28 days to analysis
Total Cyanide	9010	1 – 8 oz wide mouth glass jar	Cool to 4°C	12 days to analysis
Water				
Volatile Organic Compounds	8260	2 – 40 ml glass vials with Teflon® – lined lid	HCL to pH<2 Cool to 4°C	10 days to analysis
Semivolatile Organic Compounds	8270	2 – 1 liter amber glass bottle with Teflon® – lined lid	Cool to 4°C	5 days to extraction 40 days to analysis
Metals (except mercury)	6010	1 liter plastic bottle	HNO3 to pH<2	180 days to analysis
Mercury	7470		Cool to 4°C	26 days to analysis
Total Cyanide	9010	1 liter plastic bottle	Adjust to pH>12 with NaOH, cool to 4°C	12 days

Notes:

1. USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste. SW-846 3rd ed. Washington, D. C. 1996.*
2. All holding times are measured from date of collection.

TABLE V
ELECTRONIC DATA DELIVERABLE (EDD) FORMAT
QUALITY ASSURANCE PROJECT PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

Field Name	Maximum Length	Data Type	Comments
FIELD SAMPLE ID	50	TEXT	From the chain of custody. Add "RE" or "DL" to differentiate reanalyses and dilutions
SDG	50	TEXT	
LAB SAMPLE ID	50	TEXT	
MATRIX	10	TEXT	SOIL and WATER
SAMPLE TYPE	10	TEXT	FB, RB, TB, FD, FS for Field Blank, Rinse Blank, Trip Blank, Field Duplicate and Field Sample, respectively. DEFAULT TO FS
DATE COLLECTED	--	DATE/TIME	MM/DD/YY
TIME COLLECTED*	--	DATE/TIME	Military time
DEPTH START	--	NUMBER	
DEPTH END	--	NUMBER	
DEPTH UNITS	25	TEXT	FEET, INCHES, METERS, etc.
ANALYTICAL METHOD	50	TEXT	
CAS NUMBER	25	TEXT	
ANALYTE	100	TEXT	
RESULT VALUE	--	NUMBER	For non-detected results, enter Reporting Limit ("U" must be present in Lab Qualifier field).
LAB QUALIFIER	10	TEXT	"U" for non-detected, others are defined by laboratory.
REPORTING LIMIT	--	NUMBER	
RESULT UNIT	25	TEXT	
DILUTION FACTOR	--	NUMBER	
REPORTABLE RESULT	--	YES/NO	DEFAULT TO YES
FILTERED?	--	YES/NO	
DATE ANALYZED	--	DATE/TIME	MM/DD/YY
TIME ANALYZED*	--	DATE/TIME	Military time
DATE EXTRACTED*	--	DATE/TIME	MM/DD/YY
LABORATORY NAME*	50	TEXT	

Notes:

1. This definition is for an "Excel-type" spreadsheet. Fields flagged with an "*" are optional and may be left blank if not available electronically from the laboratory.
2. Depth-related fields may be left blank for samples and matrices for which they are not applicable.

APPENDIX E-1

Chain-of-Custody Form

HALEY & ALDRICH
Haley & Aldrich, Inc.
465 Medford St.,
Suite 2200,
Boston, MA 02129-1400

CHAIN OF CUSTODY RECORD

Phone (617) 886-7400
Fax (617) 886-7600

H&A FILE NO.		LABORATORY		DELIVERY DATE	
PROJECT NAME		ADDRESS		TURNAROUND TIME	
H&A CONTACT		CONTACT		PROJECT MANAGER	

Sample No.	Date	Time	Depth	Type	Analysis Requested: VOA	ABNs PAH only	MCP Metals	Pesticides PCBs	VPH Full Suite C-ranges only	EPH Full Suite C-ranges only	TPH (specify)	TCLP (specify)	Reactivity Ignitability Corrosivity				Number of Containers	Comments (special instructions, precautions, additional method numbers, etc.)
																		Laboratory to use applicable DEP CAM methods, unless otherwise directed.

Sampled and Relinquished by	Received by
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time
Relinquished by	**Received by**
Sign	Sign
Print	Print
Firm	Firm
Date Time	Date Time

LIQUID

												VOA Vial
												Amber Glass
												Plastic Bottle
												Preservative
												Volume

SOLID

												VOA Vial
												Amber Glass
												Clear Glass
												Preservative
												Volume

PRESERVATION KEY

A Sample chilled	**C** NaOH	**E** H_2SO_4	**G** Methanol
B Sample filtered	**D** HNO_3	**F** HCL	**H** Sodium Bisulfate

Sampling Comments

Evidence samples were tampered with? YES NO

If YES, please explain in section below.

Presumptive Certainty Data Package (Laboratory to use applicable DEP CAM methods)

If Presumptive Certainty Data Package is needed, initial all sections:

__________ The required minimum field QC samples, as designated in BWSC CAM-VII have been or will be collected, as appropriate, to meet the requirements of Presumptive Certainty.

__________ Matrix Spike (MS) samples for MCP Metals and/or Cyanide are included and identified herein.

__________ This Chain of Custody Record (specify)__________includes __________does not include samples defined as Drinking Water Samples.

__________ If this Chain of Custody Record identifies samples defined as Drinking Water Samples, Trip Blanks and Field Duplicates are included and identified and analysis of TICs are required, as appropriate. Laboratory should (specify if applicable)__________analyze __________hold for contingency testing the Drinking Water Field Duplicate and Drinking Water Trip Blank samples.

Required Reporting Limits and Data Quality Objectives

☐ RC-S1	☐ S1	☐ GW1
☐ RC-S2	☐ S2	☐ GW2
☐ RC-GW1	☐ S3	☐ GW3
☐ RC-GW2		

APPENDIX E-2

Laboratory Standard Operating Procedure

Laboratory Standard Operating Procedures to be supplied by the Analytical Laboratory retained by NYSEG to provide analytical services in connection with the PSA Investigation.

COMMUNITY AIR MONITORING PLAN
SENECA FALLS FORMER MGP SITE
187 FALL STREET
SENECA FALLS, NEW YORK

by

Haley & Aldrich of New York
Rochester, New York

for

New York State Electric & Gas Corporation
Binghamton, New York

File No. 34507-001
10 July 2007
Revised 11 September 2007

TABLE OF CONTENTS

1. INTRODUCTION

This *Community Air Monitoring Plan* (CAMP) has been prepared by Haley & Aldrich of New York (Haley & Aldrich) to support the Preliminary Site Assessment (PSA) Work Plan for the Seneca Falls Former Manufactured Gas Plant (MGP) site located at 187 Fall Street, Seneca Falls, New York. The former MGP was known as the Seneca Falls & Waterloo Gas Light Co., which was a predecessor company to New York State Electric & Gas Corporation (NYSEG). The former MGP site is currently referred to as the Seneca Falls Former MGP site (Site). The 187 Fall Street parcel is currently owned by New York State Electric and Gas (NYSEG) and leased to Pick-A-Flick video rental store. The parcel has had various property owners and uses since the MGP ceased operation in the early 1900's.

This CAMP fulfills the general requirements set forth by the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan, dated June 2000 (Appendix F-1), and the NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) 4031, "Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites" (Appendix F-2). The intent of this CAMP is to provide for a measure of protection of the downwind communities from potential airborne releases of constituents of concern during PSA activities. As such, this CAMP specifies the potential air emissions, air monitoring procedures, monitoring schedule and data collection and reporting for the PSA activities to be conducted as described below.

1.1 Site Description

The footprint of the Seneca Falls former MGP site is located at 187 Fall Street, Seneca Falls, Seneca County, New York. As shown on Figure 1, the Site is located adjacent to the Seneca River and Canal, which flows east towards Cayuga Lake. The site consists of an approximately 1.2 acre parcel currently owned by NYSEG and located in a mixed residential/commercial area. The site is bordered by Fall Street to the north, residential properties to the east, and a Sunoco gas station to the west. The layout of the Site and surrounding properties is shown on Figure 2. A current aerial photograph that shows the Site and the adjacent area is presented as Appendix A. The parcel located at 187 Fall Street is physically defined by upland and lowland areas, separated by a steep slope running east-west, located in the approximate center of the parcel. The upland area of the parcel is occupied by a building that is actively used. A paved parking lot is located immediately west of the building. The steep slope and lowland area of the parcel are wooded. The upland area of the site is generally flat with an elevation of approximately 456 feet above sea level, steeply sloping south to the lowland area of the site. The lowland area of the site gently slopes south to the Seneca River and Canal, with elevations from approximately 430 to 433 feet above sea level. Surface drainage (at a macro scale) is believed to be to the south toward the Seneca River and Canal.

1.2 Summary of Selected Site Investigation Activities

The proposed PSA activities for the Site include surface and subsurface soil sampling using a tractor mounted direct-push rig, an excavator, and a conventional drill rig, groundwater monitoring well installation and development, and groundwater sampling. A more detailed description of the investigation activities can be found in the PSA Work Plan.

1.3 Potential Air Emissions Related to Investigation Activities

Certain intrusive PSA activities to be conducted at the Site have the potential to generate localized impacts to air quality including drilling, test pitting, and subsurface soil sampling.

Some non-intrusive PSA activities to be conducted may also have the potential to generate impacts to air quality, and include the collection of groundwater and surface soil samples.

1.4 Air/Odor Emissions and Control Measures

Air emissions control and fugitive dust suppression techniques will be used during the PSA activities identified above, as necessary, to limit the air/odor emissions from the Site. Air monitoring will take place during both intrusive and non-intrusive site activities.
Odor and dust control measures will be available at the Site and used when necessary. The following dust and odor suppression measures may be used during these activities, depending upon specific circumstances and air monitoring results:

- Water spray; and
- Polyethylene sheeting (for covering drill cuttings, soil stockpiles, etc.).

Polyethylene sheeting will be used to control nuisance odors and volatile organic compound (VOC) emissions, as needed. Also, dust emissions at the Site will be controlled by spraying water on exposed dry surface soil areas (e.g., temporary access roads, stockpiled drill cuttings, etc.), through the use of silt fences, and by covering soil stockpiles. Odor and dust control measures will be implemented based on visual or olfactory observations, and the results of airborne particulate and VOC monitoring.

2. AIR MONITORING PROCEEDURES

Real-time air monitoring will be implemented at the Site for volatile organic carbons (VOCs), polycyclic aromatic hydrocarbons (PAHs), and particulate matter less than 10 microns in diameter (PM10). Particulate monitoring will not be performed, however, during non-intrusive activities and precipitation events. Upwind and downwind monitoring locations will be determined through visual observation (wind vane, windsock, or similar technique). Monitoring will occur at each sample location and will include the use of hand-held direct-reading survey instruments.

2.1 Sampling Location Selection

Sampling activities will be determined daily based on visual observation of a wind direction. A single upwind location will be selected daily where both VOC and PM10 will be recorded. This upwind location will be established at the start of the workday, each day before the start of PSA activities. Sampling activities will continue in a downwind direction throughout the day. If wind direction shifts radically during the workday, (greater than approximately +/- 60 degrees from original upwind) new upwind and downwind sampling locations will be established. Any location changes will be documented in the field logbook.

2.2 VOCs and PAHs Monitoring

As required by the NYSDOH guidance for community air monitoring during intrusive activities, VOCs will be monitored continuously during ground intrusive site activities (installation of soil borings or monitoring wells) with instrumentation that is equipped with electronic data-logging capabilities. Because real-time monitors for PAHs do not exist, the real-time VOC monitors will also serve as surrogate indicators of PAH emissions at the Site. A real-time VOC monitor equipped with either a photoionization detector (PID) or a flame ionization detector (FID) will be used to conduct the monitoring for VOCs and PAHs. A MiniRAE 2000 (or equivalent) with 10.6 eV lamp will be used to conduct the real-time VOC monitoring. Appendix F-3 provides detailed information on the MiniRAE 2000. All 15-minute readings will be recorded in the field logbook or on the task-appropriate form, as well as any instantaneous readings taken to facilitate activity decisions. During non-intrusive site activities (monitoring well development, collection of groundwater samples from monitoring wells, and specific capacity testing), VOCs will be monitored periodically. Periodic monitoring may include monitoring upon arrival at the sample location, monitoring while opening a well cap or overturning surface soil, monitoring during well bailing and/or purging, and/or monitoring prior to leaving a sample location. However, if a sampling location is proximal to potentially exposed individuals, VOCs will be monitored continuously during sampling activities at that location.

2.3 Particulate Matter Monitoring

As required by the NYSDOH guidance, real-time particulate matter will be monitored continuously during intrusive site activities using instrumentation equipped with electronic data-logging capabilities. A MIE DataRAM (or equivalent) will be used to conduct the real-time PM10 monitoring. Appendix F-3 provides detailed information on the MIE DataRAM. All 15-minute readings will be recorded in the field logbook or on the task-appropriate form, as well as any instantaneous readings taken to facilitate activity decisions.

Fugitive dust migration will be visually assessed during all work activities, and reasonable dust suppression techniques will be used during any site activities that may generate fugitive dust. These activities and their design controls were discussed previously in Section 1.3 of this report.

2.4 Action Levels

The action levels provided below are to be used to initiate response actions, if necessary, based on real-time monitoring.

2.4.1 Action Levels for VOCs and PAHs

As outlined in the NYSDOH guidance document for CAMPs, if the ambient air concentration of total VOCs exceeds 5 parts per million (ppm) above background (upwind location) for the 15-minute average, intrusive site activities will be temporarily halted while monitoring continues. If the total VOC concentration readily decreases (through observation of instantaneous readings) below 5 ppm above background, then intrusive site activities can resume with continuous monitoring. If the ambient air concentrations of total VOCs persist at levels in excess of 5 ppm above background but less than 25 ppm above background, intrusive site work activities will be halted, the source of the elevated VOC concentrations identified, corrective actions to reduce or abate the emissions undertaken, and air monitoring will be continued. Once these actions have been implemented, intrusive site work activities can resume provided the following two conditions are met.

- The 15-minute average VOC concentrations remain below 5 ppm above background; and
- The VOC level 200 feet downwind of the sample location or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less but in no case less than 20 feet) is below 5 ppm over background for the 15-minute average.

If the ambient air concentrations of total VOCs exceed 25 ppm above background, the intrusive site activities must cease, and emissions control measures must be implemented.

Periodic monitoring for VOCs is required during non-intrusive activities. If these activities are undertaken at the Site, ambient direct-reading (instantaneous) VOC data will be periodically collected at the location of the non-intrusive activity and recorded in the field activity logbooks.

2.4.2 Action Level for PM10

As required by the NYSDOH guidance, if the ambient air concentration of PM10 at any one (or more) of the sampling locations is noted at levels in excess of 100 micrograms per cubic meter (µg/m3) above the background (upwind location), or if airborne dust is observed leaving the work area, intrusive site activities will be temporarily halted. The source of the elevated PM10 concentration is to be identified, corrective actions to reduce or abate the emissions will be undertaken, and air monitoring will continue. Work may continue following the implementation of dust suppression techniques provided the PM10 levels do not exceed 150 µg/m3 above background.

If, after implementation of dust suppression techniques, PM10 levels are greater than 150 µg/m3 above background, work must be stopped and site activities must be re-evaluated. Work may only resume provided that the dust suppression measures and other controls are successful in reducing PM10 levels less than 150µg/m3 above background and in preventing visible dust from leaving the Site.

If the ambient air concentration of PM10 is above 150 µg/m3 above background, the intrusive site activities must cease and emissions control measures must be implemented.

2.5 Meteorological Monitoring

Wind direction is the only meteorological information considered relevant for the PSA activities and CAMP. Meteorological monitoring will be conducted periodically at the Site using a windsock, wind vane, or other appropriate equipment. Wind direction will be established at the start of each work day and may be reestablished at any time during the work day if a significant shift in wind direction is noted.

2.6 Instrument Calibration

Calibration of the VOC and PM10 instrumentation will occur in accordance with each of the equipment manufacturer's calibration and quality assurance requirements. The VOC and PM10 monitors will be calibrated at least daily, and calibrations will be recorded in the field activity logbook.

3. MONITORING SCHEDULE, DATA COLLECTION, AND REPORTING

The following identifies the monitoring schedule, data collection, and reporting requirements.

3.1 Monitoring Schedule

Real-time VOC and PM10 monitoring will be performed continuously throughout the intrusive activities. VOC monitoring will also be performed during non-intrusive sampling-type activities. Wind direction will be determined at the start of each day and at any other appropriate time during PSA activities.

3.2 Data Collection and Reporting

Air monitoring data will be collected continuously from VOC and PM10 monitors during intrusive site activities by an electronic data-logging system. The data management software will be set up so that instantaneous observed readings would be recorded by the electronic data acquisition system and averaged over 15-minute time periods. All readings will be recorded and archived for review by NYSDOH and NYSDEC personnel. Any interruptions to air monitoring (e.g. a precipitation event) will be noted in the air monitoring record.

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APPENDIX F-1

Generic Community Air Monitoring Plan

APPENDIX 1A

New York State Department of Health
Generic Community Air Monitoring Plan

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

APPENDIX F-2

Fugitive Dust Suppression and Particulate Monitoring Programs at Inactive Hazardous Waste Sites

TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM #4031

FUGITIVE DUST SUPPRESSION AND PARTICULATE MONITORING PROGRAM AT INACTIVE HAZARDOUS WASTE SITES

TO: Regional Hazardous Waste Remediation Engrs., Bur. Directors & Section Chiefs

FROM: Michael J. O'Toole, Jr., Director, Division of Hazardous Waste Remediation

SUBJECT: DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM -- FUGITIVE DUST SUPRESSION AND PARTICULATE MONITORING PROGRAM AT INACTIVE HAZARDOUS WASTE SITES

DATE: Oct 27, 1989

Michael J. O'Toole, Jr. (signed)

1. Introduction

Fugitive dust suppression, particulate monitoring, and subsequent action levels for such must be used and applied consistently during remedial activities at hazardous waste sites. This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

2. Background

Fugitive dust is particulate matter--a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles, liquid droplets or solids, over a wide range of sizes--which becomes airborne and contributes to air quality as a nuisance and threat to human health and the environment.

On July 1, 1987, the United States Environmental Protection Agency (USEPA) revised the ambient air quality standard for particulates so as to reflect direct impact on human health by setting the standard for particulate matter less than ten microns in diameter (PM_{10}); this involves fugitive dust whether contaminated or not. Based upon an examination of air quality composition, respiratory tract deposition, and health effects, PM_{10} is considered conservative for the primary standard--that requisite to protect public health with an adequate margin of safety. The primary standards are 150 ug/m^3 over a 24-hour averaging time and 50 ug/m^3 over an annual averaging time. Both of these standards are to be averaged arithmetically.

There exists real-time monitoring equipment available to measure PM_{10} and capable of integrating over a period of six seconds to ten hours. Combined with an adequate fugitive dust suppression program, such equipment will aid in preventing the off-site migration of contaminated soil. It will also protect both on-site personnel from exposure to high levels of dust and the public around the site from any exposure to any dust. While specifically intended for the protection of on-site personnel as well as the public, this program is not meant to replace long-term monitoring which may be required given the contaminants inherent to the site and its air quality.

3. Guidance

A program for suppressing fugitive dust and monitoring particulate matter at hazardous waste sites can be developed without placing an undue burden on remedial activities while still being protective of health and environment. Since the responsibility for implementing this program ultimately will fall on the party performing the work, these procedures must be incorporated into appropriate work plans. The following fugitive dust suppression and particulate monitoring program will be employed at hazardous waste sites during construction and other activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Such activities shall also include the excavation, grading, or placement of clean fill, and control measures therefore should be considered.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM_{10}) with the following minimum performance standards:

   Object to be measured: Dust, Mists, Aerosols
   Size range: <0.1 to 10 microns
   Sensitivity: 0.001 mg/m^3
   Range: 0.001 to 10 mg/m^3
   Overall Accuracy: ±10% as compared to gravimetric analysis of stearic acid or reference dust

   Operating Conditions:
   Temperature: 0 to 40°C
   Humidity: 10 to 99% Relative Humidity

   Power: Battery operated with a minimum capacity of eight hours continuous operation

   Automatic alarms are suggested.

   Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes. Consequently, instrumentation shall require necessary averaging hardware to accomplish this task; the P-5 Digital Dust Indicator as manufactured by MDA Scientific, Inc. or similar is appropriate.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the entity operating the equipment to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m^3 over the integrated period not to exceed 15 minutes. While conservative, this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m^3, the upwind background level must be measured immediately using the same portable monitor. If the working site particulate measurement is greater than 100 ug/m^3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see Paragraph 7). Should the action level of 150 ug/m^3 be exceeded, the Division of Air Resources must be notified in writing within five working days; the notification shall include a description of the control measures implemented to prevent further exceedences.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM_{10} at or above the action level. Since this situation has the potential to migrate contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

    1. Applying water on haul roads.
    2. Wetting equipment and excavation faces.
    3. Spraying water on buckets during excavation and dumping.
    4. Hauling materials in properly tarped or watertight containers.
    5. Restricting vehicle speeds to 10 mph.
    6. Covering excavated areas and material after excavation activity ceases.
    7. Reducing the excavation size and/or number of excavations.

    Experience has shown that utilizing the above-mentioned dust suppression techniques, within reason as not to create excess water which would result in unacceptable wet conditions, the chance of exceeding the 150 ug/m^3 action level at hazardous waste site remediations is remote. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. If the dust suppression techniques being utilized at the site do not lower particulates to an acceptable level (that is, below 150 ug/m^3 and no visible dust), work must be suspended until appropriate corrective measures are approved to remedy the situation. Also, the evaluation of weather conditions will be necessary for proper fugitive dust control--when extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended.

There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require appropriate toxics monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

APPENDIX F-3

Monitoring Equipment Specifications

MiniRAE 2000
Handheld VOC Monitor

- Intrinsically safe
- Smallest handheld VOC monitor
- Datalogging workhorse

This VOC monitor with PID (photoionization detector) sensor weighs just over one pound, yet it's a heavyweight for leak detection, fugitive emissions monitoring to EPA Method 21 and inspecting leaking underground storage tanks. The MiniRAE 2000 is also a highly useful tool in industrial hygiene applications, including confined space entry, personnel and work place monitoring and for emergency response to hazardous spills. This rugged instrument comes with a belt clip.

With built-in correction factors for more than 100 chemicals, the MiniRAE 2000 provides excellent all-around sensitivity to most VOCs, down to 0.1 ppm. Selectable survey and hygiene modes permit the user to set appropriate alarm thresholds for STEL, TWA and low/high level peak values. Datalogging and custom software.

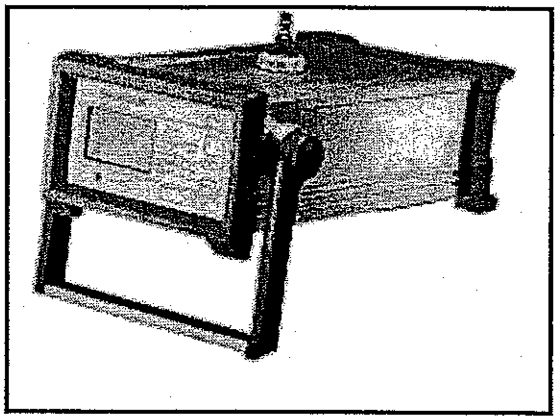
SPECIFICATIONS

Range	Resolution	Response Time	Accuracy
0 to 999 ppm	0.1 ppm	< 3 seconds	± 2 ppm or 10% of reading <2000 ppm
100 to 10,000 ppm	1 ppm	< 3 seconds	± 20% of reading > 2000 ppm
			Calibrated to 100 ppm isobutylene

Sampling Pump	Internal integrated flow rate 400 cc/minute Sample from 100' horizontally or vertically
Datalogging	15,000 points with time/date, header information
Approvals	UL and cUL Class I, Division 1, Groups A, B, C and D, EEx ia IIC T4
Battery	Rechargeable, field changeable NiMH battery pack, 10 hours operation
Dimensions (HWD)	2" x 3" x 8.2"
Weight	19.5 oz

RAE SYSTEMS MiniRAE 2000 PID rents with download cable, zero filter, probe tip, hydrophobic filter, charger, alkaline battery adapter, case and operating manual.

MIE DataRAM Aerosol Monitor
Portable Real-Time Particulate Monitor



- **Real-time measurement of particle concentrations**
- **Datalogging**

The DataRAM aerosol monitor measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, continuous unattended monitoring of indoor, duct or process air, as well as environmental and perimeter monitoring. The DataRAM has the widest measurement range of any real-time aerosol monitor — from 0.0001 mg/m³ to 400 mg/m³, or a total span of almost seven decades.

OPTIONAL ACCESSORIES

Respirable Cyclone Precollector, for respirable particle monitoring.
Isokinetic Sampling Probe, for isokinetic sampling within ducts.
Temperature Conditioning Heater, for monitoring above 70 percent RH.
Omnidirectional Sampling Inlet, for ambient monitoring under a variety of wind speeds and directions.
PM-10 Inlet Head, for PM-10 or PM-2.5 ambient particulate monitoring.

SPECIFICATIONS

Concentration Measurement Ranges (autoranging)	0.1 to 999.99 µg/m³, with resolution of 0.1 µg/m³ 1.00 to 39.99 mg/m³, with resolution of 0.01 mg/m³ 40.0 to 399.9 mg/m³, with resolution of 0.1 mg/m³
Accuracy	± 5% of reading ± precision
Particle Size Range of Maximum Response	0.1 to 10 µm
Sample Flow Rate	1.7 to 2.3 lpm
Datalogging	10,000 data points, with average, minimum and maximum concentrations for each point
Output	RS-232 port
Power	Sealed lead-acid battery, 24 hours operation, or AC operation with adapter
Dimensions (HWD)	5.28" x 7.25" x 13.63"
Weight	11.7 lbs

The MIE DataRAM aerosol monitor rents with an AC adapter/charger, serial download cable, software, filter cassette, soft carrying case and operating manual.

HALEY & ALDRICH, INC.

SITE-SPECIFIC HEALTH & SAFETY PLAN

for

Preliminary Site Assessment

Seneca Falls Former MGP Site
Seneca Falls, New York
Project/File No. 34507-001

Prepared by: Kristina Gross Date: 25 June 2007
Revised by: Kristina Gross Date: 11 September 2007

APPROVALS: The following signatures constitute approval of this Health & Safety Plan

______________________________ ____________________
Chip Osgood - Local H&S Coordinator Date

______________________________ ____________________
Doug Allen - Site/Project Manager Date

______________________________ ____________________
Chris Merrifield - Corporate H&S Manager Date
(Only required per request of LHSCs)

Date printed: 10/2/2007 at 2:44 PM

Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.

PRE-JOB SAFETY CHECKLIST

The following is a checklist that is designed to help Project Managers prepare for the H&S requirements needed for their projects. The use of this form should be used during the planning stage of the project and not intended to be used the day before the project. This form is to be attached to the front off all Health and Safety Plans (HASPs) before going to the field.

Please initial in each appropriate box and sign on the bottom of the appropriate box that the required materials, equipment, training, etc., has been procured before commencement of work on a site.

#	Project H&S Requirements	Approval by PM or LHSC (initial each box or place NA)	Date Approved
1.0	HASP and supporting documentation is complete and signed by all members		
2.0	Task Safety Analysis performed and attached to the HASP.		
3.0	All staff scheduled for project current with 40 hour or 8 hour refresher training.		
4.0	Is a Hazwoper site supervisor needed, if so, are they trained?		
5.0	Additional Training Requirements met: e.g.- nuclear density gauge, DOT, CSE, Competent Person Training for Excavation, etc		
6.0	We have met the client's additional H&S requirements above and beyond H&A's requirements. Example: facility safety orientations, safety documentation, meetings, PPE requirements		
7.0	H&A subcontractors have met H&A's minimum requirements, including- - Training - Medical surveillance - Written HASP - Insurance - MSDSs		
8.0	All H&A staff involved in project have met their Medical Surveillance examination requirements.		
9.0	Staff that may be required to wear a respirator, medically qualified and fit test card available.		
10.0	MSDSs on site and available for chemicals on site.		
11.0	Safety equipment available, such as: Flashlights, Telephone for communications, Ladders, Cones, Barricade tape, Fire extinguisher, First Aid Kit, PPE, Respiratory Protection, Air Instrumentation and Calibrated, Personal Flotation Device (PFD), 90' life line with ring, Decontamination equipment		

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Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.

ISSUANCE AND COMPLIANCE

- This Health and Safety Plan (HASP) must be signed by all Haley & Aldrich, Inc. (Haley & Aldrich) staff members who will work on the project, including Haley & Aldrich visitors.
- This HASP or a current signed copy must be retained at the site at all times when Haley & Aldrich staff are present. Senior management does recognize that it is difficult to utilize one HASP when many staff members are involved and there is no stationary location to maintain the HASP.
- Deviations from this HASP are not permitted without prior approval from the above signed. Unauthorized deviations may constitute a violation of Haley & Aldrich company procedures/policies and may result in disciplinary action.
- Revisions to this HASP must be outlined within the contents of the HASP. If immediate or minor changes are necessary, the LHSC and Haley & Aldrich Project Manager may use Appendix A (HASP Amendment Form), located in the back of this HASP. Any revision to the HASP requires employees to be informed of the changes and they understand the requirements of the change.
- This HASP is not for Haley & Aldrich Subcontractor use. Subcontractors must have their own HASP. This HASP will be made available for review by “reference only” to ensure that Haley & Aldrich has properly informed our subcontractors of the hazards associated with the site to the extent we are aware.
- See Appendix F (OP1016-Recordkeeping and Reporting) for recording keeping and incident reporting requirements
- This Site Specific HASP provides only site-specific descriptions and work procedures. General safety and health compliance programs in support of this HASP (e.g., injury reporting, medical surveillance, personal protective equipment (PPE) selection, etc. are described in detail in the Haley & Aldrich Corporate Health and Safety Program Manual and within Standard Operating Procedures (SOPs). Both the manual and SOPs can be located on the Company Intranet. When appropriate, users of this HASP should always refer to these resources and incorporate to the extent possible. The manual and SOPs are available to clients and regulators per request.

SITE SAFETY OFFICER

This project has identified the following person as the site safety officer (SSO). **The highest ranking person on site on this list will be the designated site safety officer.** The Haley & Aldrich Project Manager may designate any person as the primary. (PMs determine who will be on site and in order of highest level of authority when on site.) **A site safety officer must be on site at all times.** When none of the following are present on site, the senior person for Haley & Aldrich on site will default to the SSO.

1. Doug Allen
2. Kristina Gross
3. Christina Ondak

Roles and Responsibilities

The SSO is responsible for field implementation of this HASP and enforcement of safety rules and regulations. SSO functions include:

- Act as Haley & Aldrich's liaison for health and safety issues with client, staff, subcontractors, and agencies.
- Verify that utility clearance has been performed by Haley & Aldrich subcontractors.
- Oversee day-to-day implementation of the HASP by Haley & Aldrich employees on site.
- Interact with subcontractor project personnel on health and safety matters.
- Verify use of required PPE as outlined in the HASP.
- Inspect and maintain Haley & Aldrich safety equipment, including calibration of air monitoring instrumentation used by Haley & Aldrich.
- Perform changes to HASP and document in Appendix A of the HASP as needed and notify appropriate persons of changes.
- Investigate and report on-site accidents and incidents involving Haley & Aldrich and its subcontractors.
- Verify that site personnel are familiar with site safety requirements (e.g., the hospital route and emergency contact numbers).
- Report accidents, injuries, and near misses to the Haley & Aldrich PM and Local Health and Safety Coordinator (LHSC) as needed.

The SSO will conduct initial site safety orientations with site personnel (including subcontractors) and conduct toolbox and safety meetings thereafter with Haley & Aldrich employees and Haley & Aldrich subcontractors at regular intervals and in accordance with Haley & Aldrich policy and contractual obligations. The SSO will track the attendance of site personnel at Haley & Aldrich orientations, toolbox talks, and safety meetings. Subcontractors will document training and provide training rosters to the Haley & Aldrich SSO.

The SSO will report accidents such as injury, overexposure, or property damage to the Local Health and Safety Coordinator, to the Project Manager, and to the safety managers of other on-site consultants and contractors. The SSO will consult with the safety managers of other on-site consultants and subcontractors on specific health and safety issues arising over the course of the project, as needed.

PRE-WORK HEALTH & SAFETY BRIEFING

Note: Only Haley & Aldrich employees sign this page.

I have attended a briefing on this Health & Safety Plan prior to the start of on-site work and declare that I understand and agree to follow the provisions and procedures set forth herein while working on this site.

PRINTED NAME	SIGNATURE	DATE

Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.

1. PROJECT INFORMATION

Name of Project: Seneca Falls Former MGP Site	**H&A File No.:** 34507-001
Location: Seneca Falls, New York	
Client/Site Contact: New York State Electric & Gas Corporation (NYSEG)/Tracy Blazicek	**Contact Phone No.:** 607.762.8839 (tel) 607.237.5325 (cell)
H&A Project Manager: Doug Allen	**PM Phone No.:** 603.391.3320 (tel) 603.566.2604 (cell)

SCOPE OF WORK

This Site-Specific Health and Safety Plan addresses the health and safety practices and procedures that will be employed by all Haley & Aldrich employees participating in the site characterization of the Seneca Falls Former MGP Site. This plan is based on an initial assessment of the site-specific health and safety risks available to Haley & Aldrich and Haley & Aldrich's experience with other former MGP sites prior to conducting the Site Characterization Investigation. The scope of work for the Site Characterization includes surface soil sampling, excavation of test pits and drilling of soil borings in conjunction with subsurface soil sampling, groundwater monitoring well installation and development, and groundwater and NAPL (if present) gauging and sampling.

The investigation activities will provide data to address the following objectives:

- Determine if MGP-related and/or non-MGP-related chemical constituents are present in soil and/or groundwater at the Site;
- Identify the potential presence of MGP-related and/or non-MGP-related by-product residuals (such as coal tar, non-aqueous phase liquid [NAPL], purifier wastes, petroleum, etc.) in soil and/or groundwater at the Site;
- Evaluate, to the extent practicable, whether groundwater flow may be a pathway for offsite migration of identified chemical constituents (if present);
- Determine compliance with applicable NYSDEC standards, criteria, and guidance values (SCGs); and
- Provide sufficient data to evaluate the necessity for further action.

Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.

Subcontractor(s) to be involved in on-site activities:

Subcontractor Firm Name	Work Activity
Drilling Contractor: Parratt Wolff, Inc. Contact: Sean Pepling	Drilling, Test pitting

Projected Start Date: 17 September 2007
Projected Completion Date: approximately 1 month
Estimated Number of Days to Complete Field Work: 20 day

2. SITE DESCRIPTION

Check one of the following:

Site classification:	☐ Industrial	☐ Commercial	☑ Other residential/commercial

GENERAL DESCRIPTION

The footprint of the Seneca Falls former MGP site is located at 187 Fall Street, Seneca Falls, Seneca County, New York. The Site is located adjacent to the Seneca River and Canal, which flows east towards Cayuga Lake. The site consists of an approximately 1.2 acre parcel currently owned by NYSEG and located in a mixed residential/commercial area. The site is bordered by Fall Street to the north, residential properties to the east, and a Sunoco gas station to the west.

The parcel located at 187 Fall Street is physically defined by upland and lowland areas, separated by a steep slope running east-west, located in the approximate center of the parcel. The upland area of the parcel is occupied by a one-story building currently leased to Pick-A-Flick, a movie rental and tanning business. A paved parking lot is located immediately west of the building. The steep slope and lowland area of the parcel are wooded. The upland area of the site is generally flat with an elevation of approximately 456 feet above sea level, steeply sloping south to the lowland area of the site. The lowland area of the site gently slopes south to the Seneca River and Canal, with elevations from approximately 430 to 433 feet above sea level. Surface drainage (at a macro scale) is believed to be to the south toward the Seneca River and Canal.

Site Status

☑ Active Movie rental and tanning business	☑ Inactive MGP has been demolished
☐ Partially active	☐ Other Enter description here

Is a **site plan** or sketch available? ☑ Y ☐ N See Appendix B.

Work Areas

List/identify each specific work area(s) on the job site and indicate its location(s) on the site plan:

1. Refer to the figure included with the work plan for proposed surface soil sampling, test pit and soil boring, and monitoring well locations.

   Work will occur on the upland area of the site in the parking lot and the grassy area in front of the on site building, on the densely vegetated and wooded lowland area of the site, east of the site in the yard area of private residential properties, and north of Fall Street in the driveway of a private residential property.

3. PROJECT TASK BREAKDOWN

Task No.	Detailed Task Description	Employee(s)	Work Date(s) or Duration
1	Site reconnaissance	Doug Allen/ Kristina Gross	1 day
2	Surface Soil Sampling	Kristina Gross/ Christina Ondak	2 days
3	Test Pitting	Kristina Gross/ Christina Ondak	2-4 days
4	Soil Boring Installation	Kristina Gross/ Christina Ondak	1 day
5	Monitoring Well Installation	Kristina Gross/ Christina Ondak	3 - 4 days
6	Monitoring Well Development	Christina Ondak	2 days
7	NAPL/Groundwater Gauging	Christina Ondak	1 day
8	NAPL/ Groundwater Sampling	Christina Ondak	2.5 days

4. HAZARD ASSESSMENT

CHEMICAL HAZARDS

Material Safety Data Sheets (MSDS) of hazardous materials used during the execution of work shall be available on site. MSDSs are required for chemicals used to prepare samples, calibration gases, etc.

Note: MSDSs are not required for waste materials.

Does chemical analysis data indicate that the site is contaminated? ☑ Y ☐ N

Data gathered from the September 1991 report by Atlantic Environmental Services, Inc. and the March 2003 memo by NYSEG summarizing surface sampling is attached to this HASP. Preliminary data indicates elevated levels of heavy metals and semi-volatile organic compounds (SVOCs) on site. Volatile organic compounds (VOCs) and cyanide are also suspected to be present, as well as coal tar and/or other MGP residuals (purifier waste, slag, etc.).

Nitrile gloves must be worn when handling soil and/or MGP residuals. Avoid getting soil and MGP residuals on clothing. Coal tar can cause burns to the skin. Always stand upwind of excavated soils.

Always wear nitrile gloves and use caution when handling analytical bottleware containing preservatives. Sample preservatives can cause burns to the skin and irritate eyes, nose, and throat. Sample bottles can break during shipping, coating the contents of the cooler/book with preservatives. Sample bottles are fragile and can even break during routine handling.

Potential **physical state** of the hazardous materials at the site:

☑ Gas/Vapor
☑ Liquid
☑ Sludge NAPL/ Coal Tar
☑ Solid/Particulate

Anticipated/actual **class of compounds**:

☐ Asbestos
☑ BTEX
☐ Chlorinated Solvents
☑ Heavy Metals
☑ Inorganics
☐ Pesticides
☑ Petroleum products
☑ Other Coal Tar

Likely **impacted environments**:

☑ Air
☑ Soil
☐ Surface water
☑ Groundwater
☐ Sediment
☐ Other

Estimated concentrations (based on Haley & Aldrich's experience with other former MGP sites) and medium of major chemicals expected to be encountered by onsite personnel:

Work Activity	Media	Chemical	Anticipated Concentration
Task No. 2, 3, 4, 5, 6, 7, 8	Air	VOCs	ND to 25 ppm (estimated)
Task No. 1, 2, 3, 4, 5	Soil	VOCs SVOCs Metals Inorganics NAPL	ND to 2000 ppm (estimated)
Task No. 3, 4, 5, 6, 7, 8	Groundwater	VOCs SVOCs Metals Inorganics NAPL	ND to 1000 ppm (estimated)

PHYSICAL HAZARDS

Is any site work area(s) to be entered for this project considered a confined space? ☐ Y ☑ N

ALL CONFINED SPACE ENTRY PROJECTS REQUIRE SPECIAL PROCEDURES, PERMITS AND TRAINING AND MUST BE APPROVED BY THE CORPORATE HEALTH & SAFETY MANAGER.

Physical Hazard Checklist

<u>It is the project manager's responsibility to determine how to eliminate/minimize the potential hazards to protect onsite personnel.</u> Note: Task numbers refer to those identified in Section 3.

Potential Job Hazards	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
Underground utilities		✓	✓	✓	✓			
Overhead utilities		✓	✓	✓	✓			
Excavations greater than 4' depth			✓					
Open excavation fall hazards			✓					
Heavy equipment		✓	✓	✓	✓			
Drilling hazards		✓	✓	✓	✓			
Noise (above 85 dBA)		✓	✓	✓	✓			
Traffic concerns	✓				✓			
Extreme weather conditions	✓	✓	✓	✓	✓	✓	✓	✓
Rough terrain for drilling equipment			✓	✓	✓			
Heavy lifting (more than 50 lbs)						✓		✓
High risk fire hazard								
Poisonous insects or plants	✓	✓	✓	✓	✓	✓	✓	✓
Water hazards and/or Use of boat								
Other								

Work will be occurring in an active parking lot. Use caution tape and traffic cones to clearly delineate the work zone and ensure that drivers understand how to travel through the parking lot. The site is located on a busy main street; exercise caution when moving equipment and vehicles. Wear high visibility garnments.

Work will be occurring in a wooded/overgrown area where there is potential for mosquitos, ticks, poison ivy, and other biological hazards. Exercise caution and use bug repellent if necessary. Because the area of overgrown, there is also a potential slip/trip/fall hazards. Clear the work area and watch your footing.

Utility Locators and Underground Hazards

Prior to drilling, Haley & Aldrich staff members will ensure that permission has been gained from the property owner to access the property. Before marking any proposed exploration or drilling location, it is critical that all readily available information on underground utilities and structures be obtained. The estimated location of utility installations, such as sewer, telephone, fuel, electric, water, or any other underground installation that may be expected to be encountered during drilling work, will be identified with the appropriate authority. Appropriate authorities include client representatives, utility companies, nonprofit organizations (e.g., "Dig-Safe), and others. A list of all state “utility locators” is posted on the Health and Safety Homepage under “Guidance Documents”.

> *Note: It is important to note that not all utilities are participants in the “one-call” agency or process. As such, inquiries must be made with the “one-call” agency to determine which entities do not participate, so they can be contacted independently.*
>
> *Also, most stake-outs or markings have a limited time period for which they remain valid, typically 2 to 3 weeks. It is critical that this time period be taken into account to prevent expiration of clearance prior to completion of the invasive activities, and the need to repeat the process.*

Completion of the utility stake out is not a guarantee that the underground facilities will not be encountered in the boreholes; Very few if any guarantee their work, nor do they accept the liability for damage or losses if one may occur. Accordingly, Haley & Aldrich field staff are expected to use extreme caution in the upper 4-5 feet in the event the clearance has failed to identify an existing facility. This may necessitate hand-excavation or probing to confirm the presence of shallow utilities.

When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, geophysical techniques, such as ground penetrating radar and/or magnetometery can be utilized to locate the potential underground hazards. Using any information that can be obtained, the site should be viewed in detail for physical evidence of buried lines or structures. Evidence of surface elements of buried utilities should be documented, such as manholes, gas or water valves, catch basins, etc.

<u>No subsurface drilling activities will be allowed until all utilities have been properly located and marked.</u>

Marking locations can be accomplished using spray paint on the ground, stakes, or other similar method. All markings of proposed locations shall be made in white, in accordance with the generally-accepted universal color code for facilities identification (AWMA 4/99).

White:	Proposed excavation or drilling location
Pink:	Temporary Survey Markings
Red:	Electrical, Power Lines, Cables, Conduit, and Lightening Cables.
Yellow:	Gas, Oil, Steam, Petroleum , and Gaseous Materials.
Orange:	Communications, Alarm, or Signal Lines, Cables, and Conduits.
Blue:	Potable Water.
Purple:	Reclaimed Water, Irrigation, and Slurry Lines.
Green:	Sewers and Drain Lines.

The public and private utility entities generally only mark the locations of their respective underground facilities within public rights-of-way. Determination of the locations on private property will most likely be the responsibility of Haley & Aldrich or the contractor. In some cases, it may be necessary to put the ultimate responsibility back on the owner, to assist in the location of the utilities. It is incumbent on Haley & Aldrich and the Contractor to exercise caution and use good judgment when faced with uncertainty.

Noise Reduction

Site activities in proximity to heavy equipment often expose workers to excessive noise. It is anticipated that situations may arise when noise levels may exceed the OSHA Action Level of 85 dBA in an 8-hour time-weighted average (TWA). An example of this possibility is working in close proximity to the subcontractor during drilling activities onsite. If excessive noise levels occur, efforts will be made to control this by issuance of earplugs to all personnel and by implementing a system of hand signals understood by all.

Weather Related Hazards

H&A employees and their subcontractors should be aware of potential health effects and/or physical hazards of working during inclement weather. Refer to Appendix C (OP1003-Cold Stress) and Appendix D (OP1015-Heat Stress) for discussion on weather hazards.

Consider the following generic hazards and control methods when developing the HASP.

POTENTIAL ACTIVITY HAZARDS

1. Abrasions
2. Access
3. Asphyxiation
4. Bacteria
5. Biological Hazards
6. Bloodborne Pathogens
7. Cave ins
8. Chemical/Thermal Burns
9. Chemicals
10. Cold Stress
11. Compressed Gases
12. Confined Spaces
13. Congestion
14. Cuts
15. Defective Equipment
16. Dermatitis
17. Dropping Materials/Tools to Lower Levels
18. Drowning or flowing water
19. Electrical Shock
20. Elevated /Visibility of Overhead Work
21. Energized Equipment
22. Ergonomics
23. Explosions
24. Fatigue
25. Fire
26. Flammability
27. Flying debris
28. Foreign Body in Eye
29. Frost bite/cold
30. Fugitive Dust
31. Generated Wastes
32. Guards removed
33. Hazardous Materials
34. Heat Stress (cramps, exhaustion, stroke)
35. Heavy Equipment Operation (improper use)
36. Heavy Lifting
37. High crime area (violence)
38. High Winds
39. Hoists, Rigging, Slings, Wire, Rope
40. Impact
41. Improper Rigging
42. Inability to Maintain Communication
43. Inclement Weather
44. Inclines
45. Insects/Reptiles
46. Known/Unknown Visitors
47. Mold
48. Moving Equipment, Conveyors or Vehicles
49. Muddy Site Conditions
50. New Personnel
51. New Rental or Change in Equipment Used
52. Noise
53. Odor/VOC Emissions
54. Overhead Utilities
55. Overhead Work
56. Overloaded Equipment (tipping)
57. Oxygen deficiency
58. Pinch Points
59. Poisonous Plants
60. Poor Housekeeping
61. Poor illumination
62. Poor Visibility
63. Pressure
64. Pressurized Lines
65. Radiation
66. Repetitive Motion
67. Sharp Objects
68. Silicosis
69. Slips, Trips, and Falls
70. Sprains and Strains
71. Steam
72. Sunburn
73. Surface Water Run-off
74. Toxicity
75. Traffic
76. Underground utilities
77. Uneven terrain
78. Unsafe Atmosphere
79. Vibration
80. Weight
81. Work at Depth
82. Work at Heights
83. Work over Water
84. Working on Ice

HAZARD CONTROLS

Air Monitoring (Specify)
Appropriate Clothing/Monitoring Of Weather
Appropriate Labels/Signage
Barricades/Fencing/Silt Fencing
Buddy System
Confined Space Procedures
Decontamination Procedures
Derived Waste Management Plan
Drinking Water/Fluids
Dust Abatement Measures
Emergency Action Plan Procedures
Equipment Inspection
Equipment Manuals/Training
Exclusion/Work Zones
Exhaust Ventilation Fall Protection - Type
Fire Extinguisher/Fire Watch
Flotation Devices/Lifelines
Ground Fault Interrupter
Ground Hydraulic Attachments
Grounds on Equipment/Tanks
Hand Signal Communication
Hazardous/Flammable Material Storage
Hearing Protection (Specify)
Hoses, Access to Water
Hotwork Procedures
Isolation of Energy Sources(Lockout/Tagout)
Machine/Equipment Guards
Manual Lifting Equipment
Proper Lifting Techniques
Proper Tool for Job
Proper Work Position/Tools
Protective Equipment (Specify)
Radio Communication
Respirator, (Specify Type)
Safety Harness/Lanyard/Scaffold
Sloping, Shoring, Trench Box
Spill Prevention Measures/Spill Kits
Stormwater Control Procedures/Methods
Vehicle Inspection
Visitor Escort/Orientation/Security
Window Cleaning/Defrost

5. PROTECTIVE MEASURES

PERSONAL PROTECTION EQUIPMENT (PPE) REQUIREMENTS

Required PPE	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
Hard hat		✓	✓	✓	✓			
Safety glasses w/side shields		✓	✓	✓	✓	✓	✓	✓
Steel-toe footwear	✓	✓	✓	✓	✓	✓	✓	✓
Hearing protection (plugs, muffs)		✓	✓	✓	✓			
Tyvek ™ coveralls								
PE-coated Tyvek™ coveralls								
Boots, chemical resistant								
Boot covers, disposable								
Leather work gloves						✓	✓	✓
Inner gloves – Nitrile		✓	✓	✓	✓	✓	✓	✓
Outer gloves - Nitrile		✓	✓	✓	✓	✓	✓	✓
Tape all wrist/ankle interfaces								
Half-face respirator								
Full-face respirator								
Organic vapor cartridges								
Acid gas cartridges								
Other cartridges: Enter type here								
P-100 (HEPA) filters								
Face shield								
Personal Flotation Device (PFD)								
High-Visibility Safety Vest		✓	✓	✓	✓			
Other:								
Level of protection required [C or D]:	D	D	D	D	D	D	D	D

The PPE checked in any box above must be on site during the task being performed. Work shall not commence unless the PPE is present.

In the event of respirator use, H&A staff that may be required to wear a respirator must be:

- Medically qualified
- Fit tested
- Fresh shaven with no facial hair that will interfere with the seal. This includes one day hair growth or more, beards, excessive long side burns, and goatees.

Personal Hygiene Safeguards

The following decontamination procedure safeguards, at a minimum, shall be adhered to:

1. No Smoking or tobacco product on any Hazwoper project
2. No eating or dinking in the exclusion (hot) zone; and
3. It is especially important to wash your hands before eating, smoking, taking medication, chewing gum/tobacco, using the restroom, or applying cosmetics and before you leave the site for the day.

It is recommended that personnel present on site shower or bathe at home at the end of each day of working on the site.

Site Safety Equipment

Check all items that are required to be on site:

- [x] Fire Extinguisher
- [x] First Aid Kit
- [ ] Flashlight
- [ ] Air horn/signaling device
- [x] Cellular Phone
- [x] Duct tape
- [ ] Ladder
- [x] Barricade tape
- [ ] Drum dolly
- [ ] Two-way radio
- [x] Safety cones
- [ ] Harness/Lanyard
- [ ] Other Specify

The equipment checked in any box above must be on site during the task being performed. Work shall not commence unless the equipment is present.

Site Security & Work Area Controls

Access to each contaminated work area will be controlled during on-site activities as follows: Consider protection of both project and non-project personnel (e.g., general public, facility personnel).

Visual control of general access of contaminated work zones (exclusion zone) or decontamination station. Areas are to be delineated by cones and barricade tape. Haley & Aldrich employees are expected to maintain the area in conjunction with the contractors. No unauthorized personnel or general public to be allowed access to active work areas. Access to individual drilling sites cannot be controlled during non-work hours. Those who desire access to the site must have authorization and a current 40 hour and/or 8 hour Hazwoper certification.

Can **site access** be controlled by a perimeter fence or similar means? ☐ Y ☑ N

If not, how will the site/work area be controlled during non-work hours to prevent access by unauthorized persons?

Whenever possible boring/drilling work will be completed prior to the end of each work day and the equipment will be demobilized. If in the event work at a specific location is not completed the area will be marked-off by safety cones and barricade tape.

Training Requirements

5.1.1 Health and Safety Training

Personnel will not be permitted to supervise or participate in field activities until they have been trained to a level required by their job function and responsibility. H&A staff members, contractors, subcontractors, and consultants who have the potential to be exposed to contaminated materials or physical hazards must complete the training described in the following sections.

The Haley & Aldrich Project Manager/LHSC will be responsible for maintaining and providing to the client/site manager documentation of H&A staff members' compliance with required training as requested. Records shall be maintained per OSHA requirements.

5.1.2 40-Hour Health and Safety Training

The 40-Hour Health and Safety Training course provides instruction on the nature of hazardous waste work, protective measures, proper use of personal protective equipment, recognition of signs and symptoms which might indicate exposure to hazardous substances, and decontamination procedures. It is required for all personnel working on-site, such as equipment operators, general laborers, and supervisors, who may be potentially exposed to hazardous substances, health hazards, or safety hazards consistent with 29 CFR 1910.120.

5.1.3 8-hour Annual Refresher Training

Personnel who complete the 40-hour health and safety training are subsequently required to attend an annual 8-hour refresher course to remain current in their training. When required, site personnel must be able to show proof of completion (i.e., certification) at an 8-hr refresher training course within the past 12 months.

5.1.4 8-Hour Supervisor Training

On-site managers and supervisors directly responsible for, or who supervise staff members engaged in hazardous waste operations, should have eight additional hours of Supervisor training in accordance with 29 CFR 1910.120. Supervisor Training includes, but is not limited to, accident reporting/investigation, regulatory compliance, work practice observations, auditing, and emergency response procedures.

5.1.5 Additional Training for Specific Projects

H&A personnel will ensure their personnel have received additional training on specific instrumentation, equipment, confined space entry, construction hazards, etc., as necessary to perform their duties. This specialized training will be provided to personnel before engaging in the specific work activities. Any staff member engaging in the following activities will be required to have additional training:

- Client specific training or orientation
- Competent person excavations
- Confined space entry (entrant, supervisor, and attendant)
- Heavy equipment including aerial lifts and forklifts

- First aid/ CPR
- Diving
- Use of fall protection
- Commercial Drivers License
- Use of Nuclear Density Gauges
- Asbestos

5.1.6 Medical Surveillance Requirements

Staff members performing field work will participate in the Medical Surveillance Program. Participation in the program, as outlined in Health and Safety OP #OP1009, "Medical Surveillance" (Appendix H), is required as a condition of employment for all H&A staff members who are engaged in potentially hazardous work, in particular, those who work on hazardous waste sites. Staff member participation in the Medical Surveillance Program is outlined in the OP.

Any H&A staff member who is determined medically unfit by an examining physician to perform field work with appropriate protection (e.g., cannot wear a respirator because of decreased pulmonary function) will not be allowed to participate in the type(s) of field activities that pose a medical threat to the staff member.

The Medical Surveillance Program applies to H&A staff members whose jobs involve activities that pose the potential for overexposure to toxic substances or physical agents, or that may require the use of respiratory protection. The medical surveillance program has been specifically designed to:

- Provide pre-placement baseline medical examinations (establish a "medical baseline") to determine the medical fitness of newly hired staff members covered by the program to perform their anticipated work tasks;

- Provide annual examinations to detect medical conditions or changes that may affect medical suitability for unrestricted work;

- Provide interim and post-exposure examinations, as necessary, based on types of projects and materials handled;

- Provide exit examinations for staff members covered by the program whose employment with H&A has been terminated;

- Limit the potential for occupational illness through early detection of subclinical disease states and the promotion of good health through risk factor reduction; and

- Comply with applicable OSHA standards that require the provision of medical surveillance examinations.

H&A has developed a recordkeeping system, consistent with OSHA requirements, which requires that all medical and related records be accessible to the respective staff members, and that confidentially be maintained.

6. MONITORING PLAN AND EQUIPMENT

Is **air/exposure monitoring** required at this work site for personal protection? ☑ Y ☐ N

Is **perimeter monitoring** required for community protection? ☑ Y ☐ N (See CAMP)

Monitoring/Screening Equipment required to be on site:

x	**Photo Ionization Detector (PID)**	X	**10.6eV**		11.7eV		Combustible Gas Indicator (CGI) (LEL)
	Organic vapor monitor (FID)						Multiple Gas Detector - LEL/O_2/H_2S/CO
	Photovac Micro Tip, 10.6eV					x	Dust/Aerosol/Fiber count monitor
	Photovac GC					x	Colorimetric tubes; Specify: Benzene
	Other:						

Standard Action Levels and Required Responses for readings obtained with a multiple gas detector or an individual monitoring instrument are listed below. Do not deviate from these guidelines unless granted specific approval from the Corporate Health and Safety Manager.

Instrument	**Normal**	**Operating Levels**	**Action levels-required responses**
Oxygen Meter	20.9%	Between 19.5-23.5%	Below 19.5%: leave area, requires supplied air Above 23.5%: leave area, fire hazard
CGI	0%	Less than 10%	Greater than 10%: fire/explosion hazard; cease work
Hydrogen Sulfide	0%	Less than 10 ppm	Greater than 15 ppm (or 10 ppm for 8 hrs) requires supplied air respirator (SAR)
Carbon Monoxide	0%	Less than 25 ppm	Greater than 200 ppm for 1 hour or 25 ppm for 8 hrs requires SAR

Description of Monitoring Requirements (include frequency and location by Task):

Monitoring Plan for Task Number(s):	2,3,4	Frequency 1		times per hour (min.)	**As needed for personnel**

Monitor breathing zone of work areas as needed with a PID instrument. If sustained reading is in breathing zone of 10 ppm or greater above background are encountered and sustained for 5 minutes or longer, allow vapors to dissipate between samples and implement appropriate engineering controls, or don the appropriate PPE (full face respirator with appropriate cartridges) to limit potential for exposure. See the Community Air Monitoring Plan (CAMP) for greater detail.

Monitoring Plan for Task Number(s):	2,3,4	Frequency 1		times per hour (min.)	**Continuous for community**

See the CAMP for greater detail.

Notes: 1. Exposure Guidelines for common contaminants are listed in **Table 1 (attached)**
2. Requirements for PPE upgrades based on monitoring are in **Table 2**

3. Record monitoring data and PPE upgrades on Record of Field Monitoring form; maintain with project files

Calibration and use of Equipment

Calibrate all monitoring equipment in accordance with manufacturers requirements and CAMP requirements (e.g., at the beginning and end of each work day). Calibration of equipment shall be documented in the field notes or Daily Field Report (DFR).

Calibration data will be recorded in a bound field notebook or in the field notes. Documentation should include:

- Date/time
- Zero reading before calibration
- Concentration of calibration gas
- Reading obtained with calibration gas before adjusting span
- Final reading obtained with calibration gas after adjusting span

Air monitoring for exposure should be based on the frequency established above (see Section 6.2). Record time, location and results of monitoring and actions taken based upon the readings.

Use the H&A established SOPs for equipment calibration.

7. DECONTAMINATION

PERSONNEL DECONTAMINATION

Are **decontamination procedures** required for personnel working on site? ☑ Y ☐ N
If yes, describe steps:

Gloves should be replaced between samples and when samples containing MGP residuals are encountered. Discarded gloves should be placed into an on-site receptacle (55-gallon drum provided by the drilling subcontractor). Excess water removed from monitoring during well development should be placed in a 5-gallon bucket and then stored in the 55-gallon drum. Used tubing and other miscellaneous sampling supplies should also be placed in the 55-gallon drum.

Location of decontamination station: In the vicinity of the proposed explorations and monitoring well to be samples.

Disposal of PPE: In containers to be provided by the drilling subcontractor

Tools & Equipment Decontamination: All decontamination should be conducted at the site and not at the office or lab.

Check all equipment and materials needed for decontamination of tools and other equipment:

☐ Acetone	☑ Distilled water	☐ Poly sheeting
☑ Alconox soap	☑ Drums for water	☑ Steam cleaner
☑ Brushes	☐ Hexane	☑ Tap water
☑ Disposal bags	☐ Methanol	☐ Washtubs
☑ Other Citra-solve, 55-gallon drum and 5-gallon buckets		

Outline the **equipment decontamination procedures** for this project:

Should decontamination of equipment be required, utilize standard decontamination procedures (clean with soapy water, rinse with tap water followed by distilled water rinse):

1. Brush off and containerize loose soils from sampling tools.

2. Soapy water, tap water and distilled water rinse.

3. Steam clean drill rig, tools, and excavation equipment to prevent cross-contamination between explorations or as needed to prevent cross contamination of deeper stratigraphic zones. If steam cleaning is necessary, drilling contractor will construct temporary decontamination area/pad for steam cleaning.

4. Containerize all investigation waste (IDW) including drill cuttings, excess soils, steam cleaner effluent and PPE

Disposal methods for contaminated decontamination materials (e.g., wash water, rags, brushes, poly sheeting) will consist of:

Soil – drummed and disposed of as IDW
Decontamination and drill water – drummed as IDW (see above)
Miscellaneous materials – uncontaminated gloves, rags, paper towels, ziplock bags, or any other material used during drilling or groundwater monitoring should be disposed of in trash bags and placed in a dumpster and disposed of on-site or in other client approved receptacles.

8. CONTINGENCY PLAN

Nearest Hospital: (see attached map) Address: Phone Number:	Geneva General Hospital 196 North Street Geneva, NY 14456 315-787-4000
Emergency Response Number:	**911**
New York State Spill Hotline:	**1-800-457-7362**
Haley & Aldrich Project Manager: Phone Number: Emergency Phone Number: Client Contact/Project Manager: Phone Number: Emergency Phone Number:	Doug Allen 603.391.3320 Cell: 603.566.2604 Tracy Blazicek 607.762.8839 Cell: 607.237.5325
Utility Emergencies:	**911**

Evacuation alarms and/or emergency information be communicated among personnel on site by the following means: _x_ Verbal communication. If communication will be by other means, describe:

Emergency services will be summoned: _x_ Via on-site phone. If contact will be by other means, describe:

The on-site phone is generally each field team member's individual cell phone.

The **site evacuation plan** is as follows: In case of an emergency, a designated meeting area will be assigned for a head count.

As a rule of thumb, the following are Haley &Aldrich's basic responses to handling Emergencies. Typically, Haley & Aldrich does not mitigate emergencies. See Appendix E (OP1021-Emergency Action Plan) for a detailed discussion of appropriate responses to various emergencies. Review this SOP and ensure that all personnel are aware of these procedures before starting work.

Fire

- Major Fires - Major fires will be mitigated by the local fire departments or by client's on-site fire/emergency response departments.
- Incipient Stage Fires -Incipient stage fires will be extinguished by on-site personnel using fire extinguishers. Only those who have received annual training may use an extinguisher.

Medical

All H&A employee injuries and illnesses will be documented using the Supervisor's Accident / Injury / Near Miss Report (SAIR). This form is available on the Intranet.

- First Aid - First aid will be addressed using the on-site first aid kit. Haley & Aldrich employees are not required or expected to administer first aid/CPR to any Haley & Aldrich, Contractor, or Civilian personnel at any time and it is Haley & Aldrich's position that those who do are doing it on their behalf and not as a function of their job.
- Trauma - Based upon the nature of the injury, the injured party may be transported to the nearest hospital or emergency clinic by on-site personnel or by ambulance. First response to a trauma incident is to call 911 or facility security. Haley & Aldrich staff members are expected to assist in ancillary roles only such as directing ambulances to the scene. It is the discretion of the staff member on site whether an ambulance should be procured in remote locations where ambulance services will not be effective.

Hazardous Materials Spill

- Small incidental spills (e.g.- pint of motor oil) caused by Haley & Aldrich employees and/or by the contractor will be mitigated by the Haley & Aldrich staff member and/or the contractor.
- Large spills (e.g.- large leak from heavy equipment fuel tank) The contractor is responsible for cleanup. In the event that it posses a serious human or environmental threat, the local Fire Department and/or client emergency response department will be contacted. Once emergency has been mitigated typically clean up will be provided by a vendor.

Rescue

Haley & Aldrich employees will not enter any confined spaces for rescue purposes.

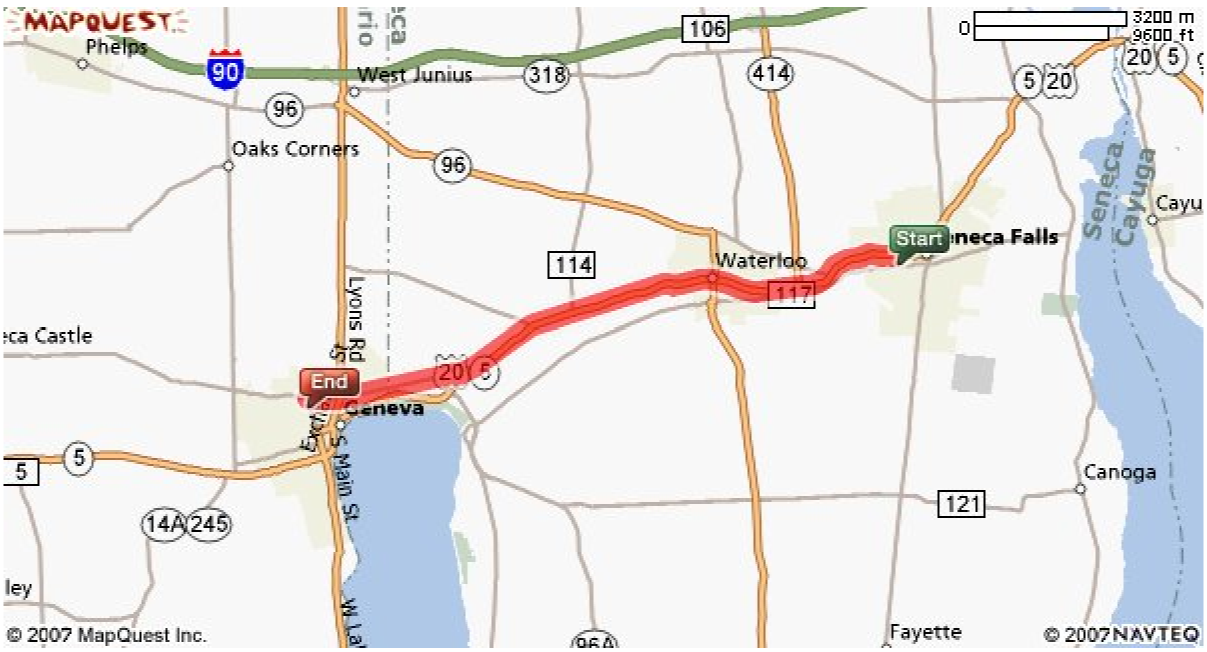
Emergency Alarming and Communication

In the event of an emergency, on site Haley & Aldrich personnel and Subcontractors shall assemble in a designated area. Role shall be completed by the SSO or senior-most H&A person present. No personnel shall leave the assembly area unless directed to do so by Project management, the SSO, or recognized emergency response agency (e.g., police, fire department). **Evacuation alarms** and/or emergency information will be communicated among personnel on site verbally. Emergency services will be summoned via on site phone. Telephones are also available in Pick-A-Flick and the adjacent Sunoco gas station. In the event of an emergency, personnel will meet at a pre-designated spot. The site is a 1.2 acre open area; evacuation will be determined based on the nature and location of the emergency.

9. HOSPITAL ROUTE

Total Est. Time: 18 minutes **Total Est. Distance:** 9.95 miles

START	**1:** Start out going WEST on US-20 / NY-5 / NY-414 toward RUMSEY ST. Continue to follow US-20 / NY-5.	7.5 miles
	2: Turn RIGHT onto CR-110.	2.4 miles
END	**3:** End at **Geneva General Hospital:** 196 North St, Geneva, NY 14456, US	



Note: This HASP is developed for Haley & Aldrich purposes only and not for use by subcontractors. Subcontractors may use this HASP as reference only.

TABLE 1
HAZARD MONITORING

(CIRCLE CONTAMINANTS OF CONCERN, WRITE ADDITIONAL CONTAMINANTS AND EXPOSURE ON LAST PAGE)

CONTAMINANTS OF CONCERN	ROUTES OF EXPOSURE	IDLH	PEL	TLV	PID (IP eV)	FID	ODOR THRES-HOLD	IRRITATION THRESHOLD	ODOR DESCRIPTION
Acetone	R, I, C	2500	1000	500 Cv 750	9.69	60	13	–	Chem, sweet, pungent
Ammonia	R, A, I, C	300	50	25 Cv 35	–	–	0.5-2	10	Pungent suffocating odor
Benzene	R,A,I,C	Ca	1	Sk 0.5	9.25	150	4.68	–	Solvent
Carbon tetrachloride (Tetrachlormethane)	R,A,I,C	Ca	2 Cv25 200: 5 min peak	Sk 5 Cv 10	11.47**	10	50	–	Sweet, pungent
Chlorobenzene	R,I,C	1000	75	10	9.07	200	0.68	–	Almond like
Chloroform	R,I,C	Ca	2	10	11.42**	65	50	–	Sweet
Cyanides (CN salts)	R,A,I,C	50 mg/m^3	5 mg/m^3	Sk Cv 5 mg/m^3	–	–	–	–	Faint almond odor
o-Dichlorobenzene	R,A,I,C	200	Cv 50	25 Cv 50	9.06	50	0.3	E 20-30	Pleasant, aromatic
p-Dichlorobenzene	R,I,C	150	Cv 75	10	8.94	–	0.18	E 80-160	Distinct, aromatic mothball-like
Dichlorodifluoromethane (Freon 12)	R,C	1500	1000	1000	11.97**	15	–	–	–
1,1-Dichloroethane	R,I,C	3000	100	100	–	80	200	–	Distinct
1,2-Dichloroethane	R,I,A,C	Ca	Cv 100 50	10	11.12**	80	88	–	Chloroform
1,1-Dichloroethylene (Vinylidene chloride, 1,1-DCE	R,I	Ca	–	5 Cv 20	*	40	190	–	–
1,2-Dichloroethylene	R,I,C	1000	200	200	9.65	50	0.85	–	Ether-like acrid
Ethanol	R,A,I,C	–	1000	1000	10.48**	25	10	–	Sweet
Ethylbenzene	R,I,C	800	100	Cv 125 100	8.76	100	2.3	E 200	Aromatic
Ethylene Glycol vapor	R,A,I,C	–	100 mg/m^3	-	–	–	–	–	–
Formaldehyde	I,C	Ca	0.75	Cv 0.3	10.88**	–	0.83	–	Hay
Gasoline	R,I,C	Ca	–	300	–	–	–	E 0.5	Petroleum
Hexane, n-isomer	R,I,C	–	500	50	10.18	70	130	E.T 1400-1500	Mild, gasoline-like
Hydrogen Cyanide (as CN)	R,A,I,C	50	10	Sk Cv-4.7	**	–	0.58	–	Bitter almond
Hydrogen peroxide	R,I,C	75	1	1	11**	–	–	–	Shar[
Methanol	R,I,C	25000	Sk 200	Sk 200	10.84**	12	1000	–	Sweet
MEK peroxide	R,I,C	–	Cv 0.7	Cv 0.2	–	–	–	–	–
Methyl Chloroform (1,1,1-TCA)	R,I,C	700	350	350	**	105	20-100	–	Chloroform-like
Methylene Chloride (Dichloromethane, Methylene dichloride)	R,I,C	Ca	25	50	11.35**	100	25-50	E 5000	Ether-like
Methyl Mercaptan	R,C	150	Cv 10	0.5	9.44	–	–	–	Garlic, Rotten Cabbage
MIBK (Hexone)	R,I,C	500	100	50 Cv 75	–	–	–	–	Pleasant
Naptha (coal tar)	R,I,C	1000	100	400	–	–	–	–	Aromatic
Naphthalene	R,A,I,C	250	10	10	8.14	–	0.3	E 15	Mothball-like
Octane	R,I,C	750	500	300 Cv 375	9.9	80	48	–	Gasoline-like
Pentachlorophenol	R,A,I,C	Ca 2.5 mg/m^3	0.5 mg/m^3 Sk	Sk 0.5 mg/m^3	–	–	–	–	Pungent when hot
Phenol	R,A,I,C	250	Sk 5	Sk 5	8.5	–	0.04	E.N.T. 68	Medicinal

TABLE 1
HAZARD MONITORING

(CIRCLE CONTAMINANTS OF CONCERN, WRITE ADDITIONAL CONTAMINANTS AND EXPOSURE ON LAST PAGE)

CONTAMINANTS OF CONCERN	ROUTES OF EXPOSURE	IDLH	PEL	TLV	PID (IP eV)	FID	ODOR THRES-HOLD	IRRITATION THRESHOLD	ODOR DESCRIPTION
Propane	R,C	2100	1000	2500	10.95**	80	1600	–	Natural gas odor
Stoddard Solvent (Mineral Sprits	R,CI,I	20000 mg/m^3	500	100	*	–	1	E 400	Kerosene-like
1,1,2,2-Tetrachloroethane	R,A,I,C	Ca (100)	Sk 5	1	11.1**	100	1.5	–	–
Tetrachloroethylene (Perchloroethylene)	R,I,C	Ca	100	25	9.32	70	4.68	N.T513-690	Ether, chloroform-like
Toluene	R,A,I,C	500	200	50	8.82	110	2.14	E300-400	Mothball-like
Trichloroethylene	R,I,C	Ca (1000)	100	50	9.47	70	21.4	–	Solventy, chloroform-like
Turpentine	R,A,I,C	800	100	100	–	–	200	E.N 200	Pine-like
Vinyl Chloride	R	Ca	1	2	9.995	–	3000	–	Ethereal
Xylenes	R,A,I,C	1000	100	100	8.56/8.44	111/116	1.1	E.N.T. 200	Aromatic
DUSTS, MISTS AND MISCELLANEOUS COMPOUNDS									
Asbestos	R	Ca	0.1 fibr/cc	Species dependent	–	–	–	–	–
PCBs-42% Chlorine	R,A,I,C	Ca	1 mg/m^3 Sk	1 mg/m^3 Sk	–	–	–	–	Mild, hydrocarbon
PCBs-54% Chlorine	R,A,I,C	Ca	0.5 mg/m^3 Sk	0.5 mg/m^3 Sk	–	–	–	–	Mild, hydrocarbon
Styrene	R,I,C	700	100	20	8.47	85	0.047	E 200-400	Rubber, solvent
Aluminum- metal dust- total	R,I,C	–	15 mg/m^3	10 mg/m^3	–	–	–	–	–
-soluble salts	R,I,C	–	2 mg/m^3	2 mg/m^3	–	–	–	–	–
Arsenic- inorganic	R,A,I,C	Ca	0.01 mg/m^3	0.2 mg/m^3	–	–	–	–	–
Barium:soluble compounds	R,I,C	250 mg/m^3	0.5 mg/m^3	0.5 mg/m^3	–	–	–	–	–
Cadmium dusts	R,I	Ca	0.005 mg/m^3	0.01 mg/m^3	–	–	–	–	–
Chromium: Species Dependent (Hexavalent)	R,I,A,C	25 mg/m^3	Spec Dep hex- (.5mg/m^3)	Spec Dep	–	–	–	–	–
Copper - dust & mist	R,I,C	–	1 mg/m^3	1 mg/m^3	–	–	–	–	–
Lead - arsenate	R,I,C	Ca	0.05 mg/m^3	0.15 mg/m^3	–	–	–	–	–
- inorg. dust & fume	R,I,C	–	0.5 mg/m^3	0.15 mg/m^3	–	–	–	–	–
- chromate	R,I,C	–	–	0.05 mg/m^3	–	–	–	–	–
Manganese & compounds	R,I	500 mg/m^3	Cv-5 mg/m^3	0.2 mg/m^3	–	–	–	–	–
Mercury & inorg. comp.	R,A,C	10 mg/m^3	Cv0.1 mg/m^3	0.1 mg/m^3	–	–	–	–	–
- (organo) alkyl comp.	R,A,I,C	2 mg/m^3	0.01 mg/m^3	0.1 mg/m^3	–	–	–	–	–
Nickel - metal, insoluble	R,I,C	Ca	1 mg/m^3	1 mg/m^3	–	–	–	–	–
- soluble comp.	R,I,C	Ca	0.1 mg/m^3	0.1 mg/m^3	–	–	–	–	–
Nuisance Dust			5mg/m^3(Resp) 15mg/m^3(total)						
Portland cement	R,I,C	–	15 mg/m^3	10 mg/m^3	–	–	–	–	–
Selenium compounds	R,A,I,C	100 mg/m^3	0.2 mg/m^3	0.2 mg/m^3	–	–	–	–	–
Silver - metal	R,I,C	–	0.01 mg/m^3	0.1 mg/m^3	–	–	–	–	–
- soluble comp.	R,I,C	–	–	0.1 mg/m^3	–	–	–	–	–
Thallium, soluble	R,A,I,C	20 mg/m^3	0.1 mg/m^3 Sk	0.1 mg/m^3 Sk	–	–	–	–	–
Tin, metal & inorganic	R,C	400 mg/m^3	2 mg/m^3	2	–	–	–	–	–
Comp. except oxides									
Tin, organic compounds	R,A,I,C	200 mg/m^3	0.1 mg/m^3	0.1 mg/m^3 Sk	–	–	–	–	–
Zinc chromates, as Cr	R,I,C	–	Cv 0.1 mg/m^3	Cv 0.1 mg/m^3	–	–	–	–	–

TABLE 1
HAZARD MONITORING

(CIRCLE CONTAMINANTS OF CONCERN, WRITE ADDITIONAL CONTAMINANTS AND EXPOSURE ON LAST PAGE)

CONTAMINANTS OF CONCERN	ROUTES OF EXPOSURE	IDLH	PEL	TLV	PID (IP eV)	FID	ODOR THRES-HOLD	IRRITATION THRESHOLD	ODOR DESCRIPTION
Zinc oxide dust (total)	R,I,C	--	15 mg/m^3	10 mg/m^3	--	--	--	--	--

Notes: All units in ppm
unless otherwise noted.

R = Respiratory (Inhalation) I = Ingestion A = Skin Absorption C = Skin and/or Eye Contact
Cv = Ceiling value Ca = Carcinogen Sk = Skin
** = Use 11.7 eV lamp

TABLE 2
Last Revised September 2002

MONITORING METHOD, ACTION LEVELS AND PROTECTIVE MEASURES

INSTRUMENT	HAZARD	ACTION LEVEL	ACTION RESPONSE
Respirable Dust Monitor	Total Particulates	> 5 mg/m^3	Upgrade to Level C Protection
OVA, HNU[(2)], Photovac Microtip	Total Organic Vapors	Background 10 ppm > background or lowest OSHA permissible exposure limit, whichever is lower, or as modified for this task. Sustained for >5 minutes in the breathing zone. 50 ppm over background, unless lower values required due to respirator protection factors	Level D Protection Upgrade to Level C - site evacuation may be necessary for specific compounds Cease work; upgrade to Level B[(3)] may be required
Explosimeter[(4)] (LEL)	Flammable/Explosive Atmosphere	<10% Scale Reading 10-15% Scale Reading >15% Scale Reading	Proceed with work Monitor with extreme caution Evacuate site
Oxygen Meter[(5)]	Oxygen-Deficient Atmosphere	19.5% - 23.5% 0_2 < 19.5% 0_2 > 23.5% 0_2	Normal - Continue work Evacuate site; oxygen deficient Evacuate site; fire hazard
Radiation Meter[(6)]	Ionizing Radiation	0.1 Millirem/Hour > 1 Millirem/Hour	If > 0.1, radiation sources may be present[(7)] Evacuate site; radiation hazard
Drager Tubes	Vapors/Gases	Species Dependent > 1 ppm vinyl chloride > 1 ppm benzene > 1 ppm 1,1-DCE	Consult Table 1 or other resources for concentration toxicity/detection data. Upgrade to Level C if concentration of compounds exceed thresholds shown at left; May need to cease work if other levels exceeded - site specific
Gas Chromatograph (GC)	Organic Vapors	3 ppm total OV > background or > lowest specific OSHA permissible exposure limit, whichever is lower	On-site monitoring or tedlar bag sample collection for off-site/laboratory analysis

Notes:
1. Monitor breathing zone.
2. Can also be used to monitor some inorganic species.
3. Positive pressure demand self contained breathing apparatus
4. Lower explosive limit (LEL) scale is 0-100%. LEL for most gasses is 15%.
5. Normal atmospheric oxygen concentration at sea level is 20%
6. Background gamma radiation is ~0.01-0.02 millirems/hour.
7. Contact H&A Health and Safety staff immediately.

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APPENDIX A
HASP Amendment Form

This Appendix is to be used whenever there is an immediate change in the project scope that would require an amendment to the HASP. For project scope changes associated with "add-on" tasks, the changes must be made in the body of the HASP. Before changes can be made, a review of the potential hazards must be initiated by the H&A Project Manager.

Amendment No.	
Site Name:	
Work Assignment No.:	
Date:	
Type of Amendment:	
Reason for Amendment:	
Alternate Safeguard Procedures:	
Required Changes in PPE:	

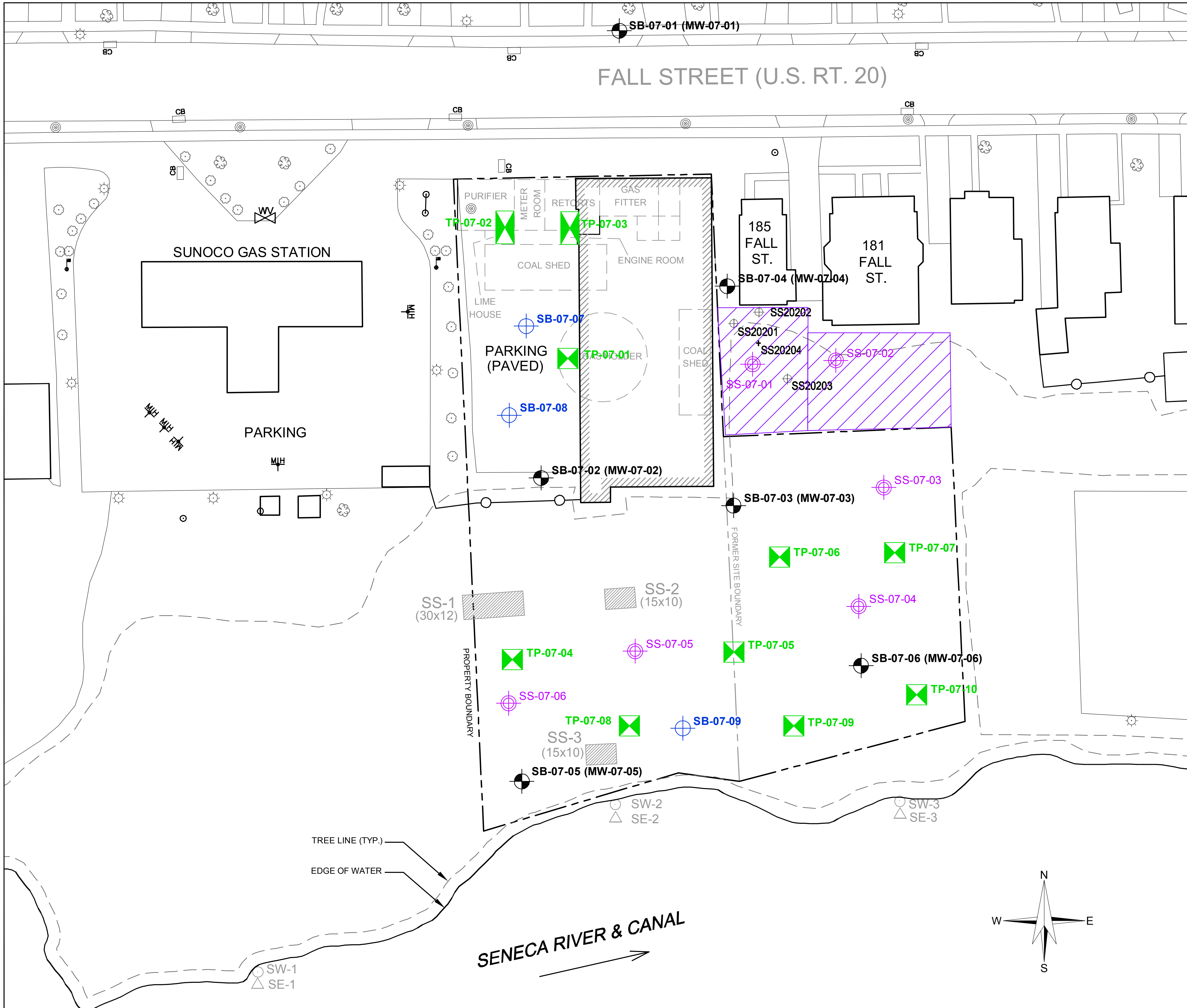
Project Manager Signature: ________________________________ Date: _________________

Local Health and Safety Coordinator : _______________________ Date: _________________

This original form must remain on site with the original HASP. If additional HASPs are in the field, it is the PMs responsibility to forward a signed copy of this amendment to those who have copies.

APPENDIX B

Site Plan



LEGEND:

TP-07-01	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED TEST PIT
SB-07-09	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED SOIL BORING
SB-07-06 (MW-07-06)	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED SOIL BORING WITH MONITORING WELL
SS-07-03	DESIGNATION AND APPROXIMATE LOCATION OF PROPOSED SURFACE SOIL SAMPLE LOCATION
	APPROXIMATE LOCATION OF PROPOSED DIRECT PUSH EXPLORATION AREA
	SURFACE SOIL SAMPLE (11/90)
	SURFACE WATER SAMPLE (11/90)
	SEDIMENT SAMPLE (11/90)
	SURFACE SOIL SAMPLE (03/03)
	POWER POLE
	LIGHT POLE
	POST
CB	CATCH BASIN
MH	MANHOLE
WV	WATER VALVE

NOTE:

1. BASE PLAN CREATED FROM ELECTRONIC FILE SENFMGP.DWG TITLED "SENECA FALLS FORMER MGP SITE VILLAGE OF SENECA FALLS SENECA COUNTY, NEW YORK" RECEIVED FROM TRACY BLAZICEK ON 18 MAY 2007.

0 50 100
SCALE IN FEET

HALEY & ALDRICH

PRELIMINARY SITE ASSESSMENT WORK PLAN
SENECA FALLS FORMER MGP SITE
SENECA FALLS, NEW YORK

PROPOSED EXPLORATION LOCATIONS

SCALE: AS SHOWN
JULY 2007

FIGURE 2

G:\34507_SENECA_FALLS\001\CAD\DRAWINGS\34507-001-0001_2007-0706_PROPEXPLLOCS.DWG

APPENDIX C

OP1003-Cold Stress

OPERATING PROCEDURE: OP1003

COLD STRESS

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED/ DATE	REVIEWED/ DATE	REVIEWED/ DATE	APPROVED/ DATE
Ver.0.0	CLM/March 2004	WER/May 04	MDD/May 04		

Total Pages: 15

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OPERATING PROCEDURE: OP1003

COLD STRESS

1. PURPOSE

This OP is designed to prevent injuries due to cold temperatures, wind chill, or emersion. Injuries from these types of exposures include hypothermia and frost bite, as defined below.

2. DISCUSSION

Cold stress is the term used to describe the effects of low temperatures on the body. Hypothermia and frostbite are the primary concerns. Persons working outdoors or indoors in low temperatures, especially at or below freezing, are subject to potential cold stress. Also, persons briefly immersed in cold water, or even in moderately cold water for extended periods, may suffer from hypothermia. Exposure to extreme cold for a short period of time can cause severe injury to the surface of the body, or can result in profound generalized cooling (hypothermia), possibly causing death. Signs of hypothermia may include sluggishness and inattention. Areas of the body which have high surface area-to-volume ratios, such as fingers, toes, and ears, are the most susceptible to frostbite. Exposed areas, such as the face, may also be rapidly affected. Frostbite may appear as a white patch on the nose, ears, or appendages.

3. APPLICATION

This SOP should be followed when H&A Staff members working in the field are potentially exposed to cold weather, especially at or below freezing. It also applies to H&A Staff members working in refrigerated or other artificially cooled environments, and to H&A Staff members working over large bodies of water. It is designed to aid in the prevention or minimization of cold stress injuries.

4. DEFINITIONS

4.1 Cold Stress

The production of physiological effects due to cold temperatures and\or wind chill.

4.2 Frostbite

Freezing of tissue, often resulting in tissue death.

4.3 Hypothermia

Condition of reduced body temperature resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

4.4 Wind Chill

The effect of air movement on apparent temperature in a cold environment.

5. PROCEDURE

5.1 Cold Stress Awareness

Employees shall be made aware of the factors, which influence the development of cold injury: ambient temperature, the velocity of the wind, and moisture. They shall be made aware of proper protective measures and equipment.

5.1.1 Low Temperatures

Low temperatures can be a threat in both outdoor and indoor environments. In either case, lack of precautions and improper clothing can contribute to injuries. H&A Staff members should use the following chart as a guide. However, employees must reduce exposures if experiencing subjective cold stress problems, even at temperatures above those listed in the chart.

5.1.2 Wind Chill

"Wind chill" describes the chilling effect of moving air in combination with cold temperatures. Even low velocity winds increase the cold stress on the body. A new "wind chill" chart is presented below (Figure 1) and should be used in gauging apparent (equivalent) temperatures for the exposure times above. Employees should make use of wind breaks, buildings, or other structures to reduce wind chill effects. Note: This is the new wind chill temperature index.

Figure 1 – Wind Chill Chart

Wind Chill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

5.1.3 Moisture

Moisture is also important, as it conducts heat away from the body. It is very important to keep dry in a cold environment. Protective clothing must keep out environmental moisture while preventing the build-up of sweat. Any employee becoming wet in a cold area should be immediately removed to a warm area to prevent hypothermia.

5.2 Personal Equipment

The essence of staying warm in the winter is having the proper clothing layers and knowing how to use them effectively.

5.2.1 Heat Loss

The body basically acts as a furnace, producing heat through chemical reactions and activity. This heat is lost through conduction, convection, evaporation, radiation, and respiration. As physical activity increases so does heat production and conversely as activity decreases so does heat production. The key to keeping warm is to add insulation to the body.

5.2.2 Insulation

The thermal insulation of clothing is proportional to the thickness of the dead air space enclosed. Dead air is defined as any enclosed unit of air that is small enough that natural convection currents would not arise in it. Such currents have been detected in units as small as 2 millimeters in diameter. The dead air next to the skin is heated up by the body and provides a layer of warmth around the body. The clothing is not what is keeping you warm it is the dead air. This is because the denser a material the faster it can transfer heat through conduction, the density of air is obviously minuscule compared to a piece of a fabric.

5.2.3 The Layering Principle

The key to providing this dead air space is through having a number of layers of clothing. Each layer provides a certain amount of additional dead air space. This allows you to add or shed layers to increase or decrease your accumulated dead air space as the temperature changes and/or as your activity level changes. Remember, your body is the heat source, the clothing layers only serve to trap the heat and slow down your heat loss to the cold environment. You need to find the proper heat balance between the number and types of layers and your activity level.

Why not just have lots of layers on and sweat? Heat loss from a wet surface can be up to 25 times greater than a dry surface (due to the higher density of water). If you sweat and get soaked, you will lose heat much more quickly through evaporation of the water. Also you are loosing an incredible amount of water through sweating since the air is so dry. Too much water loss leads to dehydration which significantly increases the risk of hypothermia. So you want to control your layers so as to be warm at the activity level you are in but not sweating profusely.

Thus, working in the cold is a *constant* process of adjusting your layers to keep comfortable. This means having a number of layers you can add or subtract and allowing for versatility within layers. Convection may account for the greatest amount of heat loss under most conditions. In order to properly insulate, you need to have an outer layer that is windproof.

Another convective factor is the "bellows action" of clothing. As you move a bellows action occurs which tends to pump your accumulated warm air out through openings in your clothing and sucks the cooler air in. In some conditions this action can reduce your body's personal insulation by 50% or more. Thus, it is important that *all* layers have effective methods of being "sealed" (i.e. buttons, zippers etc.) Openings in layers allow you to ventilate, to open the "chimney damper" if you are beginning to overheat, without having to actually remove a layer. So opening and closing zippers on a jacket, or armpit zips will allow you to either ventilate if you are getting too hot or seal up if you are getting chilly, all without having to add or take off a layer. With clothes that are too loose, the bellows action pumps warm air out through the openings. You need to have clothes that fit properly but not tightly. Too tight, and the clothes compress and actually reduce dead air space in layers below as well as restricting body movement.

5.3 Precautionary Measures

All employees working in low temperatures, especially at or below freezing, are to follow specific precautionary measures to prevent cold stress, which include:

- Take a spare set of clothing with you in case your work clothes are not warm enough or become wet.
- Dress in layers. If you are cold, add a layer. If you begin to sweat, remove a layer. Maintain a clothing level that keeps you warm but dry (not sweating).
- Recognize the environmental and workplace conditions that may be dangerous;
- Learn the signs and symptoms of cold-induced illnesses and injuries and what to do to help workers;
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm;
- When the air temperature is below 41 F, staff should be aware that cold stress is now considered a potential hazard;
- Wearing thermal clothing, including gloves and footwear, beneath chemical resistant clothing where necessary;
- When clothing becomes wet and temperatures are below 36 F, clothing must be replaced immediately;
- Drink warm, palatable drinks to replace liquids. Dehydration is important;
- Never going into the field alone when cold stress could occur;
- Observing fellow employees for signs of cold stress and administering first aid, as necessary;
- Taking periodic breaks to allow recovery from cold stress; and
- Employees working near water in which they may become immersed must wear floatation suits offering thermal protection. Brief emersion in water below 60 or prolonged emersion at even 70 can produce hypothermia.

5.4 First Aid Procedures

During periods in which the temperature falls below freezing, workers should observe each other for signs of hypothermia or frostbite. If exposed skin begins to sting or tingle, rub the exposed area to stimulate circulation. However, if the exposed area is numb, do not rub it. Do not use snow; this will only make the injury more serious. Promptly seek a protected or indoor environment. Warm the affected parts in warm water (104 - 133 °F) or by other suitable means. Workers experiencing signs or symptoms of hypothermia should immediately be taken to a warmer environment. Heating devices should be used to provide relief from cold. Care must be exercised, however, with electrical devices in conductive or moist environments. Combustion devices, such as catalytic heaters, may be used where there is adequate ventilation. They must not be used in tightly closed spaces where accumulation of carbon monoxide can occur.

5.5 Personal Protective Equipment

Thermal protective clothing is available from various vendors, and selection assistance is available from your location's administrative assistants or LHSC. Those who qualify are offered an Allowance", details can be located on Human Resource Policy 11-6 "Clothing, Prescription Safety Eyeglasses, & Safety Footwear Allowance". This policy is located in the employee handbook. Generally, the following guidelines should be followed:

If there is a need for chemical resistant protective clothing, chemical resistant protective clothing generally does not provide protection against cold stress, and in some instances it can increase susceptibility. For this reason, thermal clothing, gloves, and footwear should be worn beneath chemical resistant personal protective equipment in cold weather. Most extreme weather wear now provides weather temperature ratings on tags or the garment. Observe tags for appropriate temperature protection.

Table 1 – PPE Clothing Recommendations

Clothing Materials

Some of the different types of materials for winter clothing and insulation are discussed below.

1. Wool - derives its insulating quality from the elastic, three-dimensional wavy crimp in the fiber that traps air between fibers. Depending on the texture and thickness of the fabric, as much as 60-80% of wool cloth can be air. Wool can absorb a fair amount of moisture without imparting a damp feeling because the water "disappears" into the fiber spaces. Even with water in the fabric wool still retains dead air space and will still insulate you. The disadvantage to wool is that it can absorb so much water (maximum absorption can be as much as 1/3 third the garment weight) making wet wool clothing very heavy. Wool releases moisture slowly, with minimum chilling effect. Wool can be woven in very tight weaves that are quite wind resistant. An advantage to wool is that it is relatively inexpensive (if purchased at surplus stores). However, it can be itchy against the skin and some people are allergic to it.

2. Pile or Fleece fabrics - is a synthetic material often made of a plastic (polyester, polyolefin, polypropylene, etc.). This material has a similar insulative capacity as wool. Its advantages are that it holds less water (than wool) and dries more quickly. Pile is manufactured in a variety of different weights (thicknesses) offering different amounts of loft and insulation. This allows for numerous layering possibilities. The disadvantage of pile is that it has very poor wind resistance and hence a wind shell on top is almost always required. Versions of pile are available that have a middle windproof layer.

3. Polypropylene and other Hydrophobic fabrics - polypropylene is a synthetic, plastic fiber which offers dead air space and a fiber which cannot absorb water. The fiber is hydrophobic so it moves the water vapor away from the source (the body). Polypropylene layers are extremely effective worn directly against the skin as a way of keeping the skin from being wet and reducing evaporative heat loss. As the water moves away from the body it will evaporate, but each additional millimeter of distance between your skin and the point of evaporation decreases the amount of body heat lost in the evaporative process. Some fabrics rely on the chemical nature of the fiber to be hydrophobic. Others fabrics use a molecular coating t0 achieve the same end.

4. Polarguard™, Hollofil™, Quallofil™ and others - these are synthetic fibers which are primarily used in heavy outer garments like parkas. The fibers are fairly efficient at providing dead air space (though not nearly as efficient as down). Their advantages are that they do not absorb water and dry fairly quickly. Polarguard™ is made in large sheets. Hollofil™ is a fiber similar to Polarguard but hollow. This increases the dead air space and makes the fiber more thermally efficient. Quallofil™ took Hollofil™ one step further by creating four "holes" running through the fiber.

5. "Superthin" fibers - **Primaloft™, Microloft™, Thinsulate™ and others -** the principal behind these synthetic fibers is that by making the fiber thinner you can increase the amount of dead air space. For example, take an enclosed space 5 inches wide and place 2 dividers into that space, each 1 inch thick. You have an effective air layer of 3 inches. If you take the same 5 inch space and divide it with 4 dividers, each 1/4 inch thick you now have an effective air layer of 4 inches. You have gained one inch. Under laboratory conditions a given thickness of Thinsulate™ is almost twice as warm as the same thickness of down, however, the Thinsulate™ is 40% heavier. Thinsulate™ is made in sheets and therefore tends to be used primarily for outer layers, parkas and pants. New materials such as Primaloft™ and Microloft™ are superthin fibers that are close to the weight of down for an equivalent fiber volume. They are now being used in parkas as an alternative to down. They have similar warmth to weight ratios as down without the worries about getting wet.

6. Down - feathers are a very efficient insulator. They provide excellent dead air space for very little weight. The major problem with down (and it can be a major problem) in the winter is that down absorbs water. Once the feathers get wet they tend to clump, and lose dead air space. Using down items in the winter takes special care to prevent them from getting wet. Some people are allergic to down.

7. Cotton - Note: Cotton is basically useless in winter time. It wicks water, but unlike polypropylene, cotton absorbs this moisture and the water occupies the space previously occupied by dead air. This means a loss in dead air space, high evaporative cooling, and a garment that is almost impossible to dry out.

The Body and Clothing

1. Head - because the head has a very high surface to volume ratio and the head is heavily vascularized, you can lose a great deal of heat (up to 70%) from the head. Therefore, hats are essential in winter camping. The adage - if your toes are cold, put on a hat - is true. A balaclava is particularly effective and versatile. A facemask may be required if there are high wind conditions due to the susceptibility of the face to frostbite.

2. Hands - mittens are warmer that gloves. It is useful to have an inner mitten with an outer shell to give you layering capabilities. However, gloves are always essential as well in winter because of the need for dexterity in various operations.

3. Feet - finding the right footgear depends a great deal on the activity you are involved in as well as temperature and environment. Regular boots are *not* sufficient. They simply do not provide the necessary dead air space. The options for boots include:

> **Insulated Boots** - such as Sorels™ or "Mickey Mouse" boots. These are rubber or leather and rubber boots that use a layer of wool felt to provide dead air space. The Mouse boots can be Army surplus or modern copies (avoid the copies since they are often poorly made). With the true Army boots, the black boots are rated to -20 degrees and the white ones to -40 degrees.
>
> **Socks** - one of the best systems for keeping feet warm is using multiple layers. Start with a hin polypropylene liner sock next to the skin to wick moisture away followed by 1 - 2 pairs of wool or wool/nylon blend socks. Make sure the outer socks are big enough that they can fit comfortably over the inner layers. If they are too tight, they will constrict circulation and increase the chances of frostbite. Keeping your feet dry is essential to keeping your feet warm you may need to change your socks during the day.

Gaiters - are essential if you are working in the snow. They keep snow from getting into your boots and keep your socks and pants legs free from snow.

4. Outer Layer - it is essential to have an outer layer that is windproof and at least water resistant. In some cases it may be best to have the garment waterproof. It also needs to be able to be ventilated. There is a big trade off between waterproof and ability to ventilate. A completely waterproof item will keep the water that is moving through your other layers trapped, adding to weight and causing some heat loss. However, in wet snow conditions, if the garment is not waterproof it can get wet and freeze. Gore-Tex™ and other similar fabrics provide one solution. These fabrics have a thin polymer coating which has pores that are large enough to allow water vapor to pass through but too small to allow water droplets through. Nothing is perfect, however, and although Gore-Tex ™ does breathe, it doesn't breathe as well as straight cotton/nylon blends. If you opt for a straight wind garment, 65/35 blends of cotton and nylon work well. The other approach is to have a waterproof garment with sufficient ventilation openings to allow water vapor to escape. This provides the ability to work in wet snow without worrying about getting the garment soaked. Part of the basis for making the decision is the area and you are traveling in. If you are in the dry snow of the Rockies you needn't worry so much about waterproof. If you are in the northeastern mountains where freezing rain is a possibility or very wet snow, you need to be prepared to be wet.

5. Zippers - are wonderful accessories for winter clothing. Having underarm zippers on jackets can greatly increase your ability to ventilate. Having side zippers on pants can allow you to ventilate and to add or subtract a layer without taking off your boots.

Apparel	**Recommendation**
Socks	Stretch socks are not advisable, since they restrict circulation. Wool has superior insulating qualities.
Trousers	Wool, thermal, or quilted. Suspenders or coverall-types are recommended, as belts restrict circulation.
Boots	Felt-lined or insulated, rubber bottomed, leather topped.
Shirt	Wool shirt or sweater, over cotton or synthetic wicking material provides best protection.
Headcover	Wool knit hat or hood. Use a liner with hardhats. Use snorkel hoods in extreme environments.
Gloves	Mittens offer better protection, but restrict dexterity. Layers of differing materials may be appropriate for different work. Gortex outer shells are recommended to reduce dampness.
Face mask	In extreme cold, facial protection is important to prevent frostbite. A ski mask or a snorkel hood may be appropriate.
Coat	An anorak, parka, or hooded coat, as appropriate. Down provides good insulation. Synthetics such as thinsulate may be satisfactory. Gortex outer shells are recommended to reduce dampness.
Under garments	In moderate exposures, cotton may be adequate, however polypropylene and other materials, which "wick" moisture away from the skin, may be superior for heavy work.

APPENDIX A
REFERENCES

- National Weather Services- Office of Climate, Water, and Weather Services
- OSHA Trade News Release, December 2003
- Fundamentals of Industrial Hygiene, National Safety Council, 5th edition

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1000 Site Safety – Construction Sites
- OP1001 Excavation and Trenching
- OP1002 Drilling Safety
- OP1003 Utility Clearance
- OP1008 Operations Over, Near, or On Water
- OP1009 Medical Surveillance Program
- OP1010 Health and Safety Plans
- OP1014 Hazard Communication
- OP1015 Heat Stress
- OP1020 PPE Use, Purchase and Selection
- OP1022 Health and Safety
- OP1026 Policy on Confined Space Entry

APPENDIX C
FORMS

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APPENDIX D
GLOSSARY

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APPENDIX D

OP1015-Heat Stress

OPERATING PROCEDURE: OP1015

HEAT STRESS

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED/ DATE	REVIEWED/ DATE	REVIEWED/ DATE	APPROVED/ DATE
Ver.0.0	CLM/May 2004	WER/May 04	MDD/May 04		

Total Pages: 13

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OPERATING PROCEDURE: OP1015

HEAT

1. PURPOSE

To establish a hot environments program and to assure that staff members know and recognize symptoms of heat stress and are prepared to take appropriate remedial and corrective action.

2. DISCUSSION

Heat stress is a disruption of normal body functions that occurs when high heat and humidity are coupled with hard work or use of equipment that interferes with the body's normal temperature regulating system. The human body normally controls heat buildup by the evaporation of perspiration and reduced activity. The use of personal protective equipment (principally impermeable and semipermeable work clothes) and job performance requirements can impair the body's ability to dissipate heat buildup. This increase in internal core temperatures can continue until it reaches a level that involuntarily shuts down the body's ability to function properly. These conditions range from heat cramps to more serious and potentially fatal, heat stroke.

There are no Federal Occupational Safety and Health Administration (OSHA) standards regulating exposure to hot environments. However, the American Conference of Governmental Industrial Hygienists (ACGIH) has developed recommended heat stress threshold limit values (TLVs). These recommended TLVs have been used in the development of this SOP. Additional information about heat stress can be located at the following OSHA technical website:

http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html

3. APPLICATION

This OP should be followed when H&A Staff members working in the field are potentially exposed to hot working conditions. It also applies to H&A Staff members working in facilities and such where there is radiant heat sources such as furnaces, boilers, etc. It is designed to aid in the prevention or minimization of heat stress illnesses.

4. DEFINITIONS

4.1 Acclimatization

Acclimatization is a physiological adjustment to work under hot conditions. A gradual conditioning to improve a person's ability to withstand heat stress conditions and enhance the ability to perform work under those conditions.

4.2 Heat Stress

Heat stress is a basic term used to describe the illness which may be suffered by the body as a result of overexposure to heat. These illnesses include heat cramps, heat exhaustion, and heat stroke.

4.3 Heat Cramps

Heat cramps, or painful spasms of the muscles, are caused when staff members drink large quantities of water but fail to replace their bodies' salt loss. Tired muscles -- those used for performing the work -- are usually the ones most susceptible to cramps. Cramps may occur during or after working hours and may be relieved by taking liquids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required.

4.4 Heat Exhaustion

Heat exhaustion results from loss of fluid through sweating when a staff member has failed to drink enough fluids or take in enough salt or both. The staff member with heat exhaustion still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature normal or slightly higher. Treatment is usually simple: the victim should rest in a cool place and drink an electrolyte solution (a beverage used by athletes to quickly restore potassium, calcium, and magnesium salts). Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision.

4.5 Heat Rash

Also known as prickly heat, heat rash may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impedes a staff member's performance or even results in temporary total disability. It can be prevented by resting in a cool place and allowing the skin to dry.

4.6 Heat Stroke

Heat stroke is the most serious health problem for staff members in hot environments. It is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Signs include (1) mental confusion, delirium, loss of consciousness, convulsions or coma; (2) a body temperature of 106 degrees F or higher; and (3) hot dry skin which may be red, mottled, or bluish. Victims of heat stroke will die unless treated promptly. While awaiting medical help, the victim must be removed to a cool area and his or her clothing soaked with cool water. He or she should be fanned vigorously to increase cooling. Prompt first aid can prevent permanent injury to the brain and other vital organs.

4.7 Metabolic Heat

Metabolic heat is generated by the metabolic functions of the body.

4.8 Radiant Heat

Radiant heat is produced by the absorption of electromagnetic energy such as sunlight. Only the object absorbing the radiation is heated. The air through which the radiation passes is not effected.

4.9 Relative Humidity

Relative humidity is the ratio of the actual partial pressure of the water vapor in air to the saturation pressure of pure water at the same temperature.

5. PROCEDURE

5.1 Recognition of Heat Stress Conditions

5.1.1 Environmental Conditions

Ambient temperature, relative humidity, air movement, and radiant heat play major roles in heat stress. Obviously, higher temperatures enhance the likelihood of producing discomfort and heat stress. The higher the relative humidity the less evaporation of perspiration takes place and thus evaporative cooling is reduced.

Air movement (fans or natural breezes) aids in evaporative and corrective cooling. The greater the air movement, the greater the cooling effect except at temperatures higher than body temperature. When the air temperature is greater than 95 degrees F, the process of moving air across the body actually creates a greater risk than a cooling effect. Direct radiant heat can add significantly to heat stress as evidence of working in the sun. Shade is a valuable deterrent to heat stress.

5.1.2 Personal Conditions

Physical conditions play a major role in determining a person's ability to withstand heat stress. Age is a major factor. Generally speaking, younger persons are more resistant to heat stress. Those in poor physical condition, overweight, not used to physical exertion, or involved with excessive alcohol are more subject to heat stress. Ones geographical background also plays a significant role in the tolerance of working in hot work conditions such as Tucson and Southern California.

5.1.3 Working Conditions

Working conditions are just an important factor to heat stress as those mentioned above. The use of personal protective equipment can interfere with normal cooling mechanisms and greatly enhance the possibility of heat stress. Working long hours can produce fatigue that makes heat stress more likely. Working during the hottest part of the day, particularly in bright sunlight, also promotes the onset of heat stress.

5.2 Precautionary Measures

Heat stress can be minimized by following one or all of the following:

5.2.1 Engineering Controls

Engineering controls including general ventilation and spot cooling by local exhaust ventilation at points of high heat production may be helpful. Shielding is required as protection from radiant heat sources. Evaporative cooling and mechanical refrigeration are other ways to reduce heat. Cooling fans can also reduce heat in hot conditions. Equipment modifications, the use of power tools to reduce manual labor and personal cooling devices or protective clothing are other ways to reduce the hazards of heat exposure for staff members.

5.2.2 Work Practices

Work practices such as providing plenty of drinking water -- as much as a quart per staff member per hour -- at the workplace can help reduce the risk of heat disorders. Training first aid staff members to recognize and treat heat stress disorders and making the names of trained staff known to all staff members is essential. Locations should also consider an individual staff member's physical condition when determining his or her fitness for working in hot environments. Older staff members, obese staff members and those on some types of medication are at greater risk. These conditions should be discussed with the company doctor at some time during your medical exam.

5.2.3 Work and Rest

Work and rest periods with longer rest periods in a cool area can help staff members avoid heat stress. If possible, heavy work should be scheduled during the cooler parts of the day and appropriate protective clothing provided. Supervisors should be trained to detect early signs of heat stress and should permit staff members to interrupt their work if they are extremely uncomfortable. The American Conference of Governmental Industrial Hygienists (ACGIH) has developed recommended heat stress threshold limit values (TLVs). These may be found in their annual handbook.

5.2.4 Acclimatization

Acclimatization to the heat through short exposures followed by longer periods of work in the hot environment can reduce heat stress. New staff members and staff members returning from an absence of two weeks or more should have 5-day period of acclimatization. This period should begin with 50 percent of the normal workload and time exposure the first day and gradually building up to 100 percent on the fifth day.

5.2.5 Staff Member Education

Staff member education is vital so that staff members are aware of the need to replace fluids and salt lost through sweat and can recognize dehydration, exhaustion, fainting, heat cramps, salt deficiency, heat exhaustion, and heat stroke as heat disorders. Staff members should also be informed of the importance of daily weighing before and after extremely heavy work activity days to avoid and recognize dehydration.

5.2.6 Measurement

Though rare, portable heat stress meters or monitors are used to measure heat conditions. These instruments can calculate both the indoor and outdoor Wet Bulb Globe Test (WBGT) index according to established ACGIH Threshold Limit Value equations. With this information and information on the type of work being performed, heat stress meters can determine how long a person can safely work or remain in a particular hot environment.

5.3 Recognition of Heat Illnesses (See Section 4)

5.3.1 Heat Cramps

- muscle spasms of large muscle groups
- pain in the leg muscles, back muscles, and abdomen

5.3.2 Heat Exhaustion

- pale, cool, moist skin
- heavy sweating
- dizziness
- nausea
- fainting

5.3.3 Heat Stroke

- red, hot, skin looks sunburn or dry pale skin with no sweating
- nausea
- irritable
- dizziness and confusion
- strong rapid pulse

- possible seizure
- possible coma

5.4 First Aid for Heat Stress

5.4.1 Heat Cramps

- Move victim to a cool place.
- Administer drinks of cool water.
- Apply manual pressure to cramped muscles.
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated.

5.4.2 Heat Exhaustion

- Respond quickly, this could turn into heat stroke.
- Move the victim to a cool and shaded place.
- Remove as much clothing as possible.
- Apply a wet cloth over body.
- If dizzy, lay on back and raise legs 6”-8”
- Administer drinks of cool water.
- Seek medical attention.

5.4.3 Heat Stroke

- Treat as a true medical emergency. Seek medical help immediately.
- Reduce body temperature quickly.
- Douse with water.
- If possible, have drink cool water every 15 minutes.
- Wrap in wet cloth.
- If available, use cold packs under arms, neck, and ankles.
- Protect from injury during convulsion.
- Assure an open airway for breathing.
- Transfer to a medical facility.

5.5 Considerations and Prevention

- Prior to entering hot work environments, provide training regarding the hazards, precautions, and first-aid for heat stress.
- Include appropriate guidance in Health and Safety Plans.
- Wear light weight and colored clothing.
- Ensure that an ample supply of suitable fluids is available.
- Ensure that a proper rest area is available.
- Take adequate breaks.
- Conduct labor intensive work during cooler part of the day.

- Ensure that staff members remain alert for symptoms of heat stress and practice good avoidance techniques.
- Ensure that observation for appearance of heat stress symptoms is maintained.
- Ensure that first-aid measures are employed rapidly when symptoms appear.
- Observe each other for the early symptoms of heat stress.
- Try to eliminate excessive amounts of alcohol from non-workhour activites.

APPENDIX A
REFERENCES

- OSHA Technical Manual (TED 1—0.15A) - Chapter 4 "Heat Stress"
- OSHA Trade News Release, December 2003
- Fundamentals of Industrial Hygiene, National Safety Council, 5th edition

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1000 Site Safety – Construction Sites
- OP1001 Excavation and Trenching
- OP1002 Drilling Safety
- OP1003 Cold Stress
- OP1003 Utility Clearance
- OP1008 Operations Over, Near, or On Water
- OP1009 Medical Surveillance Program
- OP1010 Health and Safety Plans
- OP1014 Hazard Communication
- OP1020 PPE Use, Purchase and Selection
- OP1022 Health and Safety
- OP1026 Policy on Confined Space Entry

APPENDIX C
FORMS

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APPENDIX D
GLOSSARY

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APPENDIX E

OP1021-Emergency Action Plan

OPERATING PROCEDURE: OP1021

EMERGENCY ACTION PLAN

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	N. Reardon/ Aug. 2003	CSO/ Sept. 2003	JAK/ Sept. 2003	MPD/ Oct. 2003	JAK/ Oct. 2003

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EMERGENCY ACTION PLAN

1. PURPOSE

Haley & Aldrich personnel must be prepared to respond to many types of emergency situations that may occur on company property or facilities, project sites or during travel. It is imperative that the safety of employees, subcontractors, guests, visitors and bystanders be a priority during any emergency.

All employees of Haley & Aldrich shall use the policies and procedures contained in this Plan as a guide for emergencies. This Plan is designed to provide employees and other responders such as the police or fire department with an overview of their duties and responsibilities during an emergency.

Conveying the information contained in this document to Haley & Aldrich employees through training is a critical aspect of this Emergency Action Plan (EAP).

1.1 Mission Statement

THE EMERGENCY ACTION PLAN WILL PROVIDE A FRAMEWORK FOR THE COMMUNICATION NETWORK AND ACTIONS TO BE IMPLEMENTED IN THE EVENT OF A CRISIS AT HALEY & ALDRICH OR THE SURROUNDING AREA. THE PLAN WILL (1) OUTLINE THE DECISION MAKING PROCESS TO EVALUATE THE DEGREE OF SEVERITY OF THE CRISIS SITUATION, (2) EVALUATE THE POTENTIAL IMPACT OF THE SITUATION ON THE SAFETY AND SECURITY OF THE BUILDING EMPLOYEES AND ITS GUESTS, AND (3) DEVELOP AND IMPLEMENT THE APPROPRIATE COURSE OF ACTION IN RESPONSE TO THE CRISIS SITUATION.

1.2 General Overview of the Plan

Response to an emergency affecting Haley & Aldrich is a cooperative effort between on-site personnel and local government agencies such as police, emergency medical personnel, and the fire department. This cooperative effort is intended to allow for strong lines of communication. The Plan is designed to ensure that all Haley & Aldrich staff members understand their role and responsibilities during emergencies.

1.2.1 Emergency Action Alert

An Emergency Action Alert is defined as any condition which exists (or is likely to exist) that endangers the safety of people or could cause property damage. Examples of situations that qualify as Emergency Action Alerts are medical emergencies, fires, severe weather, and/or bomb threats. These situations require the activation of the Emergency Action Plan. However, hazardous material spills, mass disasters, civil disturbances and other emergency conditions may arise that could also require the use of these emergency procedures. Should a Haley & Aldrich employee receive information regarding any type of crisis that may require the activation of the Emergency Action Plan and/or the partial/total evacuation of the facility, the local health and safety coordinator (LHSC) will be notified via telephone.

Emergency action should be initiated using any one of the following communication methods: telephones, the public address system, word-of-mouth, or the manual pull box alarms that may be located throughout the facility. Wherever stationed, all employees should familiarize themselves with the closest location of any emergency notification equipment and should be familiar with its use.

1.3 Haley & Aldrich Emergency Action Team (EAT) Members

Current members of the EAT for each Haley & Aldrich office location is presented in a table attached to this document (Appendix D).

Each Haley & Aldrich branch office has its own LSHC who should be identified to all employees working locally to the branch. In general, the LHSC will act as the "Incident Commander" in emergency situations. Should the LHSC be unavailable during an emergency, the Business Unit Leader, CEO, and/or the CHSM will act as the "Incident Commander". Therefore, whenever "LHSC" is mentioned in this plan, this term also applies to the other individuals listed in Appendix D.

1.4 Emergency Action Team Responsibilities

All EAT members will assist in monitoring the emergency by providing timely reports to the CHSM pertaining to their respective areas of responsibility and help to account for all personnel. Specific responsibilities of each team member are outlined further in this EAP.

2. PROCEDURE

The types of emergencies that can occur include, but are not limited to:

- Natural Disasters
- Utility Strikes or Failures
- Facility Failures
- Equipment Failures
- Fires
- Chemical Releases
- Explosions
- Accidents
- Medical Emergencies

Once it is determined that an incident has occurred or is about to occur, a systematic plan will be established and the EAT will be assembled to respond to the incident.

2.1 Fire Emergencies

This section of the EAP will be implemented in the event of 1) A fire alarm activation OR (2) A fire is discovered by a facility occupant OR 3) A bomb threat is received.

Because of the inherent risk of fire in the building, it is necessary to address appropriate response actions to fires.

2.1.1 Alarm Activation & General Evacuation Procedures

Any Haley & Aldrich employee or visitor that becomes aware of a fire shall immediately activate the facility fire alarm system. The fire alarm system will in turn notify all facility occupants that a fire emergency exists. This is accomplished by pulling a lever on a manual pull station, which in turn will sound an audible alarm.

All Haley & Aldrich employees and visitors will regard any activation of a fire alarm as a true fire emergency unless there has been previous notification of the alarm system being tested.

When an alarm is activated, all occupants will immediately leave the building using the escape routes posted in each office. Building evacuation procedures are outlined in more detail in Section 2.9 of this EAP.

Once out of the building, all Haley & Aldrich employees and visitors shall congregate in the designated assembly area(s) to determine if someone is missing. This headcount shall be performed to the extent possible as personal safety, time and capabilities permit. During fire evacuation events, it is typically not possible to account for every guest that may be visiting Haley & Aldrich at the time of the evacuation. However, no employee or visitor shall leave the assembly area, either to re-enter the facility or leave the property, until all known employees and guests are accounted for and until advised to do so by the LHSC or other designee (e.g., Business Unit Leader, CEO, fire department).

The LHSC will provide information as necessary and/or requested to the fire department. This information may include, but is not limited to:

- Location of the fire;
- Status of the evacuation, including personnel missing that may still be in the facility (to the extent that this information is available); and
- Special hazards associated with the facility that may impede fire fighting efforts.

2.1.2 Extinguishing Fires

Those employees trained in the use of fire extinguishers and that have been given the authority to operate a fire extinguisher may extinguish incipient stage fires (see definition below). This is only acceptable when there are no hazards beyond the normal duty of extinguishing a normal incipient stage fire.

Incipient stage fires are defined as:

- A fire which is in the initial or beginning stage and which can be controlled or extinguished by portable fire extinguishers, Class II standpipe, or small hose systems without the need for protective clothing or breathing apparatus.

Haley & Aldrich employees are not qualified to fight interior structural fires.

Interior structural fires are defined as:

- Interior structural fire fighting is the process of fire suppression and/or rescue inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. This definition is met if the structural elements of the building catch fire.

2.1.3 Return to Work

No employee is to return to the area of the fire until the fire department indicates it is safe to do so.

The fire department and building maintenance department will assess the area for damage and safety hazards once a fire, which has caused minor to major building damage, has been extinguished. Fires that have caused considerable damage may require an extensive assessment by qualified professionals. Through the collaborative of the fire department, building engineers, and maintenance personnel, a thorough assessment of the area will be conducted to determine the safety and integrity of the structure. Once the fire department and/or other qualified individuals have determined that the structure is safe, an “all-clear” will be signaled and employees may return to their work areas. It is possible that an “all clear” is signaled but employees will not return to their work areas based on the assessment. These employees may be sent home or to another, safe area of the building to continue their work.

In the event excessive damage has occurred, the area will be barricaded and signs posted to inform employees and other occupants of the requirements of not entering the structure. The appropriate authorities, company personnel and insurance company(s) will conduct proper investigations and inspections to assess the damage.

2.1.4 Post Emergency Action

All damaged fire protection equipment will be promptly identified, repaired, or removed from service.

Any extinguishing equipment that has been dispensed must be immediately removed from service and may not be placed back into service until the extinguishing agent has been replaced. In addition, all fire extinguishers that have lost the acceptable amount of pressure must be removed from service until the extinguishers’ pressure has been replenished.

In the case of a possible re-ignition of the fire, a staff member properly trained in extinguishing fires will stand by with fire equipment, such as a fire extinguisher or water hose line, until the possibility of re-ignition has been eliminated.

If conditions are such that the area must be barricaded and unauthorized individuals are not permitted to enter the area, security personnel or a designee will be posted at the designated area to prevent unauthorized entry.

Any Haley & Aldrich employee or visitor that has suffered any type of injury as a result of the fire (e.g., smoke inhalation, burns) must receive the necessary medical attention and fill out an injury incident report. An injury incident report can be filled out by a witness to the injury if the individual who sustained the injury or injuries is unable to complete the form. Injury Incident Forms are available from the LHSC and should be returned to the LHSC upon completion.

The LHSC must promptly complete an incident report describing the fire. The detail of the report will vary based on the size, extent, & severity of the fire. The final incident report describing the fire must be submitted to the CHSM upon completion. Outside professional resources should be considered if arson is suspected in any investigation.

2.2 Bomb Threats

Bomb threats may be received via telephone, e-mail, word-of-mouth, or written notice. Additionally, suspicious packages may be received via mail. Procedures for bomb threats received by telephone are outlined in the "Telephone Bomb Threat" section below. Procedures for bomb threats received by e-mail, word-of-mouth, or written notice are outlined in the "E-mail, Word-of-Mouth, or Written Notice Bomb Threat" section below. Procedures for handling suspicious packages are outlined in the "Suspicious Packages" section below.

2.2.1 Telephone Bomb Threat Procedures

BE CALM, BE COURTEOUS, AND LISTEN. DO NOT INTERRUPT THE CALLER.

1. All personnel that handle incoming calls should acquaint themselves with the bomb threat telephone log (see Appendix C). This log should be completed in all cases when a threatening call is received.

2. When the call is received, activate the call recording feature at the main switchboard (if possible) and try to keep the caller talking as long as feasible by following the bomb threat telephone log.

3. Try to ascertain the following information if the bomb threat telephone log is not available:

   - Where is the bomb located? Facility area?
   - When is the bomb going to explode?

- What kind of bomb is it? What kind of package is the bomb contained in??
- Why was the bomb placed?
- Who is speaking?
- How does the speaker know so much about the bomb?

After the phone conversation has ended, complete the basic requirements below to help respond to the incident:

1. Write out as much of the message as possible in its entirety and any other comments on a separate sheet of paper and attach it to the bomb threat telephone log or other sheet of paper that you kept notes about the conversation on. DO THIS RIGHT AWAY. YOU WILL FORGET IMPORTANT DETAILS AS TIME PASSES.

2. The person shall then notify the LHSC as soon as possible by telephone or in-person and inform them of the situation. If the LHSC not available, the employee shall notify his or her supervisor by telephone or in-person. If the supervisor is not available, the Business Unit Leader or CEO will be notified. The supervisor, Business Unit Leader, or CEO (as applicable) will then take on the role of the LHSC.

3. The LHSC will decide to the extent possible if the threat is viable and thus, if building security and the local police and/or fire department should be notified. In general, however, ALL BOMB THREATS SHOULD BE TAKEN SERIOUSLY.

4. The LHSC will then decide to the extent possible if a facility evacuation is warranted (in general, evacuation will be necessary). If it is warranted, evacuation shall take place as outlined in the Fire Emergencies section. Evacuation may be initiated by the LHSC coordinator by tripping the building's fire alarm. Again, all bomb threats should be taken seriously and the building should be evacuated when a threat is received.

5. Haley & Aldrich employees shall be informed to not touch any suspicious or unfamiliar objects.

6. The LHSC will assist in coordinating the building's security staff and informing them of the situation to the extent possible as personal safety, time and capabilities permit.

7. The LHSC will relinquish all authority of the emergency when the legal authorities arrive on site. All Haley & Aldrich employees are expected to fully cooperate with authorities.

8. The LHSC will participate in any post-incident evaluation regarding the emergency. Other Haley & Aldrich employees who are asked to participate in a post-incident evaluation are expected to cooperate fully.

2.2.2 E-mail, Word-of-Mouth, or Written Notice Bomb Threats

Upon receipt of a bomb threat by e-mail, word-of-mouth, or written notice, the employee who initially receives the threat shall immediately notify the LHSC by telephone or in person. If the LHSC is not available, the employee should notify his or her supervisor by telephone or in-person immediately. If the supervisor is not available, the Business Unit Leader or CEO should be notified. The supervisor, Business Unit Leader, or CEO (as applicable) will then take on the role of LHSC.

After the LHSC has been notified, he or she will follow the following procedures:

1. The LHSC will decide to the extent possible if the threat is viable and, thus, if building security and the local police and/or fire department should be notified. In general, however, ALL BOMB THREATS SHOULD BE TAKEN SERIOUSLY.

2. The LHSC will then decide to the extent possible if a facility evacuation is warranted (generally, evacuation will be necessary). If it is warranted, evacuation shall take place as outlined in the Fire Emergencies section. Again, all bomb threats should be taken seriously and the building should be evacuated when a threat is received.

3. Haley & Aldrich employees shall be informed to not touch any suspicious or unfamiliar objects.

4. The LHSC will assist in coordinating the building's security staff and informing them of the situation to the extent possible as personal safety, time and capabilities permit.

5. The LHSC will relinquish all authority of the emergency when the legal authorities arrive on site. All Haley & Aldrich employees are expected to fully cooperate with authorities.

6. The LHSC will participate in any post-incident evaluation regarding the emergency. Other Haley & Aldrich employees who are asked to participate in a post-incident evaluation are expected to cooperate fully.

2.2.3 Suspicious Packages

Once a package has been identified as potentially dangerous, the employee who initially received or encountered the packaged and identified it as suspicious shall clear the immediate area without causing any unnecessary alarm or panic to guests or other employees. Additional employees may assist with clearing the area.

The employee who initially received or encountered the package shall then notify the LHSC by telephone or in-person. If the LHSC is not available, the employee should notify his or her supervisor by telephone or in-person immediately. If the supervisor is not available, the Business Unit Leader or CEO should be notified. The supervisor, Business Unit Leader, or CEO (as applicable) will then take on the role of LHSC.

The LHSC will follow the following procedures after being informed of a suspicious package:

1. The LHSC will decide to the extent possible if the threat is viable and, thus, if building security and the local police and/or fire department should be notified.

2. The LHSC will then decide to the extent possible if a facility evacuation is warranted. If it is warranted, evacuation shall take place as outlined in the Fire Emergencies section of this document.

3. Haley & Aldrich employees shall be informed to not touch any suspicious or unfamiliar objects.

4. The LHSC will assist in coordinating the building's security staff and informing them of the situation to the extent possible as personal safety, time and capabilities permit.

5. The LHSC will relinquish all authority of the emergency when the legal authorities arrive on site. All Haley & Aldrich employees are expected to fully cooperate with authorities.

6. The LHSC will participate in any post-incident evaluation regarding the emergency. Other Haley & Aldrich employees who are asked to participate in a post-incident evaluation are expected to cooperate fully.

2.2.4 Bomb Searches

Personnel familiar with the facility and its contents will assist in conducting the bomb search when requested by legal authorities. All search activities will be conducted by an outside, trained agency (e.g., State or Local Police Bomb Squad). Haley & Aldrich personnel will generally NOT participate in any bomb searches.

2.3 Medical Emergencies

Haley & Aldrich employees should be aware of the various types of medical emergencies that may take place at the offices or on job sites. Examples of injuries or illnesses that may occur at Haley & Aldrich include but are not limited to:

- Lacerations (i.e., cuts);
- Back injuries;
- Burns;
- Sprains;
- Chemical irritation;
- Asphyxiation (i.e., suffocation);
- Seizures;
- Heart problems;
- Choking;
- Slips, trips, and falls; and/or
- Intoxication

2.3.1 First Aid Emergencies

First aid medical emergencies are situations that require only on-site first aid to treat the injury or illness. Outside medical professionals or other emergency responders are not notified in these situations.

Haley & Aldrich employees that have been trained in Cardiopulmonary Resuscitation (CPR), use of a defibrillator, and/or basic First Aid should assist in medical emergencies that occur within or near the Building. These employees are not expected to provide medical assistance that they do not feel comfortable or qualified to perform.

Basic employee responsibilities during first aid emergencies include:

- All employees must know where the nearest first aid kit is located prior to the commencement of any type of physical work. The kit must be easily accessible and have the materials that most occupational first aid kits would expect to contain (e.g., bandages, antiseptic, cotton, tape, scissors, anesthetic spray, ointment, etc.);
- Each kit must be monitored three times per year and supplies replenished, as needed, to ensure that the materials are available;
- Kits must be kept in an orderly arrangement and clean from dust, debris and chemical exposure. All fluids and materials that have expiration dates must be checked three times per year and replaced when needed;
- Employees that are designated to perform first aid services must receive adequate first aid training. This training shall address the basic concepts of first aid, cardiopulmonary resuscitation, blood borne pathogens, and special requirements dealing with the hazards that might be encountered at the facility which may include:
  - Electrocution
  - Chemical burns
  - Crushing and pinching injuries
  - Dehydration
  - Fall related injuries
  - Seizures;
  - If the injury appears that it will require more sophisticated medical services, immediately have someone, such as a bystander, contact emergency medical services (i.e., dial 911);

2.3.2 First Responder to a Medical Emergency

- Never jeopardize your own safety to provide medical attention to a co-worker. Assess the area to determine the possible cause of the injury (e.g., chemical spill, electrocution) prior to entering an area in order to prevent your own injury.

- Never enter a fire-engulfed area in an attempt to rescue or assist a trapped and/or injured person.

- Dial 911 and provide the dispatcher with the following information:

  - Type of emergency;

  - Specific location of the victim;

  - Condition of the victim;

  - Any dangerous conditions that may impede medical personnel from getting to the victim; and

  - If the injury or emergency involves a chemical, provide the name of the chemical and have Material Safety Data Sheet (MSDS) available. MSDS's are available through the LHSC for each office.

- Comfort the victim if possible and try not to move him or her until emergency medical services have arrived.

- Attempt to provide the level of first aid that you feel comfortable with in helping suppress any symptoms, bleeding, etc. DO NOT ATTEMPT TO PROVIDE ANY TYPE OF FIRST AID THAT YOU ARE NOT FAMILIAR WITH OR HAVE NOT BEEN TRAINED IN.

- Send someone outside the facility at the nearest gate or building entrance, if possible, to "flag down" the emergency medical service when they reach the vicinity of the facility.

- Do not touch any spilled body fluids. Contact appropriate contractors post-incident to facilitate this type of clean-up. Barricade any areas where body fluids have been spilled until these medical waste clean-up contractors have arrived.

- Once the victim has been cared for and is transported, witnesses to the injury should report to the LHSC to fill out an official Accident Report.

2.4 Civil Disturbances

Civil disturbances include all of the following: bomb threats, arson, violence, vandalism, labor strikes, and riots. In general, Haley & Aldrich employees are not trained to handle these types of emergencies. It is the responsibility of law enforcement agencies to respond to these types of disturbances.

Bomb threats are specifically discussed in Section 2.2 of this document.

It is possible that Haley & Aldrich employees may inadvertently become involved with such disturbances. Employees are expected to respond logically and with common sense in such an event. Do not take an active role in defusing or mitigating the disturbance.

The EAT members may be requested to assist in the event that an evacuation of the building is required.

In general, all civil disturbances shall be responded to in the following manner:

- Notify the LHSC.
- The LHSC will immediately contact the local police department and/or other emergency response agencies as needed.
- Employees will be evacuated if needed, or be alerted to any potential dangers.
- NO employees will attempt to mitigate any civil disturbance.
- If the civil disturbance is a bomb threat, follow the procedures outlined in Section 2.2 of this plan.

2.5 Hazardous Materials Spills

2.5.1 General Overview of Response to Hazardous Chemicals

Haley & Aldrich does not respond to major chemical spills or releases. It is the policy of the company to respond to spills that Haley & Aldrich has the resources and ability to mitigate.
Any clean up of a chemical spill that requires the use of any type of respiratory protection is strictly prohibited.

This section is a guide to assist the EAT in evaluating spills and provides technical assistance for responding to spills and releases that the LHSC or designee has determined are within the scope of Haley & Aldrich's capabilities.

2.5.2 First Responder Responsibilities

- An employee discovering the spill shall immediately notify the LHSC.

- Pull the fire alarm in the area of the spill if the release warrants a building evacuation.

- The LHSC will determine if the area should be immediately evacuated and barricaded. Barricade the area only if it can be done safely.

- The LHSC will also determine if the spill can or cannot be handled in-house, has entered the municipal or local sewer system, or has left the Haley & Aldrich premises.

- If the spill can be handled in-house, the LHSC will determine the procedures necessary to conduct proper clean-up. If the spill cannot be handled in-house, the LHSC will contact an independent Hazardous Waste Clean-up contractor to conduct the clean-up.

- If the spill or release has left Haley & Aldrich property or entered the sewer system, the local fire department shall be contacted immediately.

First Responder Operations requires 8 hours of training. Hazardous Material Technician level requires a minimum of 24 hours of training. At this time, Haley & Aldrich does not have anyone trained at this level. Therefore, spills that are determined by the LHSC to not be manageable in-house must be cleaned-up by a qualified contractor.

2.6 Natural Disasters

2.6.1 Winter Storms

Winter storms can create several problems that may challenge Haley & Aldrich in its attempt to protect the well-being of its personnel and prevent damage to property. These problems may include but are not limited to:

- Hazardous walking conditions;
- Inaccessibility to valves, hydrants, fire hoses, and fire pumps;
- Roof collapse due to excessive accumulation of ice and/or snow;
- Evacuation difficulties;
- Driving conditions that impede emergency vehicles from accessing the property; and
- Stranded guests at the building (possibly many guests)

Once it has been determined that an emergency condition exists, the EAT will coordinate such tasks as:

- Monitoring of snow removal procedures, such as:

  - cleaning snow and ice from exits, entrances, and fire hydrants;
  - removing snow from roofs in areas subject to drifting; and
  - inspecting and clearing roof drains
  - monitoring weather reports from the National Weather Service.

After the storm has ended:

- An immediate damage assessment will be made by the EAT and temporary repairs will be undertaken as soon as possible by the building maintenance department
- If damage to the building due to the severe weather presents a danger to employees, the area or building will be evacuated as necessary until required repairs have been made and the area is deemed safe for occupancy; and
- Any remaining snow will be removed, with priority given to valves, hydrants, pump houses, and fire department access routes.

2.6.2 Tornadoes

It is customary for the National Weather Service to alert citizens of impending tornadoes by stating that there is a "WATCH" or "WARNING."

- A tornado WATCH implies that a tornado is expected to develop.
- A tornado WARNING means that a tornado has been sighted and residents in the immediate area should take cover.

Any Haley & Aldrich employee who learns that the National Weather Service has issued a tornado “WATCH” for the area where the office is located should alert the LHSC. After the LHSC has been alerted, he or she may elect to send “spotters” to various locations of the building, depending on the direction of the storm or weather hazard, to watch for any approaching tornadoes. The LHSC will keep updated on developments from the National Weather Service.

Immediately upon receiving a report that a tornado “warning” has been issued in the area, the LHSC will alert all employees of the approaching tornado by using the Public Announcement System within the office.

- Employees and guests will be required to move to the lowest level of the building or other designated safe area and will be instructed to follow the directions of the EAT members.

After the tornado has passed, search and rescue operations will begin immediately, if appropriate. In addition, the following actions will occur if needed:

- The building maintenance department will be contacted and will take action to protect personnel and property from further harm (e.g. temporary repair or covering of openings in the buildings and clearing debris and water from roofs to prevent the roof from collapsing).

- If damage due to the tornado presents a danger to employees, the building or area will be evacuated as necessary until repairs have been made and the area/building is deemed safe for occupancy;

- EAT members will ensure that the fire protection system is intact and will be on alert for possible fires or flooding.

- Salvage operations will be initiated only upon determination that any threats to human life have been eliminated.

2.6.3 Severe Weather Emergency Action Communications

Severe weather can include, but is not limited to heavy rains, tornadoes, hail, snow, ice, frequent lightning, high winds, severe thunderstorms and hurricanes. Notification of severe weather will be received through local television or radio stations or through verified word-of-mouth from Haley & Aldrich staff.

2.6.4 General Response for Adverse Weather Conditions

2.6.4.1 Severe thunderstorm, winter storm or tornado WATCH:

- When a severe thunderstorm warning, winter storm warning, or tornado watch is issued, the LHSC will monitor the weather conditions and may dispatch a weather spotter to an appropriate area of the building, if necessary.

2.6.4.2 Severe thunderstorm, winter storm or tornado WARNING:

- When a severe thunderstorm warning is issued, actions to be taken by the LHSC include:

  - If employees need to be informed of the situation, provide a briefing on known information;

  - Inform employees of any actions that will be taken; and

  - If necessary, instruct employees to move to a safe area of the building.

2.7 Training

Once the Emergency Action Plan is finalized, a training plan will be developed to acquaint all employees with its procedures. Employees shall receive adequate basic training in the procedures outlined in this document. During new employee orientation, the LHSC will review the EAP with the new staff member. A copy of the plan must be provided to the new employee at that time.

The EAP must be located on a bulletin board in a conspicuous area at all times so that all staff members have an opportunity to review it.

2.8 Communications

2.8.1 Communicating with the Media

Employees shall refrain from giving information regarding emergency situations to the media or other various emergency organizations when at work or away from their job, and shall direct all inquiries to Haley & Aldrich BULTs/SULTs. Information conveyed to the media must be accurate and factual. This requires ample time to investigate the emergency, including speaking with involved individuals and the authorities. If needed, and only after consulting with Haley & Aldrich top management, Haley & Aldrich will establish a press release and it shall be reviewed for accuracy by the LHSC or other individual who served as Incident Commander during the emergency.

2.8.2 Communicating with Emergency Organizations (Police, Fire, City, Hospital)

All Haley & Aldrich employees are expected to cooperate fully with authorities. It is crucial to maintain a complete and straight line of communication with Emergency Organizations during an incident. If possible, the LHSC will act as a liaison between H&A employees and the responding emergency organization.

2.8.3 Communicating with Families

Haley & Aldrich's Human Resources Manager will maintain accurate records of employee names, addresses and phone numbers so that family members can be contacted if necessary.

All employees should refrain from contacting family members of co-workers who may have been injured in an emergency. Such contacts should be made only by the Human Resources Manager or their designee due to the emotional impact such information may have on family members and the need to ensure that accurate and correct information is communicated.

2.9 Evacuation Procedures

Employees should familiarize themselves with this section prior to the commencement of work by physically walking the different evacuation routes as if an actual emergency were taking place. Employees should examine posted evacuation plans to familiarize themselves with escape routes. Periodically, Haley & Aldrich may conduct drills to assure that all employees are familiar with the evacuation procedure. During building evacuation, employees should proceed out of the building calmly.

After leaving the building, employees will assemble in one of the designated assembly areas during an emergency. Because of the nature of our work and the unique egress patterns, there is no primary rally area for any one person or work function. However, it is imperative that ALL employees remain in a rally area until an "All Clear" has been announced. Outdoor areas where employees should assemble during an emergency vary among each office location. Each office must designate a specific outdoor assembly area or areas at least 200 feet away from the building and must communicate the location of this area(s) to all employees.

APPENDIX A
REFERENCES

- Occupational Health and Safety Regulations (OSHA), 29 CFR 1910.38, Employee Emergency Plans

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1022 Health and Safety Manual

APPENDIX C
FORMS

- Telephone Log – Bomb Threat

BOMB THREAT TELEPHONE LOG

*****STAY CALM. CREATE AUDIO RECORDING OF CALL IF POSSIBLE*****

Date:	
Time call received:	
Time call ended:	

QUESTIONS TO ASK

1. When is the bomb going to explode?
2. Where in the building is the bomb located right now?
3. What kind of bomb is it?
4. What does it look like?
5. Why did you place the bomb?
6. Who is speaking?
7. How do you know about the bomb?

DESCRIPTION OF CALLER'S VOICE & TONE OF VOICE:

MALE	FEMALE	YOUNG	MIDDLE-AGED	OLDER
ANGRY	CALM	PLEASANT	NERVOUS	

Any distinguishing features of caller's voice (e.g., accents, etc.)?

Any background noise? What is it?

Is the voice familiar to you? If so, who do you think it sounds like?

OTHER NOTES

APPENDIX D
EMERGENCY ACTION TEAM (EAT) MEMBERS

Emergency Action Team Members	**Employee (primary/secondary)**
LSHC	Boston: Nancy Reardon / Mark Dobday
	Boston Lab: Mark Dobday / Nancy Reardon
	HADC: Christopher Merrifield / Stew Wiley
	Portland: David Dearden / James Weaver
	Hartford: Jeffrey Duigou / Thomas Benedict
	Manchester: Boyd Smith
	Newark: Sunila Gupta / Ed Zamiskie
	Washington, D.C.: Tara Meadows / Michael Wolf
	Rochester: Michael Beikirch / Robert Mahoney
	Cleveland: Mark Pomfrey / Daniel Putz
	Dayton: Bruce Midolo / Cliff Schindel
	Detroit: Christopher Merrifield
	Los Angeles: Leah Levy/Loretta Quast
	San Diego: Beth Breitenbach / Anita Broughton
	Santa Barbara: Leah Levy/Loretta Quast
	Tuscon: Christopher Brooks / Kurt Blust
	Kansas City: Mariruth Gruis / Bruce Wilkinson
CHSM	Christopher Merrifield
Business Unit Leader (IE/RE/IN)	Lawrence Smith / William Beck / Alec Smith

Emergency Action Team Members	**Employee (primary/secondary)**
CEO	Bruce Beverly / Joseph Rixner

APPENDIX E
GLOSSARY

APPENDIX F

OP1016-Recordkeeping and Reporting

OPERATING PROCEDURE: OP1016

RECORDKEEPING AND REPORTING

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	CLM/ 2002	MPD/ April 03			DAS/ July 03

Total Pages: 15

HALEY & ALDRICH

TABLE OF CONTENTS

OPERATING PROCEDURE: OP1016

RECORDKEEPING AND REPORTING

1. PURPOSE

Haley & Aldrich has developed this procedure to:

1. ensure compliance with federal and state requirements for the recording and reporting of occupational injuries and illnesses, and

2. provide procedures required for the investigation of accidents and near miss incidents resulting in an injury/illness or damage to individuals and to property.

1.1 Discussion

The OSHA standard requires that work-related accidents be reported to the employer and serious injuries and illnesses be reported to the administering federal and/or state agencies. The Occupational Safety and Health Administration (OSHA) standard, "Reporting Occupational Injuries and Illnesses" (29 CFR 1904) requires that employers prepare and maintain records of recordable, work-related injuries and illnesses incurred by their staff members. The Bureau of Labor Statistics of the U.S. Department of Labor is responsible for administering the recordkeeping system established by the standard.

The following states have their own OSHA-approved job safety and health programs for workers. States with approved programs must have a standard that is identical to, or at least as effective as, the federal standard. A review of these states websites indicates that the recordkeeping requirements and forms used by Federal OSHA will satisfy our needs for these states recordkeeping requirements. In addition, the "First Report of Injury" form filled out by Human Resources (HR) to our insurance carrier (Liberty Mutual) satisfies all mandatory OSHA initial incident reporting for all states.

Michigan	Michigan Occupational Health and Safety Admin.
Arizona	Industrial Commission of Arizona
California	California Div. of OSHA
Virginia	Virginia Department of Labor

Every state requires some type of injury and illness notification. These requirements usually involve the completion and submission of that state's "employers' first report of injury" form for occupational injuries and illnesses, which meet that state's "reportable" criteria. The report filed with Liberty Mutual, by HR, satisfies this requirement. This procedure has been developed, in part, to assure compliance with these federal and state requirements. Finally, injury and illness data is tracked and utilized by the CHSM to identify problem areas and reduce recurrence of such injuries and illnesses.

1.2 Application

This policy applies to all H&A staff members.

2. PROCEDURE

2.1 Accident Reporting

Staff members must report all work-related accidents, near miss incidents, and incidents resulting in property damage or injury to their staff managers immediately after the occurrence. Staff Managers must report all work-related accidents (other than those resulting in only minor injuries) and all near miss incidents to their Local Health and Safety Coordinator (LHSC). The notification of the LHSC by the staff manager must be made verbally, as soon as possible after the occurrence. Prior to filling out any documentation, management must ensure that the emergency is over and the injured staff member has received the proper medical attention immediately following the incident.

2.2 Supervisor Accident Injury Report (SAIR – SAF 004 Form)

All injuries and accidents must be reported to the LHSC or the Corporate Health and Safety Manager (CHSM) as soon as possible and prior to conducting any type of accident investigation. The summary of the accident or incident investigation must be recorded on the Supervisors Accident Injury Report (see Company Intranet or Appendix C for copy). The completed SAIR must be submitted to the LHSC **within 24 hours of the occurrence** of the accident or incident. The SAIR must be forwarded by the LHSC to the CHSM and the Human Resources Department in Boston as soon as possible. The report is used by HR as the basis to initiate a worker's compensation claim with our insurance carrier.

2.3 Instructions for Completing the Supervisor Accident Injury Report (SAF 004)

If more than one staff member is injured, complete a report for each staff member. It is important that applicable details are included on the form. The staff member must be involved in filling out the SAIR to ensure accuracy and concurrence of events. Below are the entries required to successfully filling out the SAIR.

1. Name of injured staff member

2. Haley & Aldrich ID #

3. Staff member's home office and department

4. Accident date, day of week, and time of day

5. Name of project and project manager

6. Project number

7. Description of the specific location of the accident, including the facility name and location, and the specific location within the facility where the accident occurred.

8. Description of the specific activity the staff member was engaged in when the accident occurred. Describe in detail how the accident occurred, using all factors that may have contributed to it. Answer all the "W Questions": who, what, when, where, why, and how.

9. Names of any witnesses

10. Equipment and materials involved in incident

11. Description of the injury in detail, e.g., "injured lower back while lifting a ream of paper in the office."

12. Description of first aid or medical treatment provided

13. Name and address of medical provider if known

14. Statement whether any lost time will be incurred, approximately how much lost time will be involved, and the date that the lost time began

15. Staff member's specific job title (e.g., geologist, project manager, equipment operator, etc.).

16. Description of the preliminary determination of cause of incident.

17. Description of the action(s) necessary to prevent recurrence. Describe the action(s) taken thus far to prevent recurrence.

18. Person(s) who are responsible for corrective actions

The staff manager preparing the report should then sign it and submit it to their LHSC for review and signature. After review by the LHSC and signature, the report should be submitted to the CHSM and HR.

2.4 Timeliness of Reporting

To assure that matters related to internal recordkeeping, state reporting requirements and Worker's Compensation are addressed in a timely fashion and that prompt and appropriate medical attention is provided to the ill or injured staff member, it is imperative that:

- Staff members report all work-related injuries and illnesses incurred, regardless of their severity, to their staff manager immediately after their occurrence. All injuries must be reported to the appropriate staff manager **within 24 hours**. If an injury occurs on a Friday, staff members are required to leave a message on their staff manager's voice mail during the weekend or talk to them prior to returning back to work on Monday.

- Staff members notify their staff manager as soon as they become aware that a work related injury or illness **is likely to result in a day away from work.**

- Staff members notify their LHSC or staff manager if they **become aware that a first aid case has increased in severity** and may result in the need for additional medical attention. (Example, cut that becomes infected.)

- Staff managers notify their LHSC as soon as they become aware that an staff member has incurred a work-related injury or illnesses (other than a minor injury) or that an injury or illness is likely to result in a day away from work.

Our insurance carrier reserves the right to refuse any claim that is not reported in a timely manner. It is essential that staff members communicate their injury status to the LHSC and staff manager as soon as possible to avoid refusal of payment of medical bills.

2.5 Reporting Serious Accidents

Within eight (8) hours after the death of any staff member from a work-related incident or the in-patient hospitalization of three or more staff members as a result of a work-related incident, we must orally report the fatality/multiple hospitalization by telephone or in person to the Area Office of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, that is nearest to the site of the incident. The CHSM will use the OSHA toll-free central telephone number, 1-800-321-OSHA (1-800-321-6742). If the incident occurs in a state-approved program, the CHSM, or designee, will call the applicable state agency.

If the incident involves a motor vehicle accident and occurs on a public street or highway, and does not occur in a construction work zone, we do not have to report the incident to OSHA. However, these injuries must be recorded on the office's OSHA injury and illness records.

To assure that these requirements are met:

- All serious accidents, must be reported to the CHSM and/or the LHSC of the office in which the accident occurred.
- If the serious accident is reported to the LHSC first, he/she must immediately report it to the CHSM. The CHSM, or his designee, will then report the accident to H&A management, OSHA and other appropriate agencies.

2.6 Accident Investigation

The objective of the accident investigation is to provide factual documentation of root cause and contributing factors and to determine strategies to prevent recurrence. The accident investigation is a learning tool (fact-finding) to be used to improve operations and is not a device used to assess blame (fault-finding). On some occasions H&A may be required to conduct a formal accident investigation and provide supporting documentation to our clients.

It should be assumed that an incident that may result in legal action will require an investigation. If we anticipate that legal action may result from the incident, most likely the project manager of the project will be asked by H&A legal counsel to facilitate an investigation.

2.6.1 Investigation Procedure

In general, the project manager should perform the accident investigation. In cases where the staff member's project manager is not present or available, a representative from the business unit will conduct the accident investigation. Haley & Aldrich does not have a standard investigation protocol or a standard document format at this time. CHSM and corporate counsel will assist in determining the required protocol and document format for each case. The investigator should be familiar with the staff member's job function, the equipment used, and activity at the time of the accident. The investigation should begin as soon as possible after the occurrence of the accident, and after any injured staff member's welfare has been initially addressed.

2.7 Injury and Illness Recordkeeping

OSHA 29 CFR 1904, or state equivalent rule, requires that each employment facility prepare and maintain records of recordable, work-related injuries and illnesses incurred by their staff members. Specific requirements of this standard include the recording of each recordable injury and illness on:

- A separate supplementary record of occupational injuries and illnesses form (i.e., OSHA No. 301 Form) or an equivalent state "Employer's First Report of Injury" form (Accomplished by HR when reporting incidents to Liberty Mutual) and on
- A regularly updated, cumulative log of injuries and illnesses (i.e., the OSHA No. 300 Log), and on
- An Annual Summary of Work Related injuries and Illnesses (i.e., the OSHA No 300A Form)

Offices in Michigan, Arizona, California, and Virginia may use the federal forms to satisfy this recordkeeping requirement. These forms and this log must be available in each facility for inspection at all times and the OSHA 300A Form must be posted in the workplace each year during the month of February for three consecutive months.

2.8 OSHA 300 Log

Recordable injuries and illnesses must be entered on the facility's OSHA 300 Log by the LHSC within **six work days** after receiving information of the injury or illness. The log must be maintained and each entry onto the log made in strict accordance with OSHA rules. The instructions to fill out the log can be retained from the H&A Safety Homepage. The information on the Homepage is the Bureau of Labor Statistics publication "Recordkeeping Guidelines for Occupational Injuries an Illnesses" and should be used by the LHSC for guidance. The CHSM will be involved in all cases to determine recordability.
Blank copies of the Log of Work-Related injuries and Illnesses (OSHA 300 Log) can be found on the Safety Homepage under "forms- OSHA 300log.xls". To successfully utilize this form, it must be downloaded from the Intranet and altered from "protected" by following the prompt on the screen.

The determination of recordability of all injuries and illnesses will be made by the CHSM.

At the completion of the calendar year, the log must be finalized and totaled, reviewed by the CHSM, reviewed by the LHSC, and properly filed at the office. In addition a Supplementary Form (OSHA 300A) will be filled out at the end of the year by the LHSC, reviewed and signed by the CHSM and posted in each facility during the month of February through April. Original OSHA 300 Logs and OSHA 300A Forms must be maintained by the LHSC in each facility for 5 years following the year for which they pertain.

2.9 Supplementary Record of Occupational Injuries and Illnesses (OSHA 301 Form)

For each recordable injury or illness reported, a Supplementary Record of Occupational Injuries and Illnesses, OSHA 301 Form, or its equivalent must be filled out. This is accomplished by HR. H&As insurance carrier satisfies this requirement on H&As behalf when a report of the incident is filled out with our insurance carrier. The particular state's "Employer's First Report of Injury" form, a form which generally contains all the information required by the OSHA 301 Form, is utilized by the insurance carrier to determine compensability. Note that each state requires that its "Employer's First Report of Injury" form be completed and submitted only if an injury or illness meets its "reportability" criteria. We rely solely on our insurance carrier to satisfy the reporting of this form(s) for each state. This report is generated by the information provided by the staff manager in the Form SAF004- SAIR. Thus, it is imperative that the information is accurate and thorough on the SAIR.

2.10 Worker's Compensation Claims

Any occupational illness or injury, which results in a worker's compensation claim that was not initially reported, must be reported to the HR representative in Boston so that a state "Employer's First Report of Injury" form can be completed. Questions regarding the filing and processing of Worker's Compensation claims should be directed to the LHSC or CHSM.

2.11 Responsibilities

2.11.1 Staff Members

- Report all real or potential work-related injuries and illnesses, regardless of their severity, to their staff managers and LHSC after their occurrence;
- Report all changes in the status of their injury or illness to their staff manager and LHSC as soon as possible; and
- Report all near miss incidents and property damage to their staff manager and LHSC after their occurrence.

2.11.2 Staff Managers

- Report all work-related illnesses and injuries, other than minor injuries, which their staff members incur, to their LHSC within one day of their occurrence;
- Report serious accidents to the CHSM or their LHSC after their occurrence;
- Participate or conduct a formal accident investigation of the incident based on the severity, when instructed by their LHSC; and
- Complete and submit an SAIR to the LHSC, when instructed by their LHSC.

2.11.3 Corporate Health and Safety Manager

- Determines the recordability of all injuries and illnesses for the company;
- Works with HR and the LHSCs to ensure that the proper recordkeeping has been initiated, filed, and retained as required by the authorities;
- Obtains and maintains sufficient original blank copies of all required forms and logs on the Health & Safety Hompage on the company intranet;
- Participates in accident investigations as needed;
- Evaluates OSHA 300 logs to determine trends and make recommendations to management to reduce the occurrences of injuries or illnesses; and
- Forwards copies of the updated, totaled, and signed OSHA 300 Log and Summary (300A) for the previous year to their LHSC by the 2nd Monday of each January.

2.11.4 Local Health and Safety Coordinators

- Perform all the injury/illness recordkeeping requirements specified in this OP at the local level;
- Provide completed copies of SAIRs to HR as soon as possible as to assist the HR Representative in the completion of the "Employer's First Report of Injury" form and other worker's compensation documentation;
- Maintain a proper account of all injuries and illnesses for their office, including first aid cases;
- Post OSHA 300A Summary Form in their respective offices from February 1 through April 30;

- Responsive to any possibility that a staff member may be injured and ensure that the proper process is implemented; and

- Track injuries and illnesses within their offices by maintaining a 300 log of all injuries and illnesses reported to them by staff managers within their office.

APPENDIX A
REFERENCES

- Occupational Safety and Health Administration (OSHA) standard, "Reporting Occupational Injuries and Illnesses" (29 CFR 1904).

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1009 Medical Surveillance Program
- OP1010 Health and Safety Plans
- OP1013 Radiation Safety Program
- OP1014 Hazard Communication
- OP1017 Chemical Hygiene Plan
- OP1020 PPE Use, Purchase and Selection
- OP1022 Health and Safety

APPENDIX C
FORMS

- Supervisor Accident Injury Report (SAF 004) – please see the Health and Safety page on the intranet to retrieve this form.

APPENDIX D
GLOSSARY

- **Days Away From Work-** When an injury or illness involves one or more days away from work, we must record the injury or illness on the OSHA 300 Log with a check mark in the space for cases involving days away and an entry of the number of calendar days away from work in the number of days column. If the staff member is out for an extended period of time, you must enter an estimate of the days that the staff member will be away, and update the day count when the actual number of days is known. Weekend days, holidays, vacation days or other days off are included in the total number of days recorded if the staff member would not have been able to work on those days because of a work-related injury or illness.

- **Facility** - A single physical location where business is conducted or where services or industrial operations are performed. Distinctly separate activities performed at a single location are each treated as a separate facility for recordkeeping purposes. Therefore, each H&A office is considered a separate facility and recordkeeping is required to be maintained at each office.

- **First Aid** - Any one-time treatment, and any follow-up visit for the purpose of observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care. This treatment is considered first aid even though it is provided by a physician or registered professional personnel.

- **Medical Treatment** - Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. For purposes of the OSHA recordkeeping requirement, "medical treatment" does not include first-aid treatment even though provided by a physician or a registered medical professional. "Medical treatment" means the management and care of a patient to combat disease or disorder.

- **Near-miss Incident** - Any abnormal work occurrence, that could have resulted in a serious injury or significant property damage, but, for a matter of chance does not result in either. Such occurrences indicate a potential problem as surely as do accidents resulting in injury or property damage.

- **Property Damage** – Significant damage or loss to equipment, facilities, or other property.

- **Recordable Occupational Injuries or Illnesses** - Any work-related illness, or a work-related injury that results in any of the following:

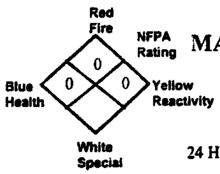
  - Death
  - Days away from work
  - Hospitalization or medical treatment (other than first aid)
  - Restricted work or transfer to another job
  - Loss of consciousness
  - Diagnosis of significant injury or illness
  - Significant aggravation of pre-existing condition

- **Restriction of Work** - Occurs when an staff member, because of a work-related injury or illness:
  - Is kept from performing one or more of the routine functions of his or her job, or from working the full workday that he or she would otherwise have been scheduled to work; or
  - Is recommended by a physician or other licensed health care professional that the staff member not perform one or more of the routine functions of his or her job, or not work the full workday that he or she would otherwise have been scheduled to work.
- **Serious Accident** - Any work-related accident that results in:
  - A death
  - Hospitalization of three or more staff members
- **Work Related** - You must consider an injury or illness to be work-related if an event or exposure in the work environment either caused or contributed to the resulting condition or significantly aggravated a pre-existing injury or illness.

MSDS

H&A Field Representative Package, Table of Content

Alconox ®



MATERIAL SAFETY DATA SHEET

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

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

I. IDENTIFICATION

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

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

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

III. PHYSICAL/CHEMICAL CHARACTERISTICS

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

IV. FIRE AND EXPLOSION DATA

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

V. REACTIVITY DATA

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

VI. HEALTH HAZARD DATA

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

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

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

VIII. CONTROL MEASURES

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

CORNELL

Material Safety Data Sheets

Division of Facilities Services

DOD Hazardous Material Information (ANSI Format) For Cornell University Convenience Only

DISTILLED WATER

Section 1 - Product and Company Identification
DISTILLED WATER

Product Identification: DISTILLED WATER
Date of MSDS: 12/13/1995 **Technical Review Date:** 05/01/1996
FSC: 6810 **NIIN:** 00-682-6867
Submitter: D DG
Status Code: C
MFN: 01
Article: N
Kit Part: N

Manufacturer's Information

Manufacturer's Name: SPECIALTY PRODUCTS INC
Manufacturer's Address1: 1712 1ST AVE W
Manufacturer's Address2: BIRMINGHAM, AL 35208-5219
Manufacturer's Country: US
General Information Telephone: 205-833-3541
Emergency Telephone: 205-833-3541
Emergency Telephone: 205-833-3541
MSDS Preparer's Name: HMIS (VBA)
Proprietary: N
Reviewed: Y
Published: Y
CAGE: 1M628
Special Project Code: N

Item Description

Item Name: DISTILLED WATER,REAGENT
Item Manager: S9G
Specification Number: ASTM 1193
Type/Grade/Class: TYPE III
Unit of Issue: BX **Quantitative Expression:** 00000000006EA
Unit of Issue Quantity: 1
Type of Container: BOTTLE

Preparer Information

Preparer's Name: SPECIALTY PRODUCTS INC
Preparer's Address1: 1712 1ST AVE W
Preparer's Address2: BIRMINGHAM, AL 35208-5219
Preparer's CAGE: 1M628
Assigned Individual: N

Contractor Information

Contractor's Name: MCKESSON CORP MCKESSON CHEMICAL CO DIV
Contractor's Address1: 1734 HAYES AVE
Contractor's Address2: LONG BEACH, CA 90813
Contractor's Telephone: 415-983-9214
Contractor's CAGE: 1JK82

Contractor Information

Contractor's Name: SPECIALTY PRODUCTS INC
Contractor's Address1: 1712 1ST AVE W
Contractor's Address2: BIRMINGHAM, AL 35208-5219

Contractor's Telephone: UNKNOWN
Contractor's CAGE: 1M628

Section 2 - Compositon/Information on Ingredients
DISTILLED WATER

Ingredient Name: WATER, DISTILLED
Ingredient CAS Number: 7732-18-5 **Ingredient CAS Code:** M
RTECS Number: ZC0110000 **RTECS Code:** M
=WT: =WT Code:
=Volume: =Volume Code:
>WT: >WT Code:
>Volume: >Volume Code:
<WT: <WT Code:
<Volume: <Volume Code:
% Low WT: % Low WT Code:
% High WT: % High WT Code:
% Low Volume: % Low Volume Code:
% High Volume: % High Volume Code:
% Text: 100
% Enviromental Weight:
Other REC Limits: NONE RECOMMENDED
OSHA PEL: NOT ESTABLISHED **OSHA PEL Code:** M
OSHA STEL: OSHA STEL Code:
ACGIH TLV: NOT ESTABLISHED **ACGIH TLV Code:** M
ACGIH STEL: N/P **ACGIH STEL Code:**
EPA Reporting Quantity:
DOT Reporting Quantity:
Ozone Depleting Chemical: N

Section 3 - Hazards Identification, Including Emergency Overview
DISTILLED WATER

Health Hazards Acute & Chronic: NO HEALTH HAZARDS ARE EXPECTED, ACUTE OR CHRONIC.

Signs & Symptoms of Overexposure:
NONE

Medical Conditions Aggravated by Exposure:
NONE

LD50 LC50 Mixture: LD50 (ORAL RAT) IS UNKNOWN

Route of Entry Indicators:
Inhalation: NO
Skin: NO
Ingestion: NO

Carcenogenicity Indicators
NTP: NO

IARC: NO
OSHA: NO

Carcinogenicity Explanation: THIS COMPOUND CONTAINS NO INGREDIENTS AT CONCENTRATIONS OF 0.1% OR GREATER THAT ARE CARCINOGENS OR SUSPECT CARCINOGENS.

Section 4 - First Aid Measures
DISTILLED WATER

First Aid:
NO HAZARD; NO TREATMENT REQUIRED.

Section 5 - Fire Fighting Measures
DISTILLED WATER

Fire Fighting Procedures:
NO SPECIAL REQUIREMENTS.
Unusual Fire or Explosion Hazard:
NONE
Extinguishing Media:
N/R
Flash Point: Flash Point Text: NONE

Autoignition Temperature:
Autoignition Temperature Text: UNK
Lower Limit(s): N/R
Upper Limit(s): N/R

Section 6 - Accidental Release Measures
DISTILLED WATER

Spill Release Procedures:
NO SPECIAL REQUIREMENTS.

Section 7 - Handling and Storage
DISTILLED WATER

Handling and Storage Precautions:

Other Precautions:

Section 8 - Exposure Controls & Personal Protection
DISTILLED WATER

Repiratory Protection:
NO SPECIAL REQUIREMENTS.
Ventilation:
NO SPECIAL REQUIREMENTS
Protective Gloves:
NONE
Eye Protection: SAFETY GLASSES
Other Protective Equipment: NONE
Work Hygenic Practices: NONE
Supplemental Health & Safety Information: NONE

Section 9 - Physical & Chemical Properties
DISTILLED WATER

HCC: N1
NRC/State License Number: N/R
Net Property Weight for Ammo: N/R
Boiling Point: Boiling Point Text: 212F,100C
Melting/Freezing Point: Melting/Freezing Text: 32.0F,0.0C
Decomposition Point: Decomposition Text: UNKNOWN
Vapor Pressure: 18 **Vapor Density:** N/K
Percent Volatile Organic Content:
Specific Gravity: 1.0
Volatile Organic Content Pounds per Gallon:
pH: 7
Volatile Organic Content Grams per Liter:
Viscosity: N/R
Evaporation Weight and Reference: <1 (NBUAC=1)
Solubility in Water: COMPLETE
Appearance and Odor: LIQUID, COLORLESS, ODORLESS
Percent Volatiles by Volume: 100
Corrosion Rate: UNKNOWN

Section 10 - Stability & Reactivity Data
DISTILLED WATER

Stability Indicator: YES
Materials to Avoid:
NONE
Stability Condition to Avoid:
NONE
Hazardous Decomposition Products:
NONE
Hazardous Polymerization Indicator: NO
Conditions to Avoid Polymerization:
NOT RELEVANT

Section 11 - Toxicological Information
DISTILLED WATER

Toxicological Information:
N/P

Section 12 - Ecological Information
DISTILLED WATER

Ecological Information:
N/P

Section 13 - Disposal Considerations
DISTILLED WATER

Waste Disposal Methods:
FLUSH TO A SANITARY SEWER.

Section 14 - MSDS Transport Information
DISTILLED WATER

Transport Information:
N/P

Section 15 - Regulatory Information
DISTILLED WATER

SARA Title III Information:
N/P
Federal Regulatory Information:
N/P
State Regulatory Information:
N/P

Section 16 - Other Information
DISTILLED WATER

Other Information:
N/P

HMIS Transportation Information

Product Identification: DISTILLED WATER
Transporation ID Number: 82205
Responsible Party CAGE: 1M628
Date MSDS Prepared: 12/13/1995
Date MSDS Reviewed: 05/01/1996
MFN: 05/01/1996
Submitter: D DG
Status Code: C

Container Information
- **Unit of Issue:** BX
- **Container Quantity:** 1
- **Type of Container:** BOTTLE
- **Net Unit Weight:** 49.8 LBS

Article without MSDS: N
Technical Entry NOS Shipping Number:
Radioactivity:
Form:
Net Explosive Weight:
Coast Guard Ammunition Code:
Magnetism: N/P
AF MMAC Code:
DOD Exemption Number:
Limited Quantity Indicator:
Multiple Kit Number: 0
Kit Indicator: N
Kit Part Indicator: N
Review Indicator: Y
Additional Data:
NONE

Department of Transportation Information

DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
DOT PSN Code: ZZZ
Symbols: N/R
DOT PSN Modifier:
Hazard Class: N/R
UN ID Number: N/R
DOT Packaging Group: N/R
Label: N/R
Special Provision(s): N/R
Packaging Exception: N/R
Non Bulk Packaging: N/R
Bulk Packaging: N/R
Maximimum Quanity in Passenger Area: N/R
Maximimum Quanity in Cargo Area: N/R
Stow in Vessel Requirements: N/R
Requirements Water/Sp/Other: N/R

IMO Detail Information

IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IMO PSN Code: ZZZ
IMO PSN Modifier:
IMDG Page Number: N/R
UN Number: N/R
UN Hazard Class: N/R
IMO Packaging Group: N/R
Subsidiary Risk Label: N/R
EMS Number: N/R
Medical First Aid Guide Number: N/R

IATA Detail Information

IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA PSN Modifier:
IATA UN Id Number: N/R
IATA UN Class: N/R
Subsidiary Risk Class: N/R
UN Packaging Group: N/R
IATA Label: N/R
Packaging Note for Passengers: N/R
Maximum Quantity for Passengers: N/R
Packaging Note for Cargo: N/R
Maximum Quantity for Cargo: N/R
Exceptions: N/R

AFI Detail Information

AFI Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI Symbols:
AFI PSN Code: ZZZ
AFI PSN Modifier:
AFI UN Id Number: N/R
AFI Hazard Class: N/R
AFI Packing Group: N/R

AFI Label: N/R
Special Provisions: N/A
Back Pack Reference: N/A

HAZCOM Label Information

Product Identification: DISTILLED WATER
CAGE: 1M628
Assigned Individual: N
Company Name: SPECIALTY PRODUCTS INC
Company PO Box:
Company Street Address1: 1712 1ST AVE W
Company Street Address2: BIRMINGHAM, AL 35208-5219 US
Health Emergency Telephone: 205-833-3541
Label Required Indicator: N
Date Label Reviewed: 05/01/1996
Status Code: C
Manufacturer's Label Number: NONE
Date of Label: 05/01/1996
Year Procured: N/K
Organization Code: N
Chronic Hazard Indicator: N
Eye Protection Indicator: N/P
Skin Protection Indicator: N/P
Respiratory Protection Indicator: N/P
Signal Word: NONE
Health Hazard: None
Contact Hazard: None
Fire Hazard: None
Reactivity Hazard: None

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MATERIAL SAFETY DATA SHEET (MSDS)

Click here for the French version / Appuyer ici pour la version française

MATERIAL SAFETY DATA SHEET

EM SCIENCE

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer.............:
EM SCIENCE
A Division of EM Industries
P.O. Box 70
480 Democrat Road
Gibbstown, N.J. 08027

Preparation Date.: 10/24/00

Information Phone Number.: 856-423-6300
Hours: Mon. to Fri. 8:30-5
Chemtrec Emergency Number: 800-424-9300
Hours: 24 hrs a day

Catalog Number(s):

MX0475 MX0480 MX0483 MX0484 MX0485 MX0487 MX0488
MX0489 MX0490 AX1699M MX0475P MX0482 MX0485P MX0485S
MX0488B MX0488P MX0485J MX0480P MX0472 0060248D 64753
MX0481 MX0491 MX0492 951P 1.06036 1.16715 1.06004
VW5790 MX0475PH 512768

Product Name:
Methanol
Synonyms:
Methyl Alcohol, Wood Alcohol
Chemical Family:
Aliphatic Alcohol
Formula:
CH_3OH
Molecular Weight.:
32.04

2. COMPOSITION / INFORMATION ON INGREDIENTS

Component	CAS #	Appr %
Methanol	67-56-1	100%

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
FLAMMABLE LIQUID AND VAPOR.
VAPOR HARMFUL.
MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED.
CANNOT BE MADE NON-POISONOUS.
MAY CAUSE DAMAGE TO LUNGS AND CENTRAL NERVOUS SYSTEM.
ABSORPTION THROUGH SKIN HARMFUL.

Appearance:
Colorless liquid, characteristic alcoholic odor

POTENTIAL HEALTH EFFECTS (ACUTE AND CHRONIC)

Symptoms of Exposure:
Toxic by ingestion and inhalation. Can be toxic by skin absorption. After ingestion or inhalation, initial symptoms may be only that of mild intoxication, but may become severe after 12 to 18 hours. Affects Central Nervous System, especially optic nerve. Marked impairment of vision and enlargement of the liver has been reported with chronic exposure. Chronic exposure may also cause damage to kidneys and Central Nervous System. Causes dizziness, nausea, muscle weakness, narcosis, respiratory failure. Ingestion can produce blindness (100 ml can be fatal). Prolonged or repeated skin contact may cause irritation. Fetal development abnormalities and effects on embryo or fetus has been reported from prolonged exposure to methyl alcohol in laboratory tests involving pregnant rats enlargement of the liver has been reported with chronic exposure.

Medical Cond. Aggravated by Exposure:
Skin conditions, eye problems, or impaired liver or kidney function.

Routes of Entry:
Inhalation, ingestion or skin contact.

Carcinogenicity:
The material is not listed (IARC, NTP, OSHA) as cancer causing agent.

4. FIRST AID MEASURES

Emergency First Aid:
GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE.
Skin: Wash thoroughly with soap and water.
Eyes: Immediately flush thoroughly with water for at least 15 minutes.
Inhalation: Remove to fresh air; give artificial respiration if breathing has stopped.
Ingestion: Get immediate medical attention. If medical attention is not immediately available, induce vomiting. Do not induce vomiting if patient is unconscious.
Remove contaminated clothing and wash before reuse.

5. FIRE FIGHTING MEASURES

Flash Point (F): 52F (tcc)
Flammable Limits LEL (%): 6.7
Flammable Limits UEL (%): 36.5
Extinguishing Media:
Use water spray, foam, dry chemical, or CO_2.

Fire Fighting Procedures:
Wear self-contained breathing apparatus.

Fire & Explosion Hazards:
Dangerous fire and explosive hazard. Closed containers may explode upon heating. Vapor can travel distances to ignition source and flash back. Hot organic chemical vapors or mists are susceptible to sudden spontaneous combustion when mixed with air. Ignition may occur at temperatures below published autoingnition or ignition temperatures. Ignition temperatures decrease with increasing vapor volume and vapor/air contact time and are influenced by pressure changes. Ignition may occur at typical elevated temperature process conditions, especially in process operating under vacuum if subjected to sudden ingress of air, or outside process equipment operating under elevated pressure if sudden escape of vapors or mists to the atmosphere occurs.

6. ACCIDENTAL RELEASE MEASURES

Spill Response:
Evacuate the area of all unnecessary personnel. Wear suitable protective equipment listed under Exposure / Personal Protection. Eliminate any ignition sources until the area is determined to be free from explosion or fire hazards. Contain the release and eliminate its source, if this can be done without risk. Take up and containerize for proper disposal as described under Disposal. Comply with Federal, State, and local regulations on reporting releases. Refer to Regulatory Information for reportable quantity and other regulatory data.
EM SCIENCE recommends Spill-X absorbent agents for various types of spills. Additional information on the Spill-X products can be provided through the EM SCIENCE Technical Service Department (856) 423-6300. The following EM SCIENCE Spill-X absorbent is recommended for this product:

```
SX0863  Solvent Spill Treatment Kit
```

7. HANDLING AND STORAGE

Handling & Storage:
Keep container closed. Store in a cool area away from ignition sources and oxidizers. Do not breath vapor or mist. Do not get in eyes, on skin, or on clothing. Electrically ground all equipment when handling this product.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT:

Ventilation, Respiratory Protection, Protective Clothing, Eye Protection:
Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), a NIOSH/MSHA approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions (see your safety equipment supplier). Engineering and/or administrative controls should be implemented to reduce exposure. Material should be handled or transferred in an approved fume hood or with adequate ventilation. Protective gloves must be worn to prevent skin contact (Butyl Rubber, Viton or equivalent) Safety glasses with side shields must be worn at all times.

Work/Hygenic Practices:
Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

EXPOSURE GUIDELINES

OSHA - PEL:

	TWA		STEL		CL		
Component	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	Skin
Methanol	200	260	250	325			X

ACGIH - TLV:

	TWA		STEL		CL		
Component	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	Skin
Methanol	200	262	250	328			X

If there are no exposure limit numbers listed in the Exposure Guidelines chart, this indicates that no OSHA or ACGIH exposure limts have been established.

9. PHYSICAL AND CHEMCIAL PROPERTIES

Boiling Point (C 760 mmHg) : 64.5C
Melting Point (C) : -98C
Specific Gravity (H_20 = 1) : 0.791
Vapor Pressure (mm Hg) : 97 20C
Percent Volatile by vol (%): 99.9+%
Vapor Density (Air = 1) : 1.1
Evaporation Rate (BuAc = 1): 5.91
Solubility in Water (%) : Miscible
Appearance :
Colorless liquid, characteristic alcoholic odor

10. STABILITY AND REACTIVITY

Stability: Yes

Hazardous Polymerization:
Does not occur

Hazardous Decomposition:
CO_x, Formaldehyde

Conditions to Avoid:
Heat; contact with ignition sources.

Materials To Avoid:

```
( ) Water
(X) Acids
( ) Bases
( ) Corrosives
(X) Oxidizers
(X) Other: Reactive metals
```

11. TOXICOLOGICAL INFORMATION

Toxicity Data

```
orl-hmn LDLo:  143 mg/kg  orl-rat LD50:  5628 mg/kg
ihl-rat LC50: 64000 ppm/4H  skn-rbt LD50:  15800 mg/kg
```

Toxicological Findings:
Test on laboratory animals indicate material may produce adverse mutagenic and reproductive effects.
Cited in Registry of Toxic Effects of Chemical Substances (RTECS)

12. DISPOSAL CONSIDERATIONS

EPA Waste Numbers: U154 D001

Treatment:
Incineration, fuels blending or recycle. Contact your local permitted waste disposal site (TSD) for permissible treatment sites.
ALWAYS CONTACT A PERMITTED WASTE DISPOSER (TSD) TO ASSURE COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

13. TRANSPORT INFORMATION

DOT Proper Shipping Name:
Methanol

DOT ID Number :
UN1230

14. REGULATORY INFORMATION

TSCA Statement:
The CAS number of this product is listed on the TSCA Inventory.

Component	SARA EHS (302)	SARA EHS TPQ (lbs)	CERCLA RQ (lbs)
Methanol			5000

Component	OSHA Floor List	SARA 313	DeMinimis for SARA 313 (%)
Methanol	Y	Y	1.0

If there is no information listed on the regulatory information chart, this indicates that the chemical is not covered by the specific regulation listed.

15. OTHER INFORMATION

Comments:
None

NFPA Hazard Ratings:

```
Health          : 1
Flammability    : 3
Reactivity      : 0
Special Hazards :
```

```
Revision History:  1/7/00  1/25/00  2/1/83  10/1/83
5/1/85  12/8/86  1/31/87  6/10/87  8/28/87  10/27/87
8/10/88  10/6/88  3/14/89  9/28/89  10/9/89  5/10/90
1/11/91  3/1/91  8/7/91  11/8/91  10/9/96  2/12/97  6/6/97
8/30/97  2/12/98  3/5/99  8/18/99
```

| = Revised Section

N/A = Not Available

N/E = None Established

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANE

MSDS Number: H2381 --- *Effective Date: 11/02/01*

1. Product Identification

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride; Hexane 95%
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
9262, 9304, 9308, N168

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	85 - 100%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
Trace amount of Benzene (10 ppm)	071-43-2	*	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and

water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

5. Fire Fighting Measures

Fire:
Flash point: -23C (-9F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.2; uel: 7.7
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:

Light odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
130 @ 20C (68F)
Evaporation Rate (BuAc=1):
9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\--------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	No	1

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 52L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 52L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	10	U019	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 3[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID, 0.01N to 0.2N VOLUMETRIC SOLUTIONS (0.04 to 0

MSDS Number: H2500 — *Effective Date: 11/02/01*

1. Product Identification

Synonyms: None
CAS No.: Not applicable to mixtures.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable.
Product Codes: J.T. Baker: 0326, 5611, 5614, 5621
Mallinckrodt: 2853, H148, H156

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	0.04 - 0.4%	Yes
Water	7732-18-5	> 99%	No

3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from

skin, eyes and clothing.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 0 - None
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
Not expected to be a health hazard.
Ingestion:
Large oral doses may cause gastrointestinal disturbances.
Skin Contact:
No adverse effects expected.
Eye Contact:
May cause irritation, redness and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Not expected to require first aid measures.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Not expected to require first aid measures.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Not applicable.
Ventilation System:
Not expected to require any special ventilation.
Personal Respirators (NIOSH Approved):
Not expected to require personal respirator usage.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Safety glasses. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, colorless solution.
Odor:
Odorless.
Solubility:
Infinitely soluble.
Specific Gravity:
ca. 1.0
pH:
No information found.
% Volatiles by volume @ 21C (70F):
> 99
Boiling Point:
ca. 100C (32F)
Melting Point:
ca. 0C (32F)
Vapor Density (Air=1):
Essentially the same as water.
Vapor Pressure (mm Hg):
Essentially the same as water.
Evaporation Rate (BuAc=1):
Essentially the same as water.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No information found.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
No incompatibility data found.
Conditions to Avoid:
No information found.

11. Toxicological Information

--------\Cancer Lists\--------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Dilute with water and flush to sewer if local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	--Canada-- NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	-SARA 302- TPQ	------SARA 313------ List	------SARA 313------ Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: No information found.
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 0 Flammability: 0 Reactivity: 0
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Product Number: 17078
Product Name: Nitric acid

Valid 05/2002 - 07/2002

Fluka Chemical Corp.
1001 West St. Paul
Milwaukee, WI 53233 USA
Tel: 414-273-3850

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - -
CATALOG #: 17078
NAME: NITRIC ACID 65%
SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -
CAS #: 7697-37-2
EC NO: 231-714-2
SYNONYMS
ACIDE NITRIQUE (FRENCH) * ACIDO NITRICO (ITALIAN) * AQUA FORTIS * AZOTIC ACID * AZOTOWY KWAS (POLISH) * HYDROGEN NITRATE * KYSELINA DUSICNE (CZECH) * NITRIC ACID (ACGIH:OSHA) * SALPETERSAURE (GERMAN) SALPETERZUUROPLOSSINGEN (DUTCH) *
SECTION 3. - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -
LABEL PRECAUTIONARY STATEMENTS
OXIDIZING
CORROSIVE
CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE.
TOXIC IF SWALLOWED.
VERY TOXIC BY INHALATION.
CAUSES SEVERE BURNS.
TARGET ORGAN(S):
LUNGS
TEETH
DO NOT BREATHE VAPOR.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
PROTECT FROM LIGHT.
SECTION 4. - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATE CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOU CALL A PHYSICIAN IMMEDIATELY.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.
SECTION 5. - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -
EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
SECTION 6. - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -
EVACUATE AREA.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLET
SECTION 7. - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - -
REFER TO SECTION 8.
SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - -
CHEMICAL SAFETY GOGGLES.
SAFETY SHOWER AND EYE BATH.
NIOSH/MSHA-APPROVED RESPIRATOR IN NONVENTILATED AREAS AND/OR FOR EXPOSURE ABOVE THE ACGIH TLV.
MECHANICAL EXHAUST REQUIRED.
RUBBER GLOVES.
AVOID BREATHING VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
TOXIC.
KEEP TIGHTLY CLOSED.
PROTECT FROM LIGHT.
STORE IN A COOL DRY PLACE.
SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - -
APPEARANCE AND ODOR
LIQUID.
SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -
INCOMPATIBILITIES
BASES
AMINES
ALKALI METALS
COPPER, COPPER ALLOYS
ALUMINUM
CORRODES STEEL
SENSITIVE TO LIGHT
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
NITROGEN OXIDES
SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -
ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY RESULT IN SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
RTECS #: QU5775000
NITRIC ACID
TOXICITY DATA

ORL-HMN LDLO:430 MG/KG	YAKUD5 22,651,1980
UNR-MAN LDLO:110 MG/KG	85DCAI 2,73,1970

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.
SECTION 12. - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - -
DATA NOT YET AVAILABLE.
SECTION 13. - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSI AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN CONTROLLED BY THE RATE OF ADDITION.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.
SECTION 14. - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -
CONTACT FLUKA CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.
SECTION 15. - - - - - - - - - REGULATORY INFORMATION - - - - - - - - -
EUROPEAN INFORMATION

EC INDEX NO: 007-004-00-1
OXIDIZING
CORROSIVE
R 35
CAUSES SEVERE BURNS.
S 23
DO NOT BREATHE VAPOR.
S 26
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
S 36
WEAR SUITABLE PROTECTIVE CLOTHING.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK
ACGIH TLV-STEL 4 PPM DTLVS* TLV/BEI,1999
ACGIH TLV-TWA 2 PPM DTLVS* TLV/BEI,1999
MSHA STANDARD-AIR:TWA 2 PPM (5 MG/M3)
DTLVS* 3,181,1971
OSHA PEL (GEN INDU):8H TWA 2 PPM (5 MG/M3)
CFRGBR 29,1910.1000,1994
OSHA PEL (CONSTRUC):8H TWA 2 PPM (5 MG/M3)
CFRGBR 29,1926.55,1994
OSHA PEL (SHIPYARD):8H TWA 2 PPM (5 MG/M3)
CFRGBR 29,1915.1000,1993
OSHA PEL (FED CONT):8H TWA 2 PPM (5 MG/M3)
CFRGBR 41,50-204.50,1994
OEL-ARAB REPUBLIC OF EGYPT: TWA 2 PPM (5 MG/M3), JAN1993
OEL-AUSTRALIA: TWA 2 PPM (5 MG/M3), STEL 4 PPM, JAN1993
OEL-AUSTRIA: MAK 2 PPM (5 MG/M3), JAN1999
OEL-BELGIUM: TWA 2 PPM (5.2 MG/M3), STEL 4 PPM (10 MG/M3), JAN1993
OEL-DENMARK: TWA 2 PPM (5 MG/M3), JAN1999
OEL-FINLAND: TWA 2 PPM (5 MG/M3), STEL 5 PPM (13 MG/M3), SKIN, JAN1
OEL-FRANCE: VME 2 PPM (5 MG/M3), VLE 5 PPM (10 MG/M3), JAN1999
OEL-GERMANY: MAK 2 PPM (5 MG/M3), JAN1999
OEL-HUNGARY: STEL 5 MG/M3, JAN1993
OEL-JAPAN: OEL 2 PPM (5.2 MG/M3), JAN1999
OEL-NORWAY: TWA 2 PPM (5 MG/M3), JAN1999
OEL-THE PHILIPPINES: TWA 2 PPM (5 MG/M3), JAN1993
OEL-POLAND: MAC(TWA) 5 MG/M3, MAC(STEL) 10 MG/M3, JAN1999
OEL-RUSSIA: TWA 2 PPM, STEL 2 MG/M3, SKIN, JAN1993
OEL-SWEDEN: NGV 2 PPM (5 MG/M3), KTV 5 PPM (13 MG/M3), JAN1999
OEL-THAILAND: TWA 2 PPM (5 MG/M3), JAN1993
OEL-TURKEY: TWA 2 PPM (5 MG/M3), JAN1993
OEL-UNITED KINGDOM: LTEL 2 PPM (5 MG/M3), STEL 4 PPM (10 MG/M3), JAN1993
OEL IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO NITRIC ACID-AIR:10H TWA 2 PPM;STEL 4 PPM
NIOSH* DHHS #92-100,1992
NOHS 1974: HZD 50742; NIS 197; TNF 19088; NOS 101; TNE 132401
NOES 1983: HZD 50742; NIS 201; TNF 18239; NOS 120; TNE 297627; TFE 76316
EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-SA7/SHE
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001
NIOSH ANALYTICAL METHOD, 1994: ACIDS, INORGANIC, 7903
OSHA ANALYTICAL METHOD #ID-127

U.S. INFORMATION

THIS PRODUCT IS OR CONTAINS A COMPONENT THAT IS SUBJECT TO SARA313 REPORTING REQUIREMENTS.

SECTION 16. - - - - - - - - - - OTHER INFORMATION- - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPOR BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLI OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SULFURIC ACID, 52 - 100 %

MSDS Number: S8234 — *Effective Date: 02/18/02*

1. Product Identification

Synonyms: Oil of vitriol; Babcock acid; sulphuric acid
CAS No.: 7664-93-9
Molecular Weight: 98.08
Chemical Formula: H2SO4 in H2O
Product Codes:
J.T. Baker: 5030, 5137, 5374, 5802, 5815, 5889, 5897, 5960, 5961, 5971, 5997, 6902, 9673, 9674, 9675, 9676, 9679, 9680, 9681, 9682, 9684, 9687, 9691, 9693, 9694
Mallinckrodt: 2468, 2876, 2878, 2900, 2904, 3780, 4222, 5524, 5557, H644, H976, H996, V344, V651, XL003

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	52 - 100%	Yes
Water	7732-18-5	0 - 48%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. May cause lung edema, a medical emergency.
Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.
Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion. Circulatory shock is often the immediate cause of death.
Eye Contact:
Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give

oxygen. Call a physician immediately.
Ingestion:
DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.
Eye Contact:
Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

5. Fire Fighting Measures

Fire:
Concentrated material is a strong dehydrating agent. Reacts with organic materials and may cause ignition of finely divided materials on contact.
Explosion:
Contact with most metals causes formation of flammable and explosive hydrogen gas.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Do not use water on material. However, water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Sulfuric Acid:
- OSHA Permissible Exposure Limit (PEL) -
1 mg/m3 (TWA)
- ACGIH Threshold Limit Value (TLV) -
1 mg/m3(TWA), 3 mg/m3 (STEL), A2 - suspected human carcinogen for sulfuric acid contained in strong inorganic acid mists.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge and particulate filter (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P particulate filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear oily liquid.
Odor:
Odorless.
Solubility:
Miscible with water, liberates much heat.
Specific Gravity:
1.84 (98%), 1.40 (50%), 1.07 (10%)
pH:
1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) = 2.1.
% Volatiles by volume @ 21C (70F):
No information found.
Boiling Point:
ca. 290C (ca. 554F) (decomposes at 340C)
Melting Point:
3C (100%), -32C (93%), -38C (78%), -64C (65%).
Vapor Density (Air=1):
3.4
Vapor Pressure (mm Hg):
1 @ 145.8C (295F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Concentrated solutions react violently with water, spattering and liberating heat.
Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.
Conditions to Avoid:
Heat, moisture, incompatibles.

11. Toxicological Information

Toxicological Data:
Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m3/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.
Carcinogenicity:
Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

--------\Cancer Lists\--------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sulfuric Acid (7664-93-9)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.
Environmental Toxicity:
LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.
This material may be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SULFURIC ACID (WITH MORE THAN 51% ACID)
Hazard Class: 8

UN/NA: UN1830
Packing Group: II
Information reported for product/size: 440LB

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN1830
Packing Group: II
Information reported for product/size: 440LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Sulfuric Acid (7664-93-9)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sulfuric Acid (7664-93-9)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sulfuric Acid (7664-93-9)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sulfuric Acid (7664-93-9)	1000	No	No
Water (7732-18-5)	No	No	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: Yes         (Pure / Liquid)
```

Australian Hazchem Code: 2P
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 2 Other: **Water reactive**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Do not contact with water.
Label First Aid:
In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 3.
Disclaimer:
****

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Material Safety Data Sheet Collection
Sodium Bisulfate **MSDS No. 218**
Date of Preparation: 11/87 Revision: A, 3/97

Section 1 - Chemical Product and Company Identification 49

Product/Chemical Name: Sodium Bisulfate
Chemical Formula: $NaHSO_4$
CAS Number: 7681-38-1
Synonyms: GBS, niter cake, sodium acid sulfate, sodium hydrogen sulfate, sodium pyrosulfate
Derivation: A by-product in the manufacture of hydrochloric acid and nitric acid
General Use: For liberating carbon dioxide in carbonic acid baths and fusion of minerals to make them soluble for analysis; in the manufacture of magnesia cements; paper, soap, food, perfumes, industrial cleaners; for metal pickling, bleaching and swelling leather, carbonizing wool; as a substitute for sulfuric acid in dyeing and a lab reagent.
Vendors: Consult the latest *Chemical Week Buyers' Guide*. (73)

Section 2 - Composition / Information on Ingredients

Sodium Bisulfate, ca 100% wt

OSHA PEL	ACGIH TLV	NIOSH REL	DFG (Germany) MAK
None established	None established	None established	None established

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Sodium bisulfate is colorless crystals or white fused lumps. It is corrosive to the eyes, skin, and mucous membranes. May burn on contact. Exposure to high levels can cause fluid build up in the lungs, causes rapid, severe shortness of breath, and death. Sodium bisulfate is noncombustible, but sulfur (SO_x) and sodium (Na_2O) oxides may be released during a fire.

Wilson Risk Scale	
R	1
I	3
S	3
K	0

HMIS	
H	3*
F	0
R	0
PPE†	

*Chronic Effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation, ingestion or skin contact.
Target Organs: Eyes, skin, respiratory system.
Acute Effects:
Inhalation: Dust inhalation can cause nose, throat, and respiratory tract irritation. Exposure to high concentrations can cause pulmonary edema (fluid build up in the lungs).
Eye: Contact can cause severe irritation or burns. May cause blindness.
Skin: Contact can cause severe irritation or burns.
Ingestion: Causes oral, esophageal, and stomach burns; gastritis; gastrointestinal bleeding; perforations; necrosis; vomiting; and small intestine injury. Significant acid ingestion may cause metabolic acidosis.
Carcinogenicity: IARC, NTP, and OSHA do not list sodium bisulfate as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Respiratory conditions. *Note!* Smoking may further worsen respiratory conditions.
Chronic Effects: Based on the chronic effects caused by sulfuric acid, repeated exposure may lead to teeth erosion and/or emphysema.

Section 4 - First Aid Measures

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed. Keep the affected person warm and at rest. Get medical attention immediately.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. Get medical attention promptly.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the conscious and alert person drink 4 to 8 ounces of water. *Do not* induce vomiting. Consult physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: After an acute overexposure, perform chest x-ray and obtain blood gases. Because pulmonary edema may be delayed, medical observation is recommended for 24 to 48 hr after an acute overexposure. If pulmonary edema is present, consider PEEP.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible solid
Autoignition Temperature: None reported.
LEL: None reported.
UEL: None reported.
Extinguishing Media: Use extinguishing agents suitable for surrounding fire. Avoid getting sodium bisulfate wet.
Unusual Fire or Explosion Hazards: If wet or moist, sodium bisulfate reacts with metals to form highly flammable and explosive hydrogen gas.
Hazardous Combustion Products: None. However, upon thermal oxidative decomposition sulfur oxides (SO_x) and sodium oxide (Na_2O) are released.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. If feasible and without undue risk, move containers from fire hazard area. Otherwise cool fire-exposed containers until well after fire is extinguished.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

NFPA
0
3 0
—

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and isolate and ventilate area. Cleanup personnel should protect against dust/mist inhalation and skin or eye contact.
Small Spills: Carefully scoop up dry spills. For liquid spills, take up with a noncombustible, inert absorbent such as sand or vermiculite. Place in appropriate container with cover for later disposal.
Large Spills
Containment: For large spills, dike far ahead of liquid spill for later disposal. Cover large dry spills with plastic sheet to prevent further dispersion. *Do not* release into sewers or waterways.
Cleanup: Avoid generating dusty conditions. *Do not* dry sweep. Use a vacuum (with HEPA filter).
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid dust/mist inhalation and skin and eye contact. Use with ventilation sufficient to reduce airborne concentrations to the lowest feasible levels. Wear protective gloves, goggles, faceshield, and clothing to prevent contact. Wear respiratory protection when necessary; consult your industrial hygienist on staff. Keep away from heat and ignition sources.
Storage Requirements: Store in tightly closed containers in a cool, well-ventilated area away from heat and ignition sources and incompatibles (see Sec. 10).

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose operations and/or provide local exhaust ventilation at the site of chemical release to prevent dust dispersion into the work area. Isolating operations can also help reduce exposure.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the eyes, skin, and respiratory tract. Perform lung function tests. Educate workers about the hazards associated with sodium bisulfate. Train in work practices which minimize exposure.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved, full facepiece respirator with a high efficiency particulate filter, although powered-air purifying respirators provide greater protection. Pay close attention to the condition of the particulate filter being used, inspect for physical damage (i.e. rips or tears) and replace as needed. While wearing the filter, cartridge or canister respirator, you smell, taste, or otherwise detect sodium hydrogen sulfate, or if you are using a full facepiece respirator and you experience eye irritation, leave the area at once. Where high exposures exist, use a MSHA/NIOSH-approved, supplied-air respirator with a full facepiece operated in the positive pressure mode or with a full facepiece, hood, or helmet in

the continuous flow mode, or use a MSHA/NIOSH-approved, self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Wear protective eyeglasses or chemical safety goggles and faceshield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

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

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

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

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: Colorless crystals or white fused lumps.
Formula Weight: 120.06
Density: 2.435g/cm^3
pH (0.1 molar soln): 1.4
Water Solubility: Soluble in 2 parts water, 1 part boiling water
Other Solubilities: Sparingly soluble in alcohol
Boiling Point: Decomposes
Melting Point: 599 °F (315 °C)

Section 10 - Stability and Reactivity

Stability: Sodium bisulfate is stable at room temperature in closed containers under normal storage and handling conditions.
Polymerization: Hazardous polymerization cannot occur.
Chemical Incompatibilities: Include calcium hypochlorite; acetic anhydride + ethanol (may lead to ignition and vapor explosion); sodium carbonate + starch + calcium hypochlorite (explode when compressed).
Hazardous Decomposition Products: Thermal oxidative decomposition of sodium bisulfate can sulfur oxides (SO_x) and sodium oxide (Na_2O).

Section 11- Toxicological Information

Toxicity Data:*

Genetic Effects:
Microorganisms: 1000 ppm (-S9) caused mutations.

* Monitor NIOSH, *RTECS* (VZ1860000), for future toxicity data.

Section 12 - Ecological Information

Ecotoxicity: Data not found.
Environmental Fate: Data not found.

Section 13 - Disposal Considerations

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

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Sodium bisulfate
Shipping Symbols:
Hazard Class: 8
ID No.: UN2837
Packing Group: II*
Label: 8
Special Provisions (172.102): 8, T26

Packaging Authorizations
a) Exceptions: 173.154
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 1 L
b) Cargo Aircraft Only: 30 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other:

EPA Regulations: Please refer to 49 CFR 173.137 for Packing Group criteria. This data pertains to Packing Group II criteria: materials that cause full thickness destruction of intact skin tissue within an observation period of up to 14 days starting after the exposure time of more than 3 min but not more than 60 min.

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste (40 CFR 261.33): Not listed
RCRA Hazardous Waste Classification (40 CFR 261.22): Characteristic of Corrosivity, as aqueous* solution
CERCLA Hazardous Substance (40 CFR 302.4) as Unlisted Hazardous Waste, Characteristic of Corrosivity, as aqueous solution, specific per RCRA, Sec. 3001
CERCLA Reportable Quantity (RQ),100 lb (45.4 kg)
SARA Toxic Chemical (40 CFR 372.65): Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not listed

OSHA Regulations:
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): Not listed

*As an aqueous solution with a pH less than or equal to 2.

Section 16 - Other Information

References: 136, 167, 190, 197, 209, 211.

Prepared By.......................... SK Poulose, BS/MJ Wurth, BS
Industrial Hygiene Review......... S Gilson, CIH
Medical Review........................ T Thoburn, MD, MPH

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Sheet No. 3
Sodium Hydroxide

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

Section 1. Material Identification

36

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

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

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

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

R	0
I	2
S	4
K	0

NFPA
0
3 1
W
Alkali

HMIS

H	3
F	0
R	1
PPG*	

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Sodium hydroxide, ca 100%

1990 OSHA PEL
Ceiling: 2 mg/m³

1990 IDLH Level
250 mg/m³ (solution mists)

1991-92 ACGIH TLV
Ceiling: 2 mg/m³

1990 DFG (Germany) MAK
2 mg/m³

1990 NIOSH REL
Ceiling: 2 mg/m³

1985-86 Toxicity Data*
Rabbit, oral, LD_{Lo}: 500 mg/kg; no toxic effect noted
Rabbit, skin: 500 mg applied over 24 hr causes severe irritation
Mouse, intraperitoneal, LD_{50}: 40 mg/kg; toxic effects not yet reviewed

* See NIOSH, *RTECS* (WB4900000), for additional irritation, mutation, and toxicity data.

Section 3. Physical Data

Boiling Point: 2534 °F (1390 °C)
Melting Point: 605 °F (318.4 °C)
Vapor Pressure: 1 mm Hg at 1362 °F (739 °C)
pH (0.5% solution): 13
Molecular Weight: 40.01
Specific Gravity: 2.13 at 77 °F (25 °C)
Water Solubility: 1 g/0.9 ml water, 1 g/0.3 ml boiling water
Other Solubilities: 1 g/7.2 ml alcohol, 1 g/4.2 ml methanol, soluble in glycerol; insoluble in acetone and ether

Appearance and Odor: Odorless, hydroscopic (readily absorbs water) white flakes, cake, lumps, chips, pellets, or sticks.

Section 4. Fire and Explosion Data

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

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

Unusual Fire or Explosion Hazards: Sodium hydroxide may melt and flow when heated.

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

Section 5. Reactivity Data

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

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

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

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

Section 6. Health Hazard Data

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

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

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

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

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

Continue on next page

Section 6. Health Hazard Data, *continued*

Acute Effects: Ingestion causes immediate burning of mouth, esophagus, and stomach; painful swallowing; excessive salivation; edematous (excess fluid in surrounding tissue) lips, chin, tongue, and pharynx covered with exudate (fluid oozed from swollen tissue); esophageal edema (swelling from fluid buildup in esophagus walls that can prevent all swallowing within hours); possibly edematous, gelatinous, and necrotic (localized tissue death) mucous membranes; vomiting (sometimes coffee grounds-like material due to digestive hemorrhage); and rapid, faint pulse; and cold, clammy skin. Death results commonly from shock, asphyxia (oxygen loss due to interrupted breathing), or pneumonia by the second or third day after ingestion. Dust inhalation can cause many small burns, temporary hair loss (in nasal passages since sodium hydroxide breaks down keratin), and possibly pulmonary edema (fluid in lungs). Skin contact causes slippery, soapy feeling that is not usually painful for 3 min after contact—even though skin damage begins immediately. It causes burns, keratin (hair and nails) destruction, and intracellular edema (excess fluid in skin cells), with damage progressing to severe burns, tissue corrosion, deep ulcerations, and permanent scarring if not immediately washed off. The cornea begins to corrode on contact. Disintegration and sloughing of conjunctival and corneal epithelium may progress to temporary or permanent corneal opacification (cloudiness, becoming impervious to light) or symblepharon (adhesion of lid to eyeball).

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

FIRST AID: Emergency personnel should protect against contamination.

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

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

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

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

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

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

Section 7. Spill, Leak and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate hazard area, deny entry, and stay upwind of spills. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Use water spray to disperse vapors, but do not spray directly on spills. For small dry spills, avoid excess dust generation by carefully scooping or vacuuming (with appropriate filter) into a suitable container (above 60 °C sodium hydroxide corrodes steel) for later disposal. For large dry spills, cover with plastic sheet or other impermeable layer and contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

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

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

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

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.22): Characteristic of corrosivity
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 311 (b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

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

Section 8. Special Protection Data

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

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

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

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

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

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

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

Section 9. Special Precautions and Comments

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

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

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

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Sodium hydroxide; dry, solid, flake, bead *or* granular
DOT Hazard Class: Corrosive material
ID No.: UN1823
DOT Label: Corrosive
DOT Packaging Exceptions: 173.244
DOT Packaging Requirements: 173.245b

IMO Shipping Name: Sodium hydroxide, solid
IMO Hazard Class: 8
ID No.: UN1823
IMO Label: Corrosive
IMDG Packaging Group: II

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

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** ER O'Connor, MS

AIR LIQUIDE

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: ISOBUTYLENE

SYNONYMS: 2-Methylpropane; Isobutylene USP
CHEMICAL FAMILY: Alkane (hydrocarbon)
FORMULA: C_4H_8

Document Number: 20103

PRODUCT USE: For fuel and synthetic chemical use; food additive, agricultural uses, aerosol propellant, refrigerant.

SUPPLIER/MANUFACTURER'S NAME: AIR LIQUIDE AMERICA CORPORATION
ADDRESS: 2700 Post Oak Drive
Houston, TX 77056-8229

EMERGENCY PHONE: CHEMTREC: 1-800-424-9300

BUSINESS PHONE:
General MSDS Information: 1-713/896-2896
Fax on Demand: 1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm	IDLH ppm	ppm
Isobutylene	115-11-7	> 99%	There are no specific exposure limits for Isobutylene. Isobutylene is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					
Maximum Impurities		< 1%	None of the trace impurities in this product contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalents standards.					

NE = Not Established C = Ceiling Limit

NOTE: all WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This product is a colorless, liquefied, flammable gas. The gas has an unpleasant odor similar to burning coal. Both the liquid and gas pose a serious fire hazard when accidentally released. Rapid evaporation of liquid from cylinder may cause frostbite. Flame or high temperature impinging on a localized area of the cylinder of this product can cause the cylinder to burst or rupture without activating the cylinder's relief devices. Isobutylene is an asphyxiant and presents a significant health hazard by displacing the oxygen in the atmosphere. Isobutylene can also be a narcotic at high concentrations. Provide adequate fire protection during emergency response situations.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation.

INHALATION: Isobutylene also has some degree of anesthetic action and can be mildly irritating to the mucous membranes. High concentrations of this gas can cause an oxygen-deficient environment. It should be noted that before suffocation could occur, the lower flammability limit of Isobutylene in air would be exceeded; possibly causing an oxygen-deficient and explosive atmosphere. Individuals breathing an oxygen deficient atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The following effects associated with various levels of oxygen are as follows:

CONCENTRATION	SYMPTOM OF EXPOSURE
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea and vomiting, collapse or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

HAZARDOUS MATERIAL INFORMATION SYSTEM		
HEALTH	(BLUE)	0
FLAMMABILITY	(RED)	4
REACTIVITY	(YELLOW)	0
PROTECTIVE EQUIPMENT		B
EYES / RESPIRATORY / HANDS / BODY		
See Section 8		
For routine industrial applications		

OTHER POTENTIAL HEALTH EFFECTS: Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after such contact can quickly subside.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

ACUTE: The most significant hazard associated with this product is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, and, at high concentrations, unconsciousness or death may occur. The skin of a victim of over-exposure may have a blue color. Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after contact with liquid can quickly subside.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to the components of this compressed gas.

TARGET ORGANS: Respiratory system.

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant Personal Protective equipment should be worn. Adequate fire protection must be provided during rescue situations.

Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

4. FIRST-AID MEASURES (Continued)

SKIN EXPOSURE: Exposure to the liquefied gas can cause frostbite. Remove any clothing that may restrict circulation to any frozen area. Do not rub frozen parts as tissue damage may occur. As soon as practicable, place any affected area in warm water bath which has a temperature that does not exceed 105°F (40°C). NEVER USE HOT WATER. NEVER USE DRY HEAT. If area of frostbite is extensive, and if possible, remove clothing while showering with warm water. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area of the body in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

Frozen tissue is painless and appears waxy, with a possible yellow color. Frozen tissue will become swollen, painful and prone to infection when thawed. If the frozen part of the body has been thawed by the time medical attention has been obtained, cover the area with a dry sterile dressing and a large bulky protective covering.

EYE EXPOSURE: If liquid is splashed into eyes, or if irritation of the eye develops after exposure to liquid or gas, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Seek medical assistance immediately, preferably an ophthalmologist.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

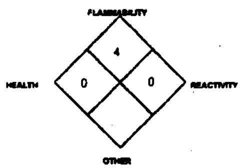
FLASH POINT: -10°C (< 14°F)

AUTOIGNITION TEMPERATURE: 465°C (869°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 1.8%
Upper (UEL): 9.6%

NFPA RATING



FIRE EXTINGUISHING MATERIALS: Extinguish Isobutylene fires by shutting-off the source of the gas. Use water spray to cool fire-exposed containers, structures, and equipment.

UNUSUAL FIRE AND EXPLOSION HAZARDS: When involved in a fire, this material may decompose and produce toxic gases including carbon monoxide and carbon dioxide.

DANGER! Fires impinging (direct flame) on the outside surface of unprotected cylinders of this product can be very dangerous. Exposure to fire could cause a catastrophic failure of the cylinder releasing the contents into a fireball and explosion of released gas. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the cylinder. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Static discharge may cause this product to ignite explosively, if released.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural fire-fighters must wear Self-Contained Breathing Apparatus and full protective equipment. Because of the potential for a BLEVE, evacuation of non-emergency personnel is essential. If water is not available for cooling or protection of cylinder exposures, evacuate the area. The North American Emergency Response Guidebook (Guide #115) recommends 0.5 miles. Other information for pre-planning can be found in the American Petroleum Institute Publications 2510 and 2510A.

6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a gas release, clear the affected area, protect people, and respond with trained personnel.

Eliminate any possible sources of ignition, and provide maximum explosion-proof ventilation. If the gas is leaking from cylinder or valve, contact the supplier. Adequate fire protection must be provided. Use only non-sparking tools and equipment during the response.

Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves and Self-Contained Breathing Apparatus.** Use only non-sparking tools and equipment. Locate and seal the source of the leaking gas. Protect personnel attempting the shut-off with water-spray. Allow the gas to dissipate.

6. ACCIDENTAL RELEASE MEASURES (Continued)

Combustible gas concentration must be below 10% of the LEL (1.8%) prior to entry. Monitor the surrounding area for combustible gas levels and oxygen level. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in-place or remove it to a safe area and allow the gas to be released there.

THIS IS AN EXTREMELY FLAMMABLE GAS. Protection of all personnel and the area must be maintained.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this product could occur without any significant warning symptoms. Non-sparking tools should be used.

STORAGE AND HANDLING PRACTICES: Specific requirements are listed in NFPA 58. Cylinders should be stored upright (with valve-protection cap in place) and firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Cylinders should be stored in dry, well-ventilated areas away from sources of heat, ignition and direct sunlight. Keep storage area clear of materials which can burn. Do not allow area where cylinders are stored to exceed 52 °C (125 °F). Store containers away from heavily trafficked areas and emergency exits. Store away from process and production areas, away from elevators, building and room exits or main aisles leading to exits. Protect cylinders against physical damage.

Cylinders should be separated from oxygen cylinders, or other oxidizers, by a minimum distance of 20 ft., or by a barrier of non-combustible material at least 5 ft. high, having a fire-resistance rating of at least 0.5 hours. Isolate from other incompatible chemicals (refer to Section 10, Stability and Reactivity).

Storage areas must meet national electrical codes for Class 1 Hazardous Areas. Post "No Smoking or Open Flames" signs in storage or use areas. Consider installation of leak detection and alarm for storage and use areas. Have appropriate extinguishing equipment in the storage area (i.e. sprinkler system, portable fire extinguishers).

Keep the smallest amount on-site as is necessary. Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time.

Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion proof. Use a check valve in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Compressed gases can present significant safety hazards. The following rules are applicable to work situations in which cylinders are being used:

Before Use: Move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap (where provided) in-place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Use piping and equipment adequately designed to withstand pressures to be encountered. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Do not use oils or grease on gas-handling fittings or equipment. Do not "crack" valve open before connecting it, since self-ignition may occur. Leak check system with leak detection solution, never with flame. Immediately contact the supplier if there are any difficulties associated with operating cylinder valve. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, casing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc on a compressed gas cylinder or make a cylinder part of an electric circuit.

After Use: Close main cylinder valve. Valves should be closed tightly. Replace valve protection cap. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers designed for flammable gas storage. Earth-ground and bond all lines and equipment associated with this product. Close valve after each use and when empty.

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA: Use the proper connections, DO NOT USE ADAPTERS:

THREADED: 0-500 PSIG - CGA 510
PIN-INDEXED YOKE: Not Applicable.
ULTRA HIGH INTEGRITY: Not Applicable.

7. HANDLING and USE (Continued)

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (i.e. nitrogen) before attempting repairs. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Provide natural or explosion-proof ventilation adequate to ensure Isobutylene does not reach its lower flammability limit of 1.8%. Local exhaust ventilation is preferred, because it prevents gas dispersion into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the level of flammable gas.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if oxygen levels are below 19.5% (air-purifying respirators will not function) or during emergency response to a release of this product. During an emergency situation, before entering the area, check for flammable gas level as well as oxygen-deficient atmospheres. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards.

EYE PROTECTION: Safety glasses.

HAND PROTECTION: Wear leather gloves when handling cylinders of this product. Otherwise, wear glove protection appropriate to the specific operation for which this product is used. Use low-temperature protective gloves when working with containers of Liquid Isobutylene.

BODY PROTECTION: Use body protection appropriate for task. Cotton clothing is recommended for use to prevent static electric build-up. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require use of fire retardant clothing.

9. PHYSICAL and CHEMICAL PROPERTIES

GAS DENSITY @ 21.1°C (70°F) and 1 atm: 0.14957 lb/ft^3 (2.3959 kg/m^3)
BOILING POINT: -6.9°C (19.6°F)
FREEZING/MELTING POINT @ 10 psig: -140°C (-220.6°F)
SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 1.997
SOLUBILITY IN WATER vol/vol @37.8°C (100°F): Insoluble.
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not determined.
VAPOR PRESSURE @ 21.1°C (70°F) psig: 23.85
pH: Not applicable.
MOLECULAR WEIGHT: 56.108
EXPANSION RATIO: Not applicable.
SPECIFIC VOLUME (ft^3/lb): 6.54
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

APPEARANCE AND COLOR: Colorless gas which is shipped as a liquefied gas under its own vapor pressure. The gas has an unpleasant odor similar to burning coal.

HOW TO DETECT THIS SUBSTANCE (warning properties): The unpleasant odor may be a warning property. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: : When ignited in the presence of oxygen, this gas will burn to produce carbon monoxide, carbon dioxide.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride).

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks and other sources of ignition. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicity data are applicable for pure Isobutylene.

LC50 (inhalation, rat) = 620,000 mg/kg/4 hours
LC50 (inhalation, mouse) = 415,000 mg/kg

SUSPECTED CANCER AGENT: Isobutylene is not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA; therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Isobutylene can cause some irritation to mucus membranes. In addition, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION TO THE PRODUCT: Isobutylene is not known to cause sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Isobutylene on the human reproductive system.

<u>Mutagenicity</u>: No mutagenicity effects have been described for Isobutylene gas.
<u>Embryotoxcity</u>: No embryotoxic effects have been described for Isobutylene gas.
<u>Teratogenicity</u>: No teratogenicity effects have been described for this Isobutylene gas.
<u>Reproductive Toxicity</u>: No reproductive toxicity effects have been described for Isobutylene gas.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by over-exposure to the components of this product.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Isobutylene.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary; treat symptoms; reduce or eliminate exposure.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen deficient environments. No adverse effect is anticipated to occur to plant-life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to Air Liquide. Do not dispose of locally.

For emergency disposal, secure the cylinder and slowly discharge the gas to the atmosphere in a well-ventilated area or outdoors, away from all sources of ignition.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

		Alternate Description:
PROPER SHIPPING NAME:	Isobutylene	Petroleum gases, liquefied
HAZARD CLASS NUMBER and DESCRIPTION:	2.1 (Flammable Gas)	2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1055	UN 1075
PACKING GROUP:	Not applicable.	Not applicable.
DOT LABEL(S) REQUIRED:	Flammable Gas	Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115

14. TRANSPORTATION INFORMATION (Continued)

MARINE POLLUTANT: Isobutylene is not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles present serious safety hazards and should be discouraged.

NOTE: Shipment of compressed gas cylinders which have not been filled with the owners consent is a violation of Federal law (49 CFR, Part 173.301 (b).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Isobutylene is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

CANADIAN DSL INVENTORY STATUS: Isobutylene is listed on the Canadian DSL Inventory.

U.S. TSCA INVENTORY STATUS: Isobutylene is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS:

- Isobutylene does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82).
- Isobutylene is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for of this gas is 10,000 pounds.
- Depending on specific operations involving the use of this product, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Isobutylene is not listed in Appendix A, however, any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lbs (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.
- Isobutylene is listed as a Regulated Substance, per 40 CFR, Part 68, of the Risk Management for Chemical Releases as a flammable substance. The threshold quantity for Isobutane under this regulation is 10,000 lbs.

OTHER CANADIAN REGULATIONS: Isobutylene is categorized as a Controlled Product, Hazard Classes A, and B1 as per the Controlled Product Regulations.

U.S. STATE REGULATORY INFORMATION: Isobutylene is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Liquefied Petroleum Gas.
California - Permissible Exposure Limits for Chemical Contaminants:
Florida - Substance List: Isobutylene.
Illinois - Toxic Substance List: Liquefied Petroleum Gas.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: Isobutylene.
Minnesota - List of Hazardous Substances: Isobutylene.
Missouri - Employer Information/Toxic Substance List: Liquefied Petroleum Gas.
New Jersey - Right to Know Hazardous Substance List: Isobutylene.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.
Pennsylvania - Hazardous Substance List: Isobutylene.
Rhode Island - Hazardous Substance List: Liquefied Petroleum Gas.
Texas - Hazardous Substance List: Liquefied Petroleum Gas.
West Virginia - Hazardous Substance List: Liquefied Petroleum Gas.
Wisconsin - Toxic and Hazardous Substances: Liquefied Petroleum Gas.

CALIFORNIA PROPOSITION 65: Isobutylene is not on the California Proposition 65 lists.

16. OTHER INFORMATION

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1	*"Safe Handling of Compressed Gases in Containers"*
P-14	*"Accident Prevention in Oxygen-Rich and Oxygen Deficient Atmospheres"*
SB-2	*"Oxygen Deficient Atmospheres"*
	"Handbook of Compressed Gases"

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
9163 Chesapeake Drive, San Diego, CA 92123-1002
619/565-0302

Fax on Demand: 1-800/231-1366

AIR LIQUIDE

AERVOE® Material Safety Data Sheet

TO: MSDS USERS

Please find below the material safety data sheet as per your request.

The information presented in these forms is believed to be correct and sufficient to meet the requirements of OSHA Hazard Communication standard (29 CFR 1910.1200) concerning worker's right to know. In order for the information contained in the MSDS to be most helpful we recommend that these forms be made available to all those who handle or may otherwise be exposed to the product.

The following material safety data sheet covers the hazardous ingredients associated with more than one color aerosol product. As per 29 CFR 1900. 1200 paragraph (g); whenever the hazards associated with similar mixtures are the same, then one MSDS may be prepared to cover several products.

This MSDS covers the following Aervoe-Pacific aerosol products.

MARKING PAINT

REGULAR		*FLUORESCENT*	*16 oz. L. A. C.*		*HIGH DELIVERY*
201 RED	207 WHITE	220 RED	261S RED	270S FLUORESCENT RED	281 RED
202 YELLOW	208 HI VISIBILITY YELLOW	222 ORANGE	262S YELLOW	272S FLUORESCENT ORANGE	282 YELLOW
203 BLUE	209 LIGHT BLUE	224 GREEN	263S BLUE	274S FLUORESCENT GREEN	288 FLUORESCENT ORANGE
204 GREEN	210 SILVER	226 YELLOW	264S GREEN	275S FLUORESCENT RED/ORANGE	
205 ORANGE	212 PURPLE	227 BLUE	265S ORANGE	279S FLUORESCENT PINK	
206 BLACK	213 BROWN	229 PINK	266S BLACK		
		230 RED/ORANGE	267S WHITE		

PRODUCT NAME: MARKING PAINT - ALL COLORS **PRODUCT CODE:** 17A **HMIS CODES:** H F R P
2 4 1 X

SECTION I - MANUFACTURER IDENTIFICATION

MANUFACTURER'S NAME: Aervoe-Pacific Company, Inc.
ADDRESS: 1198 Mark Circle, Gardnerville, NV 89410
INFORMATION PHONE: 775-782-0100
EMERGENCY PHONE: 1-800-424-9300
DATE REVISED: 01-31-01
REASON REVISED: Updated

SECTION II - HAZARDOUS INGREDIENTS / SARA III INFORMATION OCCUPATIONAL EXPOSURE LIMITS

HAZARDOUS COMPONENTS	WEIGHT PERCENT	OSHA PEL	ACGIH TLV	OTHER	LD50 SPECIES & ROUTE	LC50 SPECIES & ROUTE
*XYLENE (CAS 1330 20 7)	20	100 PPM	100 PPM		4300 mg / kg RAT (ORAL)	6700 PPM; 4 hr RAT (INHA)
MINERAL SPIRITS (CAS 8052 41 3)	<5.0%	100 PPM	100 PPM		N/A	N/A
ACETONE (CAS 67 64 1)	<5.0%	750 PPM	750 PPM		9750 mg / kg RAT (ORAL)	6700 PPM / 4 hr RAT (INHA)
*GLYCOL ETHER EB ACETATE (CAS 112 07 2)	1	N/A	N/A	N/A	N/A	N/A
*HEXANE (CAS 110 54 3)	12	50 PPM	50 PPM		28,710 mg / kg RAT (ORAL)	N/A
PROPANE (CAS 74 98 6)	10	1000 PPM	1000 PPM		N/A	N/A
ISOBUTANE (CAS 75 28 5)	<5.0%	800 PPM	800 PPM	ESTIMATED	N/A	57 PPH /15 min RAT (INHA)
NORMAL BUTANE (CAS 106 97 8)	5	600 PPM	600 PPM		N/A	658 mg / L; 4 hr RAT (INHA)

*Indicates toxic chemical(s) subject to the reporting requirements of section 313 of Title III and of 40 CFR 372.

NOTE: N/A applies to not available or not applicable

PRODUCT CODE: 17A

SECTION III - PHYSICAL / CHEMICAL CHARACTERISTICS

BOILING POINT: 10° F / -12° C **SPECIFIC GRAVITY (H20=1):** 0.9 **COEFFICIENT OF WATER/OIL DIST:** N/A
ODOR THRESHOLD: N/A **VAPOR DENSITY:** Heavier than air **SOLUBILITY IN WATER:** Negligible
EVAPORATION RATE: Faster than n-Butyl Acetate **APPEARANCE AND ODOR:** Opaque Liquid / Solvent Based Odor
COATING V.O.C.: 5.96 lbs / Imp gal 4.96 lbs / US gal 594 gms / ltr **FREEZING POINT:** N/A **pH:** N/A

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: -26° F / -32° C **METHOD USED:** Estimated **FLAMMABLE LIMITS IN AIR BY VOLUME - LOWER:** 0.8% **UPPER:** 9.6%
EXTINGUISHING MEDIA: Foam, Alcohol Foam, CO_2, Dry Chemical, Water Fog
SPECIAL FIRE FIGHTING PROCEDURES: Water spray may be ineffective, but water spray may be used to cool containers exposed to heat or fire to prevent pressure build up. Self-contained breathing apparatus should be used if product is involved in fire.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Closed containers may explode due to pressure build up from extreme heat or fire. Aerosol spray is extremely flammable.
FLAMMABILITY: Yes - Flammable aerosol under conditions of sparks, flame, or hot surfaces.
SENSITIVITY TO IMPACT: Do not puncture **SENSITIVITY TO STATIC DISCHARGE:** Primarily vapors

SECTION V - REACTIVITY DATA

STABILITY: Stable **CONDITIONS TO AVOID:** High temperatures
INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents
HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: Carbon Monoxide and Carbon Dioxide
HAZARDOUS POLYMERIZATION: Will not occur

SECTION VI - HEALTH HAZARD DATA

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: May cause dizziness or nausea.
SKIN AND EYE CONTACT HEALTH RISKS AND SYMPTOMS OF EXPOSURE: SKIN - May cause irritation or burning sensation.
EYES - Primary irritation.
SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: May cause irritation or burning sensation.
INGESTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: N/A
HEALTH HAZARDS (ACUTE AND CHRONIC): INHALATION - Anesthetic. Irritation of the respiratory tract or nervous system depression (characterized by headache, dizziness, nausea or possible unconsciousness). SKIN OR EYE CONTACT - Primary irritation. Prolonged or repeated contact to skin may cause dermatitis - exercise due care.
CARCINOGENICITY: None known **NTP?** No **IARC MONOGRAPHS?** No **OSHA REGULATED?** No
TERATOGENICITY: N/A **MUTAGENICITY:** N/A **TOXICOLOGICALLY SYNERGISTIC PRODUCT:** N/A
MEDICAL CONDITION GENERALLY AGGRAVATED BY EXPOSURE: None known
EMERGENCY AND FIRST AID PROCEDURES: VAPORS - Remove from exposure and restore breathing, seek medical attention.
SPLASH - (SKIN) Wash affected area, remove contaminated clothing, see physician if any irritation persists.
SPLASH - (EYES) Flush immediately with water for 15 minutes and take to a physician.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Remove all sources of ignition - Flames, sparks, static electricity & electrical. Ventilate area, avoid run off into sewer by diking, and soak up with inert absorbent using non-sparking type tools.
WASTE DISPOSAL METHOD: Dispose of in accordance with local, state and federal regulations. Do not incinerate closed containers.
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Do not store above 120° F / 49° C. Do not store or use near heat, sparks or flame.
OTHER PRECAUTIONS: Do not get in eyes. Do not breathe vapors. Avoid skin contact. Do not take internally. Smoking while using this product must be strictly prohibited. In addition to all other hazards and precautions - dust from sanding the dry paint films should be treated as a nuisance dust with a TLV of 10mg/cubic meter.

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION: Outdoors - Recommend an approved mechanical particulate filter to remove any airborne overspray. In restricted areas with poor ventilation, use a NIOSH approved Organic Cartridge Respirator. For concentrations above the exposure limit, use a positive air supplied respirator.
VENTILATION: All application areas should be adequately ventilated in order to keep the items in SECTION II below their exposure limits.
PROTECTIVE GLOVES: Impervious gloves (natural rubber) are recommended to prevent skin contact.
EYE PROTECTION: Safety glasses with side shields are recommended to prevent eye contact.
OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Impervious apron (natural rubber) is recommended to prevent skin contact. Eye wash fountain and safety shower.
WORK / HYGIENIC PRACTICES: Avoid prolonged or repeated contact. Do not breathe vapors. Wash contaminated clothing prior to reuse.

SECTION IX - DISCLAIMER

THE INFORMATION CONTAINED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT WARRANTED TO BE SO. NOTHING CONTAINED HEREIN CONSTITUTES A SPECIFICATION NOR IS IT INTENDED TO WARRANT SUITABILITY FOR THE INTENDED USE.

CORNELL

Material Safety Data Sheets

Division of Facilities Services

DOD Hazardous Material Information (ANSI Format) For Cornell University Convenience Only

UNLEADED REGULAR GASOLINE

Section 1 - Product and Company Identification
UNLEADED REGULAR GASOLINE

Product Identification: UNLEADED REGULAR GASOLINE
Date of MSDS: 03/07/1988 **Technical Review Date:** 04/25/1988
FSC: 9130 **NIIN: LIIN:** 00B010045
Submitter: B DT
Status Code: C
MFN: 01
Article: N
Kit Part: N

Manufacturer's Information

Manufacturer's Name: AMOCO OIL COMPANY
Post Office Box: N/K
Manufacturer's Address1: 200 EAST RANDOLPH DRIVE
Manufacturer's Address2: CHICAGO, IL 60601
Manufacturer's Country: US
General Information Telephone: 312 856-3907
Emergency Telephone: 800 447-8735
Emergency Telephone: 800 447-8735
MSDS Preparer's Name: N/K
Proprietary: N
Reviewed: Y
Published: Y
CAGE: 15958
Special Project Code: N

Contractor Information

Contractor's Name: AMOCO OIL CO
Contractor's Address1: 200 E RANDOLPH DR MC 1408
Contractor's Address2: CHICAGO, IL 60601-6401
Contractor's Telephone: 312-856-3907
Contractor's CAGE: 15958

Section 2 - Compositon/Information on Ingredients
UNLEADED REGULAR GASOLINE

Ingredient Name: GASOLINE
Ingredient CAS Number: 8006-61-9 **Ingredient CAS Code:** M
RTECS Number: LX3300000 **RTECS Code:** M
=WT: =WT Code:
=Volume: =Volume Code:
>WT: >WT Code:
>Volume: >Volume Code:
<WT: <WT Code:
<Volume: <Volume Code:
% Low WT: % Low WT Code:
% High WT: % High WT Code:
% Low Volume: % Low Volume Code:
% High Volume: % High Volume Code:
% Text: N/K
% Enviromental Weight:
Other REC Limits: N/K
OSHA PEL: 300 PPM/500 STEL **OSHA PEL Code:** M
OSHA STEL: OSHA STEL Code:
ACGIH TLV: 300 PPM/500STEL;9192 **ACGIH TLV Code:** M
ACGIH STEL: N/P **ACGIH STEL Code:**
EPA Reporting Quantity:

DOT Reporting Quantity:
Ozone Depleting Chemical: N

Section 3 - Hazards Identification, Including Emergency Overview
UNLEADED REGULAR GASOLINE

Health Hazards Acute & Chronic: INHALATION:MODERATELY TOXIC FOR ACUTE EXPOSURES BY THIS ROUTE.EYE:NO SIGNIFICANT IRRITATION EXPECTED.INGESTION:HARMFUL IF SWALLOWED AND/OR ASPIRATED INTO LUNGS.

Signs & Symptoms of Overexposure:
INHALATION:EXCESSIVE EXPOSURES TO VAPORS WILL PRODUCE SYMPTOMS OF INTOXICATION,HEADACHE,DIZZINESS.AND NAUSEA.SKIN:PROLONGED OR REPEATED CONTACT CAN DEFAT THE SKIN AND LEAD TO IRRITATION AND/OR DERMATI TIS.

Medical Conditions Aggravated by Exposure:
N/K

LD50 LC50 Mixture: N/K

Route of Entry Indicators:
Inhalation: YES
Skin: YES
Ingestion: YES

Carcenogenicity Indicators
NTP: N/P
IARC: N/P
OSHA: N/P

Carcinogenicity Explanation: N/K

Section 4 - First Aid Measures
UNLEADED REGULAR GASOLINE

First Aid:
IN CASE OF EYE CONTACT,FLUSH WITH PLENTY OF WATER.SKIN CONTACT,WASH EXPOSED SKIN WITH SOAP AND WATER.REMOVE CONTAMINATED CLOTHING,INCLUDING SHOES AND THOROUGHLY CLEAN AND DRY BEFORE REUSE.INHALATION:I F HARMFUL EFFECTS OCCUR.REMOVE TO UNCONTAMINATED AREA.GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING.INGESTION:IF SWALLOWED.DO NOT INDUCE VOMITING.GET MEDICAL ATTENTION.

Section 5 - Fire Fighting Measures
UNLEADED REGULAR GASOLINE

Fire Fighting Procedures:
N/K
Unusual Fire or Explosion Hazard:
EXTREMELY FLAMMABLE VAPOR/AIR MIXTURES FORM.
Extinguishing Media:
DRY CHEMICAL B-C,CARBON DIOXIDE,WATER FOG.FOAM(WATER MAY BE INEFFECTIVE).

Flash Point: Flash Point Text: -45 F

Autoignition Temperature:
Autoignition Temperature Text: N/A
Lower Limit(s): 1.3%
Upper Limit(s): 7.6%

Section 6 - Accidental Release Measures
UNLEADED REGULAR GASOLINE

Spill Release Procedures:
REMOVE OR SHUT OFF ALL SOURCES OF IGNITION.USE WATER SPRAY TO DISPERSE VAPORS.INCREASE VENTILATION IF POSSIBLE.

Section 7 - Handling and Storage
UNLEADED REGULAR GASOLINE

Handling and Storage Precautions:

Other Precautions:

Section 8 - Exposure Controls & Personal Protection
UNLEADED REGULAR GASOLINE

Repiratory Protection:
AVOID BREATHING VAPOR AND/OR MIST.USE WITH ADEQUATE VENTILATION.
Ventilation:
N/K
Protective Gloves:
YES
Eye Protection: SAFETY GLASSES
Other Protective Equipment: WEAR PROTECTIVE CLOTHING AND GLOVES IF PROLONGED OR REPEATED CONTACT IS LIKELY.
Work Hygenic Practices: N/K
Supplemental Health & Safety Information: N/K

Section 9 - Physical & Chemical Properties
UNLEADED REGULAR GASOLINE

HCC:
NRC/State License Number:
Net Property Weight for Ammo:
Boiling Point: Boiling Point Text: 80F TO 430F
Melting/Freezing Point: Melting/Freezing Text: N/K
Decomposition Point: Decomposition Text: N/K
Vapor Pressure: 9-15 D-323 **Vapor Density:** 3 TO 4
Percent Volatile Organic Content:
Specific Gravity: H20=1 0.75
Volatile Organic Content Pounds per Gallon:
pH: N/K
Volatile Organic Content Grams per Liter:
Viscosity: N/P
Evaporation Weight and Reference: N/K

Solubility in Water: NEGLIGIBLE BELOW 0.1
Appearance and Odor: CLEAR,BRIGHT LIQUID.CHARACTERISTIC ODOR
Percent Volatiles by Volume: N/K
Corrosion Rate: N/K

Section 10 - Stability & Reactivity Data
UNLEADED REGULAR GASOLINE

Stability Indicator: YES
Materials to Avoid:
AVOID STRONG OXIDIZERS
Stability Condition to Avoid:
N/K
Hazardous Decomposition Products:
N/K
Hazardous Polymerization Indicator: N/P
Conditions to Avoid Polymerization:
N/K

Section 11 - Toxicological Information
UNLEADED REGULAR GASOLINE

Toxicological Information:
N/P

Section 12 - Ecological Information
UNLEADED REGULAR GASOLINE

Ecological Information:
N/P

Section 13 - Disposal Considerations
UNLEADED REGULAR GASOLINE

Waste Disposal Methods:
ENCLOSED-CONTROLLED INCINERATION IS RECOMMENDED UNLESS DIRECTED OTHERWISE BY APPLICABLE ORDINANCES.

Section 14 - MSDS Transport Information
UNLEADED REGULAR GASOLINE

Transport Information:
N/P

Section 15 - Regulatory Information
UNLEADED REGULAR GASOLINE

SARA Title III Information:
N/P
Federal Regulatory Information:
N/P
State Regulatory Information:
N/P

Section 16 - Other Information
UNLEADED REGULAR GASOLINE

Other Information:
N/P

HAZCOM Label Information

Product Identification: UNLEADED REGULAR GASOLINE
CAGE: 15958
Assigned Individual: N
Company Name: AMOCO OIL CO
Company PO Box:
Company Street Address1: 200 E RANDOLPH DR MC 1408
Company Street Address2: CHICAGO, IL 60601-6401 US
Health Emergency Telephone: 800 447-8735
Label Required Indicator: Y
Date Label Reviewed: 12/16/1998
Status Code: C
Manufacturer's Label Number:
Date of Label: 12/16/1998
Year Procured: N/K
Organization Code: G
Chronic Hazard Indicator: N/P
Eye Protection Indicator: N/P
Skin Protection Indicator: N/P
Respiratory Protection Indicator: N/P
Signal Word: N/P
Health Hazard:
Contact Hazard:
Fire Hazard:
Reactivity Hazard:

8/8/2002 7:12:22 AM

MOUNTAIN CEMENT CO -- MOUNTAIN PORTLAND CEMENT-TYPE I-II LOW AL

MSDS Safety Information

FSC: 8030
MSDS Date: 05/15/1995
MSDS Num: BXPLX
LIIN: 00F040724
Product ID: MOUNTAIN PORTLAND CEMENT-TYPE I-II LOW ALKALI
MFN: 01
Responsible Party
Cage: MTCEM
Name: MOUNTAIN CEMENT CO
Address: 5 SAND CREEK RD
Box: 339
City: LARAMIE WY 82070-5000
Info Phone Number: 307-745-4879
Emergency Phone Number: 307-745-4879
Review Ind: Y
Published: Y

Preparer Co. when other than Responsible Party Co.

Cage: MTCEM
Name: MOUNTAIN CEMENT CO
Address: 5 SAND CREEK RD
Box: 339
City: LARAMIE WY 82070-5000

Contractor Summary

Cage: MTCEM
Name: MOUNTAIN CEMENT CO
Address: 5 SAND CREEK RD
Box: 339
City: LARAMIE WY 82070-5000
Phone: 307-745-4879

Ingredients

Cas: 65997-15-1
RTECS #: VV8770000
Name: PORTLAND CEMENT, CONTAINS: TRICALCIUM SILICATE, DICALCIUM SILICATE, TRICALCIUM ALUMINATE, TETRACALCIUM ALUMINOFERRATE
Other REC Limits: 50 MPPCF (MSHA)
ACGIH TLV: 10 MG/CUM (DUST)

Health Hazards Data

Route Of Entry Inds - Inhalation: YES
Skin: NO
Ingestion: NO
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO
Effects of Exposure: WET CEMENT CAN DRY THE SKIN & CAUSE ALKLALI BURNS. EYES/INHALATION: CEMENT DUST CAN IRRITATE THE EYES & UPPER RESPIRATORY SYSTEM. CAN CAUSE INFLAMMATION OF THE LINING TISSUE OF THE INTERIOR OF THE NOS E & OF THE CORNEA. HYPERSENSITIVE INDIVIDUALS MAY DEVELOP AN ALLERGIC DERMATITIS.
Explanation Of Carcinogenicity: NONE
Signs And Symptions Of Overexposure: WET CEMENT CAN DRY THE SKIN & CAUSE ALKALI BURNS. CEMENT DUST CAN IRRITATE THE EYES & UPPER RESPIRATORY

SYSTEM. CAN CAUSE INFLAMMATION OF THE LINING TISSUE OF THE INTERIOR OF THE NOSE & OF THE CORNEA. HYPERSENSITIVE INDIVIDUALS MAY DEVELOPAN ALLERGIC DERMATITIS.
First Aid: EYES: IRRIGATE IMMEDIATELY & REPEATEDLY W/WATER. SKIN: WASH W/SOAP & WATER. OBTAIN MEDICAL ATTENTION IN ALL CASES.

Handling and Disposal

Spill Release Procedures: USE DRY CLEANUP METHODS THAT DON'T DISPERSE THE DUST INTO THE AIR. AVOID BREATHING THE DUST.
Waste Disposal Methods: MATERIAL CAN BE DISPOSED OF AS COMMON WASTE/RETURNED TO THE CONTAINER FOR LATER USE IF IT IS NOT CONTAMINATED. DISPOSE OF IN ACCORDANCE W/LOCAL, STATE & FEDERAL REGULATIONS.
Handling And Storage Precautions: KEEP PRODUCT DRY UNTIL USED.
Other Precautions: AVOID BREATHING DUST & AVOID PROLONGED CONTACT W/WET CEMENT. PRECAUTIONS MUST BE OBSERVED BECAUSE CEMENT BURNS W/LITTLE WARNING-LITTLE HEAT IS SENSED.

Fire and Explosion Hazard Information

Unusual Fire/Explosion Hazard: NON COMBUSTIBLE/EXPLOSIVE.

Control Measures

Respiratory Protection: IN DUSTY ENVIRONMENTS, USE A NIOSH APPROVED RESPIRATOR.
Ventilation: LOCAL EXHAUST CAN BE USED TO CONTROL AIRBORNE DUST LEVELS
Protective Gloves: REQUIRED
Eye Protection: TIGHT FITTING GOGGLES
Other Protective Equipment: BARRIER CREAMS, BOOTS, PROTECTIVE CLOTHING
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING.

Physical/Chemical Properties

Spec Gravity: 3-3.2
Solubility in Water: SLIGHT
Appearance and Odor: GREY POWDER W/NO ODOR
Percent Volatiles by Volume: 0

Reactivity Data

Stability Indicator: YES
Materials To Avoid: NONE
Hazardous Decomposition Products: NONE
Hazardous Polymerization Indicator: NO

Toxicological Information

Ecological Information

MSDS Transport Information

Regulatory Information

Other Information

HAZCOM Label

Product ID: MOUNTAIN PORTLAND CEMENT-TYPE I-II LOW ALKALI
Cage: MTCEM

Company Name: MOUNTAIN CEMENT CO
Street: 5 SAND CREEK RD
PO Box: 339
City: LARAMIE WY
Zipcode: 82070-5000
Health Emergency Phone: 307-745-4879
Label Required IND: Y
Date Of Label Review: 12/16/1998
Status Code: C
Label Date: 12/16/1998
Origination Code: G
Hazard And Precautions: WET CEMENT CAN DRY THE SKIN & CAUSE ALKLALI BURNS. EYES/INHALATION: CEMENT DUST CAN IRRITATE THE EYES & UPPER RESPIRATORY SYSTEM. CAN CAUSE INFLAMMATION OF THE LINING TISSUE OF THE INTERIOR OF THE NOS E & OF THE CORNEA. HYPERSENSITIVE INDIVIDUALS MAY DEVELOP AN ALLERGIC DERMATITIS. WET CEMENT CAN DRY THE SKIN & CAUSE ALKALI BURNS. CEMENT DUST CAN IRRITATE THE E YES & UPPER RESPIRATORY SYSTEM. CAN CAUSE INFLAMMATION OF THE LINING TISSUE OF THE INTERIOR OF THE NOSE & OF THE CORNEA. HYPERSENSITIVE INDIVIDUALS MAY DEVELOP AN ALLERGIC DERMATITIS.

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U. S. SILICA COMPANY

MSDS - MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Names/Trade Names:

Silica Sand sold under various names: ASTM TESTING SANDS • GLASS SAND • FLINT SILICA • DM-SERIES • F-SERIES • FOUNDRY SANDS • FJ-SERIES • FP-SERIES • H-SERIES • L-SERIES • N-SERIES • NJ-SERIES • OK-SERIES • P-SERIES • T-SERIES • HYDRAULIC FRACING SANDS • MIN-U-SIL® • MYSTIC WHITE® • #1 DRY • #1 SPECIAL • PENN SAND® • Q-ROK® • SIL-CO-SIL® • SUPERSIL®.

Synonyms/Common Names: Sand. Silica Sand. Quartz. Crystalline Silica. Flint. Ground Silica.

Manufacturer's Name:
U. S. Silica Company
P. O. Box 187
Berkeley Springs. WV 25411

Emergency Telephone Number: **304-258-2500**
304-258-8295 **(fax)**

Date Prepared: September 15, 2000

SECTION 2 - COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients:

	Chemical Formula	Typical %. By Weight	CAS #
Crystalline Silica (quartz)	SiO_2	99.0 - 99.9	14808-60-7
Aluminum Oxide	Al_2O_3	< .8	1344-28-1
Iron Oxide	Fe_2O_3	< .1	1309-37-1
Titanium Oxide	TiO_2	< .1	13463-67-7

Exposure Limits for Hazardous Ingredients:

	OSHA PEL	ACGIH TLV	NIOSH REL
Crystalline Silica (Quartz)	$\frac{10\ mg/m^3}{\%\ SiO_2+2}$	.05	.05

The exposure limits are time-weighted average concentrations for an 8-hour workday and a 40-hour workweek.

Crystalline silica exists in several forms. the most common of which is quartz. If crystalline silica (quartz) is heated to more than 870°C. it can change to a form of crystalline silica known as trydimite. and if crystalline silica (quartz) is heated to more than 1470°C. it can change to a form of crystalline silica known as cristobalite. The OSHA PEL for crystalline silica as trydimite and cristobalite is one-half of the OSHA PEL for crystalline silica (quartz).

SECTION 3 - HAZARD IDENTIFICATION

EMERGENCY OVERVIEW:

The U. S. Silica Company material is a white or tan sand, or ground sand. It is not flammable. combustible or explosive. It does not cause burns or severe skin or eye irritation. A single exposure will not result in serious adverse health effects. Crystalline silica (quartz) is not known to be an environmental hazard.

Crystalline silica (quartz) is incompatible with hydrofluoric acid. fluorine. chlorine trifluoride or oxygen difluoride.

POTENTIAL HEALTH EFFECTS:

Inhalation:

a. Silicosis — Respirable crystalline silica (quartz) can cause silicosis. a fibrosis (scarring) of the lungs. Silicosis may be progressive: it may lead to disability and death.

b. Cancer — Crystalline silica (quartz) inhaled from occupational sources is classified as carcinogenic to humans.

c. Autoimmune Diseases — There are some studies that show excess numbers of cases of scleroderma and other connective tissue disorders in workers exposed to respirable crystalline silica.

d. Tuberculosis — Silicosis increases the risk of tuberculosis.

e. Nephrotoxicity — There are some studies that show an increased incidence of chronic kidney disease and end-stage renal disease in workers exposed to respirable crystalline silica.

Eye Contact: Crystalline silica (quartz) may cause abrasion of the cornea.

Skin Contact: Not applicable.

Ingestion: Not applicable.

Chronic Effects: The adverse health effects -- silicosis. cancer. autoimmune diseases. tuberculosis. and nephrotoxicity -- are chronic effects.

Signs and Symptoms of Exposure: Generally. there are no signs or symptoms of exposure to crystalline silica (quartz).

Medical Conditions Generally Aggravated by Exposure: The condition of individuals with lung disease (e.g., bronchitis. emphysema. chronic obstructive pulmonary disease) can be aggravated by exposure.

See Section 11, Toxicological Information. for additional detail on potential adverse health effects.

SECTION 4 - FIRST AID MEASURES

Inhalation: No specific first-aid is necessary since the adverse health effects associated with exposure to crystalline silica (quartz) result from chronic exposures. If there is a gross inhalation of crystalline silica (quartz). remove the person immediately to fresh air. give artificial respiration as needed. seek medical attention as needed.

Eye Contact: Wash immediately with water. If irritation persists. seek medical attention.

Skin Contact: Not applicable.

Ingestion: Not applicable.

SECTION 5 - FIRE FIGHTING MEASURES

Crystalline silica (quartz) is not flammable. combustible or explosive.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Spills: Use dustless methods (vacuum) and place into closable container for disposal. or flush with water. Do not dry sweep. Wear protective equipment specified below.

Waste Disposal Method: See Section 13.

SECTION 7 - HANDLING AND STORAGE

Precautions During Handling and Use: Do not breath dust. Use adequate ventilation and dust collection. Keep airborne dust concentrations below PEL. Do not rely on your sight to determine if dust is in the air. Silica may be in the air without a visible dust cloud. If dust cannot be kept below permissible limits, wear a respirator approved for silica dust when using, handling, storing or disposing of this product or bag. Practice good housekeeping. Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain, clean, and fit test respirators in accordance with OSHA regulations. Maintain and test ventilation and dust collection equipment. Wash or vacuum clothing that has become dusty. See also control measures in Section 8.

Precautions During Storage: Avoid breakage of bagged material or spills of bulk material. See control measures in Section 8.

Do not use U. S. Silica Company materials for sandblasting.

The OSHA Hazard Communication Standard, 29 CFR Sections 1910.1200, 1915.1200, 1917.28, 1918.90, 1926.59 and 1928.21, and state and local worker or community "right-to-know" laws and regulations should be strictly followed. WARN YOUR EMPLOYEES (AND YOUR CUSTOMERS IN CASE OF RESALE) BY POSTING AND OTHER MEANS OF THE HAZARDS AND THE REQUIRED OSHA PRECAUTIONS. PROVIDE TRAINING FOR YOUR EMPLOYEES ABOUT THE OSHA PRECAUTIONS.

See also American Society for Testing and Materials (ASTM) standard practice E 1132-99a, "Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica."

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Local Exhaust: Use sufficient local exhaust to reduce the level of respirable crystalline silica to below the PEL. See ACGIH "Industrial Ventilation, A Manual of Recommended Practice" (latest edition).

Respiratory Protection: The following chart specifies the types of respirators which may provide respiratory protection for crystalline silica.

Particulate Concentration	MINIMUM RESPIRATORY PROTECTION*
10 x PEL or less	Any particulate respirator, except single-use or quarter-mask respirator. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
50 x PEL or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
500 x PEL or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 500 x PEL or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
***Use only NIOSH-approved or MSHA-approved equipment. See 29 CFR §1910.134 and 42 CFR §84.**	

See also ANSI standard Z88.2 (latest revision) "American National Standard for Respiratory Protection".

Permissible Exposure Levels:

			Exposure Guidelines						
			OSHA		ACGIH		NIOSH		
Component	CAS No.	Percentage (by wt.)	TWA	STEL	TWA	STEL	TWA	STEL	Unit
Crystalline Silica (quartz)	14808-60-7	99.0-99.9	$\frac{10}{\% SiO_2+2}$	None	.05	None	.05	None	mg/m³

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	White or tan sand; granular, crushed, or ground.		
Boiling Point:	4046°F	Odor:	None
Vapor Pressure (mm Hg.):	None	Specific Gravity (Water = 1):	2.65
Vapor Density (Air = 1):	None	Melting Point:	3110°F
Solubility in Water:	Insoluble in water	Evaporation Rate (Butyl Acetate = 1):	None

SECTION 10 - STABILITY AND REACTIVITY

Stability: Crystalline silica (quartz) is stable.

Incompatibility (Materials to Avoid): Contact with powerful oxidizing agents, such as fluorine, chlorine trifluoride and oxygen difluoride, may cause fires.

Hazardous Decomposition or Byproducts: Silica will dissolve in hydrofluoric acid and produce a corrosive gas - silicon tetrafluoride.

Hazardous Polymerization: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

A. SILICOSIS

The major concern is silicosis, caused by the inhalation and retention of respirable crystalline silica dust. Silicosis can exist in several forms, chronic (or ordinary), accelerated, or acute.

Chronic or Ordinary Silicosis (often referred to as Simple Silicosis) is the most common form of silicosis, and can occur after many years of exposure to relatively low levels of airborne respirable crystalline silica dust. It is further defined as either simple or complicated silicosis.

Simple silicosis is characterized by lung lesions (shown as radiographic opacities) less than 1 centimeter in diameter, primarily in the upper lung zones. Often, simple silicosis is not associated with symptoms, detectable changes in lung function or disability.

Simple silicosis may be progressive and may develop into complicated silicosis or progressive massive fibrosis (PMF). Complicated silicosis or PMF is characterized by lung lesions (shown as radiographic opacities) greater than 1 centimeter in diameter. Although there may be no symptoms associated with complicated silicosis or PMF, the symptoms, if present, are shortness of breath, wheezing, cough and sputum production. Complicated silicosis or PMF may be associated with decreased lung function and may be disabling. Advanced complicated silicosis or PMF may lead to death. Advanced complicated silicosis or PMF can result in heart disease secondary to the lung disease (cor pumonale).

Accelerated Silicosis can occur with exposure to high concentrations of respirable crystalline silica over a relatively short period; the lung lesions can appear within five (5) years of the initial exposure. The progression can be rapid. Accelerated silicosis is similar to chronic or ordinary silicosis, except that the lung lesions appear earlier and the progression is more rapid.

Acute Silicosis can occur with exposures to very high concentrations of respirable crystalline silica over a very short time period, sometimes as short as a few months. The symptoms of acute silicosis include progressive shortness of breath, fever, cough and weight loss. Acute silicosis is fatal.

B. CANCER

IARC - The International Agency for Research on Cancer ("IARC") concluded that there was "*sufficient evidence* in humans for the carcinogenicity of crystalline silica in the forms of quartz or cristobalite from occupational sources", and that there is "*sufficient evidence* in experimental animals for the carcinogenicity of quartz and cristobalite." The overall IARC evaluation was that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is *carcinogenic to humans (Group 1)*." The IARC evaluation noted that "carcinogenicity was not detected in all industrial circumstances studies. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." For further information on the IARC evaluation, see IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 68, "Silica, Some Silicates..." (1997).

NTP - The National Toxicology Program, in its Ninth Annual Report on Carcinogens, classified "silica, crystalline (respirable)" as a known human carcinogen.

OSHA - Crystalline silica (quartz) is not regulated by the U. S. Occupational Safety and Health Administration as a carcinogen.

There have been many articles published on the carcinogenicity of crystalline silica, which the reader should consult for additional information: the following are examples of recently published articles: (1) "Crystalline Silica and Lung Cancer: The Problem of Conflicting Evidence", Indoor Built Environ, Volume 8, pp. 121-126 (1998); (2) "Crystalline Silica and the risk of lung cancer on the potteries", Occup. Environ. Med., Volume 55, pp. 779-785 (1998); (3) "Is Silicosis Required for Silica-Associated Lung Cancer?", American Journal of Industrial Medicine, Volume 37, pp. 252-259 (2000); (4) " Silica, Silicosis, and Lung Cancer: A Risk Assessment", American Journal of Industrial Medicine, Volume 38, pp. 8-18 (2000); (5) "Silica, Silicosis, and Lung Cancer: A Response to a Recent Working Group Report", Journal of Occupational and Environmental Medicine, Volume 42, pp. 704-720 (2000).

C. AUTOIMMUNE DISEASES

There is evidence that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis is associated with the increased incidence of several autoimmune disorders, -- scleroderma, systemic lupus erythematosus, rheumatoid arthritis and diseases affecting the kidneys. For a review of the subject, the following may be consulted: "Occupational Exposure to Crystalline Silica and Autoimmune Disease", Environmental Health Perspectives, Volume 107, Supplement 5, pp. 793-802 (1999); "Occupational Scleroderma", Current Opinion in Rheumatology, Volume 11, pp. 490-494 (1999).

D. TUBERCULOSIS

Individuals with silicosis are at increased risk to develop pulmonary tuberculosis, if exposed to persons with tuberculosis. The following may be consulted for further information: Occupational Lung Disorders, Third Edition, Chapter 12, entitled "Silicosis and Related Diseases", Parkes, W. Raymond (1994); "Risk of pulmonary tuberculosis relative to silicosis and exposure to silica dust in South African gold miners." Occup Environ Med., Volume 55, pp.496-502 (1998).

E. KIDNEY DISEASE

There is evidence that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis is associated with the increased incidence of kidney diseases, including end stage renal disease. For additional information on the subject, the following may be consulted: "Kidney Disease and Silicosis", Nephron, Volume 85, pp. 14-19 (2000).

SECTION 12 - ECOLOGICAL INFORMATION

Crystalline silica (quartz) is not known to be ecotoxic; i.e., there is no data which suggests that crystalline silica (quartz) is toxic to birds, fish, invertebrates, microorganisms or plants. For additional information on crystalline silica (quartz), see Sections 9 (physical and chemical properties) and 10 (stability and reactivity) of this MSDS.

SECTION 13 - DISPOSAL CONSIDERATIONS

General: The packaging and material may be landfilled; however, material should be covered to minimize generation of airborne dust.

RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 et seq.

The above applies to materials as sold by U.S. Silica Company. The material may be contaminated during use, and it is the responsibility of the user to assess the appropriate disposal of the used material.

SECTION 14 - TRANSPORT INFORMATION

Crystalline silica (quartz) is not a hazardous material for purposes of transportation under the U. S. Department of Transportation Table of Hazardous Materials, 49 CFR §172.101.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES (FEDERAL AND STATE)

TSCA No.: Crystalline silica (quartz) appears on the EPA TSCA inventory under the CAS No. 14808-60-7.

RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 et seq.

CERCLA: Crystalline silica (quartz) is not classified as a hazardous substance under regulations of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 40 CFR §302.

Emergency Planning and Community Right to Know Act: Crystalline silica (quartz) is not an extremely hazardous substance under Section 302 and is not a toxic chemical subject to the requirements of Section 313.

Clean Air Act: Crystalline silica (quartz) mined and processed by U.S. Silica Company was not processed with or does not contain any Class I or Class II ozone depleting substances.

FDA: Silica is included in the list of substances that may be included in coatings used in food contact surfaces, 21 CFR §175.300(b)(3)(xxvi).

NTP: Respirable crystalline silica (quartz) is classified as a carcinogen.

OSHA Carcinogen: Crystalline silica (quartz) is not listed.

California Proposition 65: Crystalline silica (quartz) is classified as a substance known to the State of California to be a carcinogen.

CANADA

Domestic Substances List: U. S. Silica Company products, as naturally-occurring substances, are on the Canadian DSL.

WHMIS Classification: D2A

OTHER

EINECS No.: 238-878-4

EEC Label (Risk/Safety Phrases): R 48/20, R 40/20, S22, S38

IARC: Crystalline silica (quartz) is classified in IARC Group 1.

National, state, provincial or local emergency planning, community right-to-know or other laws, regulations or ordinances may be applicable--consult applicable national, state, provincial or local laws.

SECTION 16 - OTHER INFORMATION

Hazardous Material Information System (HMIS):

Health	*
Flammability	0
Reactivity	0
Protective Equipment	E

* For further information on health effects, see Sections 3 and 11 of this MSDS.

National Fire Protection Association (NFPA):

Health	0
Flammability	0
Reactivity	0

Web Sites with Information about Effects of Crystalline Silica Exposure:

http://www.osha.gov - The Occupational Safety and Health Administration Home Page, click on "Technical Links", then click on "silica, crystalline".

http://www.cdc.gov/niosh/silicpag.html - NIOSH Hotlinks to Silicosis Prevention.

U. S. SILICA COMPANY DISCLAIMER

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, express or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by purchase, resale, use or exposure to our silica. Customers-users of silica must comply with all applicable health and safety laws, regulations, and orders, including the OSHA Hazardous Communication Standard.

ADHESIVE

LOCTITE CORPORATION 06/02/02
ROCKY HILL, CONNECTICUT 06067
EMERGENCY PHONE: (860) 571-5100

MATERIAL SAFETY DATA SHEET Page 01 of 05

Tak Pak(R) 712 Accelerator Metered Mist
18636

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	Tak Pak(R) 712 Accelerator Metered Mist
Item No.:	18636
Product Type:	Activator

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredients	CAS No.	%
ISOPROPYL ALCOHOL	67-63-0	70-75
ISOBUTANE	75-28-5	15-20
PROPANE	74-98-6	10-15
N,N-Dialkyltoluidine	99-97-8	1-3
HYDROQUINONE	123-31-9	0.01-0.1

Ingredients which have exposure limits

Exposure Limits (TWA) Ingredients	ACGIH (TLV)	OSHA (PEL)	OTHER
ISOPROPYL ALCOHOL	400 ppm TWA 983 mg/m3	400 ppm TWA 980 mg/m3	400 ppm TWA DuPont AEL
PROPANE	2500 ppm	1000 ppm 1800 mg/m3	None
HYDROQUINONE	2 mg/m3 TWA	2 mg/m3 TWA	2 mg/m3 TWA 4 mg/m3 STEL

Exposure Limits (STEL) Ingredients	ACGIH (TLV)	OSHA (PEL)
ISOPROPYL ALCOHOL	500 ppm 1230 mg/m3	500 ppm 1225 mg/m3
PROPANE	Asphyxiant	Asphyxiant

3. HAZARDS IDENTIFICATION

Toxicity: Eye and skin irritant. Also see "Signs and symptoms of exposure".

Primary Routes of Entry: Inhalation, ingestion, skin and eye contact.

Signs and Symptoms of Exposure: Headache, nausea, dizziness, vomiting, drowziness, irritation of respiratory tract, loss of consciousness, pulmonary edema, temporary corneal damage, gastrointestinal irritation, central nervous system depression.

Existing Conditions Aggravated by Exposure: Isopropyl alcohol:

Item No.: 18636

3. HAZARDS IDENTIFICATION (continued)

Skin disorders, eye problems, respiratory disorder

Ingredients	Literature Referenced Target Organ and Other Health Effects	Carcinogen NTP	IARC	OSHA
ISOPROPYL ALCOHOL	ALG BLO CNS IRR KID	NO	N/A	NO
ISOBUTANE	CAR CNS LUN	NO	NO	NO
PROPANE	CAR CNS IRR	NO	NO	NO
N,N-Dialkyltoluidine	ALG MUT	NO	NO	NO
HYDROQUINONE	BLO BNM CNS EYE IMM IRR LIV MUT SKI THY	NO	N/A	NO

Abbreviations

N/A Not Applicable	ALG Allergen
BLO Blood	BNM Bone Marrow
CAR Cardiac	CNS Central nervous system
EYE Eyes	IMM Immune system
IRR Irritant	KID Kidney
LIV Liver	LUN Lung
MUT Mutagen	SKI Skin
THY Thyroid	

4. FIRST AID MEASURES

Ingestion: Do not induce vomiting. Keep individual calm. Obtain medical attention.

Inhalation: Remove to fresh air. If symptoms persist, obtain medical attention.

Skin Contact: Wash with soap and water.

Eye Contact: Flush at least 15 minutes with water. Obtain medical attention.

5. FIRE FIGHTING MEASURES

Flash Point: 53°F (Base) Method: Tag Closed Cup
-165°F (Propellants) Method: Open Cup

Recommended Extinguishing Agents: Carbon dioxide, foam, dry chemical

Special Firefighting Procedures: Not available

Hazardous Products formed by Fire or Thermal Decomp Oxides of carbon

Unusual Fire or Explosion Hazards: Distant ignition sources may ignite vapors traveling with moving air currents.

5. FIRE FIGHTING MEASURES (continued)

Explosive Limits:
(% by volume in air) Lower 1.2% N,N-Dialkyltoluidine

	2.0% Isopropyl alcohol
	1.8% Isobutane
	2.1% Propane
(% by volume in air)Upper	7% N,N-Dialkyltoluidine
	12.7 at 200°F Isopropyl alcohol
	8.4% Isobutane
	9.8% Propane

6. ACCIDENTAL RELEASE MEASURES

Steps to be taken in case of spill or leak: Remove sources of ignition. Allow to evaporate with good ventilation.

7. HANDLING AND STORAGE

Safe Storage: Store below 110°F away from sources of ignition.
(Contact Loctite Customer Service 1-800-243-4874 for shelf life information)
Handling: Avoid prolonged breathing vapor. Keep away from eyes. Avoid prolonged skin contact.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Eyes:	Safety glasses or goggles.
Skin:	Rubber or plastic gloves.
Ventilation:	Provide adequate local ventilation to maintain vapor concentration below TLV.
Respiratory	Not available

See Section 2 for Exposure Limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear liquid
Odor:	Alcoholic
Boiling Point:	180°F
pH:	Does not apply
Solubility in Water:	95-100%
Specific Gravity	0.79
Volatile Organic Compound (EPA Method 24)	99.9%; 789 grams/liter
Vapor Pressure:	33 mm at 70°F
Vapor Density:	2.1
Evaporation Rate (Ether = 1)	7.7

LOCTITE CORPORATION 06/02/02
ROCKY HILL, CONNECTICUT 06067
EMERGENCY PHONE: (860) 571-5100

Product Name: Tak Pak(R) 712 Accelerator Metered Mist
Item No.: 18636

10. STABILITY AND REACTIVITY

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility:	Strong oxidizing agents, aluminum, nitric acid, sulfuric acid, amines, ammonia, halogen acids and chlorides, aldehydes
Conditions to Avoid:	Not available
Hazardous Decomposition Products (non-thermal):	None

11. TOXICOLOGICAL INFORMATION

See Section 3.

12. ECOLOGICAL INFORMATION

No data available

13. DISPOSAL CONSIDERATIONS

Recommended methods of disposal:	Incinerate following EPA and local regulations. Do not incinerate cans still under pressure.
EPA Hazardous Waste Number	D001 - Hazardous waste per 40CFR 261.21

14. TRANSPORTATION INFORMATION

DOT (49 CFR 172)
Domestic Ground Transport

Proper Shipping Name:	Consumer Commodity
Hazard Class or Division:	ORM-D
Identification Number:	None
Marine Pollutant:	None

IATA

Proper Shipping Name:	Aerosols, flammable
Class or Division:	Class 2.1
UN or ID Number:	UN 1950

15. REGULATORY INFORMATION

CA Proposition 65: Not available

16. OTHER INFORMATION

Estimated NFPA(R) Code:
Health Hazard: 2
Fire Hazard: 4

LOCTITE CORPORATION 06/02/02
ROCKY HILL, CONNECTICUT 06067
EMERGENCY PHONE: (860) 571-5100

Product Name: Tak Pak(R) 712 Accelerator Metered Mist
Item No.: 18636

16. OTHER INFORMATION (continued)

Reactivity Hazard: 0
Specific Hazard: Does not apply

Estimated HMIS(R) Code:

Health Hazard:	2
Flammability Hazard:	4
Reactivity Hazards:	0
Personal Protection:	See Section 8.

NFPA is a registered trademark of the National Fire Protection Assn.
HMIS is a registered trademark of the National Paint and Coatings Assn.

Prepared By: Stephen Repetto

Title:	Research Chemist, Environmental Health & Safety
Company:	Loctite Corp., 1001 Tr Br Cr, Rocky Hill CT 06067
(24hr.) Phone:	(860) 571-5100
Revision Date:	January 26, 1999 Revision: 0014

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LOCTITE CORPORATION 06/02/02
ROCKY HILL, CONNECTICUT 06067
EMERGENCY PHONE: (860) 571-5100

MATERIAL SAFETY DATA SHEET Page 01 of 07

Loctite(R) Prism(R) 410 Black Toughened Inst Adh
41045

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	Loctite(R) Prism(R) 410 Black Toughened Inst Adh
Item No.:	41045
Product Type:	Cyanoacrylate Ester

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredients	CAS No.	%
Ethyl cyanoacrylate	7085-85-0	85-90
Ethylene copolymer rubber	54545-50-5	5-10
SILICA, AMORPHOUS, FUMED, CRYSTALLINE-FREE	112945-52-5	3-5
CARBON BLACK	1333-86-4	1-3
HYDROQUINONE*	0123-31-9	1-1.5
PHTHALIC ANHYDRIDE*	85-44-9	0.1-1

* This component is listed as a SARA Section 313 Toxic Chemical.

Ingredients which have exposure limits

Exposure Limits (TWA) Ingredients	ACGIH (TLV)	OSHA (PEL)	OTHER
Ethyl cyanoacrylate	0.2 ppm TWA	None	None
SILICA, AMORPHOUS, FUMED, CRYSTALLINE-FREE	10 mg/m3 TWA	6 mg/m3 TWA	3 mg/m3 TWA resp. dust
CARBON BLACK	3.5 mg/m3 TWA	3.5 mg/m3 TWA	5ppm
HYDROQUINONE	2 mg/m3 TWA	2 mg/m3 TWA	2 mg/m3 TWA 4 mg/m3 STEL
PHTHALIC ANHYDRIDE	1 ppm TWA	1 ppm TWA	None

Exposure Limits (STEL) Ingredients	ACGIH (TLV)	OSHA (PEL)

3. HAZARDS IDENTIFICATION

Toxicity: Skin contact may cause burns.
Bonds skin rapidly and strongly.
Skin and eye irritant.
Estimated oral LD50 more than 5000mg/kg.
Estimated dermal LD 50 more than 2000 mg/kg.

Primary Routes of Entry: None known

Signs and Symptoms of Exposure: Vapor is irritating to eyes and mucous membranes

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EMERGENCY PHONE: (860) 571-5100

MATERIAL SAFETY DATA SHEET Page 02 of 07

Product Name: Loctite(R) Prism(R) 410 Black Toughened Inst Adh
Item No.: 41045

3. HAZARDS IDENTIFICATION (continued)

above TLV. Exposure to vapors above the established limits may cause symptoms of non-allergic asthma.

Existing Conditions Aggravated by Exposure: None known

Ingredients	Literature Referenced Target Organ and Other Health Effects	Carcinogen NTP	IARC	OSHA
Ethyl cyanoacrylate	ALG IRR RES	NO	NO	NO
Ethylene copolymer rubber	No Data	NO	NO	NO
SILICA, AMORPHOUS, FUMED, CRYSTALLINE-FREE	NUI	NO	N/A	NO
CARBON BLACK	RES	NO	2B	NO
HYDROQUINONE	AC3 BLO BNM CNS EYE IMM IRR MUT SKI	NO	N/A	NO
PHTHALIC ANHYDRIDE	AC4 ALG COR IRR RES	NO	NO	NO

Abbreviations :

N/A Not Applicable	2B Possibly carcinogenic to humans
AC3 ACGIH animal carcinogen.	AC4 ACGIH-Unclassifiable as human carc.
ALG Allergen	BLO Blood
BNM Bone Marrow	CNS Central nervous system
COR Corrosive	EYE Eyes
IMM Immune system	IRR Irritant
MUT Mutagen	NUI Nuisance dust
RES Respiratory	SKI Skin

4. FIRST AID MEASURES

Ingestion: Ingestion is not likely. See supplemental page for emergency procedures.

Inhalation: Remove to fresh air. If symptoms persist, obtain medical attention.

Skin Contact: Soak in warm water. See supplemental page for emergency procedures.

Eye Contact: Flush with water. See supplemental page for emergency procedures.

5. FIRE FIGHTING MEASURES

Flash Point: 150 - 200°F Method: Tag Closed Cup

Recommended Extinguishing Agents: Carbon dioxide, foam, dry chemical

LOCTITE CORPORATION 06/02/02
ROCKY HILL, CONNECTICUT 06067
EMERGENCY PHONE: (860) 571-5100

MATERIAL SAFETY DATA SHEET Page 03 of 07

Product Name: Loctite(R) Prism(R) 410 Black Toughened Inst Adh
Item No.: 41045

5. FIRE FIGHTING MEASURES (continued)

Special Firefighting Procedures: Not available

Hazardous Products formed by Fire or Thermal Decomp: Irritating organic vapors

Unusual Fire or Explosion Hazards: None

Explosive Limits:
(% by volume in air) Lower 1.7% Phthalic anhydride
(% by volume in air) Upper 10.5% Phthalic anhydride

6. ACCIDENTAL RELEASE MEASURES

Steps to be taken in case of spill or leak: Flood with water to polymerize. Soak up with an inert absorbent. Store in a closed container until disposal.

7. HANDLING AND STORAGE

Safe Storage: Store at or below 75 deg. F
(Contact Loctite Customer Service 1-800-243-4874 for shelf life information)
Handling: Avoid contact with skin and eyes. Avoid breathing vapor.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Eyes: Safety glasses or goggles.
Skin: Nitrile or polyethylene gloves and aprons. Do not use cotton. See supplemental page for additional information.
Ventilation: Positive down-draft exhaust ventilation should be provided to maintain vapor concentration below TLV.
Respiratory: Not available

See Section 2 for Exposure Limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Black viscous liquid
Odor: Pungent
Boiling Point: More than 300°F
pH: Does not apply
Solubility in Water: Polymerized
Specific Gravity: 1.07
Volatile Organic Compound (EPA Method 24): 84.1%; 900 grams per liter

Product Name: Loctite(R) Prism(R) 410 Black Toughened Inst Adh
Item No.: 41045

9. PHYSICAL AND CHEMICAL PROPERTIES (continued)

Less than 20 g/l (California SCAQMD method 316B)
Vapor Pressure: Less than 0.2mm at 80°F
Vapor Density: Approximately 3
Evaporation Rate (Ether = 1): Not available

10. STABILITY AND REACTIVITY

Stability: Stable

Product Name: Loctite(R) Prism(R) 410 Black Toughened Inst Adh   http://www.loctite.com/datasheets/msds/41045.htm

Hazardous Polymerization: Will not occur
Incompatibility: Polymerized by contact with water, alcohols, amines, alkalies.
Conditions to Avoid: Not available
Hazardous Decomposition Products (non-thermal): None

11. TOXICOLOGICAL INFORMATION

See Section 3.

12. ECOLOGICAL INFORMATION

No data available

13. DISPOSAL CONSIDERATIONS

Recommended methods of disposal: Polymerize as above. Incinerate in accordance with EPA and local regulations.
EPA Hazardous Waste Number: NH - Not a RCRA Hazardous Waste Material

14. TRANSPORTATION INFORMATION

DOT (49 CFR 172)
Domestic Ground Transport
Proper Shipping Name: Unrestricted (Not more than 450 liters); Combustible liquids, n.o.s. (Cyanoacrylate ester) (More than 450 liters)
Hazard Class or Division: Unrestricted (Not more than 450 liters) Combustible liquid (More than 450 liters)
Identification Number: None (Not more than 450 liters); NA 1993 (More than 450 liters)
Marine Pollutant: None
IATA
Proper Shipping Name: Unrestricted (Not more than one pint); Aviation regulated liquid, n.o.s., (Cyanoacrylate

Product Name: Loctite(R) Prism(R) 410 Black Toughened Inst Adh
Item No.: 41045

14. TRANSPORTATION INFORMATION (continued)

Ester) (More than one pint)
Class or Division: Unrestricted (Not more than one pint); Class 9 (More than one pint)
UN or ID Number: None (Not more than one pint) UN 3334 (More than one pint)

15. REGULATORY INFORMATION

CA Proposition 65: No California Proposition 65 chemicals are known to be present.

16. OTHER INFORMATION

Estimated NFPA(R) Code:

Health Hazard:	2
Fire Hazard:	2
Reactivity Hazard:	1
Specific Hazard:	Does not apply

Estimated HMIS(R) Code:

Health Hazard:	2
Flammability Hazard:	2
Reactivity Hazards:	1
Personal Protection:	See Section 8.

NFPA is a registered trademark of the National Fire Protection Assn.
HMIS is a registered trademark of the National Paint and Coatings Assn.

Prepared By:	Stephen Repetto
Title:	Research Chemist, Environmental Health & Safety
Company:	Loctite Corp., 1001 Tr Br Cr, Rocky Hill CT 06067
(24hr.) Phone:	(860) 571-5100
Revision Date:	September 21, 2000 Revision: 0035

INFORMATION FOR FIRST AID AND CASUALTY ON TREATMENT FOR ADHESION OF HUMAN SKIN TO ITSELF IF CAUSED BY CYANOACRYLATE ADHESIVES

Cyanoacrylate adhesive is a very fast setting and strong adhesive. It bonds human tissue including skin in seconds. Experience has shown that accidents due to cyanoacrylates are handled best by passive, nonsurgical first aid. Treatment of specific types of accidents are given below.

SKIN CONTACT
Remove excess adhesive. Soak in warm, soapy water. The adhesive will come loose from the skin in several hours. Cured adhesive does not present a health hazard even when bonded to the skin.

Avoid contact with clothes, fabrics, rags, or tissue. Contact with these materials may cause polymerization. The polymerization of large amounts of adhesive will generate heat causing smoke, skin burns, and strong, irritating vapors. Wear nitrile or polyethylene gloves and apron when handling large amounts of adhesive.

SKIN ADHESION
First immerse the bonded surfaces in warm, soapy water. Peel or roll the surfaces apart with the aid of a blunt edge, e.g. a spatula or a teaspoon handle; then remove adhesive from the skin with soap and water. Do not try to pull surfaces apart with a direct opposing action.

EYELID TO EYELID OR EYEBALL ADHESION
In the event that eyelids are stuck together or bonded to the eyeball, wash thoroughly with warm water and apply a gauze patch. The eye will open without further action, typically in 1-4 days. There will be no residual damage. Do not try to open the eyes by manipulation.

ADHESIVE ON THE EYEBALL

Cyanoacrylate introduced into the eyes will attach itself to the eye protein and will disassociate from it over intermittent periods, generally covering several hours. This will cause periods of weeping until clearance is achieved. During the period of contamination, double vision may be experienced together with a lachrymatory effect, and it is important to understand the cause and realize that disassociation will normally occur within a matter of hours, even with gross contamination.

MOUTH
If lips are accidentally stuck together, apply lots of warm water to the lips and encourage maximum wetting and pressure from saliva inside the mouth. Peel or roll lips apart. Do not try to pull the lips

with direct opposing action.

It is almost impossible to swallow cyanoacrylate. The adhesive solidifies and adheres in the mouth. Saliva will lift the adhesive in one half to two days. In case a lump forms in the mouth, position the patient to prevent ingestion of the lump when it detaches.

BURNS
Cyanoacrylates give off heat on solidification. In rare cases a large drop will increase in temperature enough to cause a burn.
Burns should be treated normally after the lump of cyanoacrylate is released from the tissue as described above.

SURGERY
It should never be necessary to use such a drastic method to separate accidentally bonded skin.

SAUNDERS ENTERPRISES, INC.

MAGNALUBE-G
GREASES
11-51 44th ROAD, LONG ISLAND CITY, NEW YORK 11101
• TELEPHONE: (718) 729-1000
• FAX: (718) 729-2690
• www.magnalube .com

MATERIAL SAFETY DATA SHEET

MAGNALUBE-G — TEFLON/PETROLEUM GREASE

MANUFACTURER:	EMERGENCY HEALTH INFORMATION:	(718) 729-1000
SAUNDERS ENTERPRISES, INC.	EMERGENCY SPILL INFORMATION:	(718) 729-2628
11-51 44TH ROAD	OTHER PRODUCT SAFETY INFO:	(718) 729-2671
LONG ISLAND CITY, N.Y. 11101		

COMPOSITION/INFORMATION ON INGREDIENTS	CAS NUMBER	PERCENTAGE
LUBRICATING BASE OIL	* SEE BELOW	78%
SEVERELY REFINED PETROLEUM DISTILLATE		
ACGIH-TLV-5MG/M CUBED10MG/M3 (MIST) ACGIH STEL		
ORGANIC POLYUREA THICKENER		)
(TSCA PROPRIETY COMPOUND EPA FILE #26847 NON-HAZARDOUS)		) 22%
TEFLON	#9002-84-0	)

*THE BASE OIL MAY BE A MIXTURE OF ANY OF THE FOLLOWING: CAS 64741884, CAS 64741895, CAS 64741964, CAS 64741975, CAS 64742014, CAS 64742525, CAS 64742536, CAS 64742547, CAS 64742627, CAS 64742650, OR CAS 72623837.

COMPOSITION COMMENT:
ALL THE COMPONENTS OF THIS MATERIAL ARE ON THE TOXIC SUBSTANCES CONTROL ACT CHEMICAL SUBSTANCES INVENTORY.

THIS PRODUCT FITS THE ACGIH DEFINITION FOR MINERAL OIL MIST. THE ACGIH TLV IS 5 MG/M3. THE OSHA PEL IS 5 MG/M3.

HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS:

EYE:
NOT EXPECTED TO CAUSE PROLONGED OR SIGNIFICANT EYE IRRITATION.

SKIN:
CONTACT WITH THE SKIN IS NOT EXPECTED TO CAUSE PROLONGED OR SIGNIFICANT IRRITATION. SKIN CONTACT MAY CAUSE DRYING OR DEFATTING OF THE SKIN. NOT EXPECTED TO BE HARMFUL TO INTERNAL ORGANS IF ABSORBED TRHOUGH THE SKIN.

HIGH-PRESSURE EQUIPMENT INFORMATION:
ACCIDENTIAL HIGH-VELOCITY INJECTION UNDER THE SKIN OF MATERIALS OF THIS TYPE MAY RESULT IN SERIOUS INJURY. SEEK MEDICAL ATTENTION AT ONCE SHOULD AN ACCIDENT LIKE THIS OCCUR. THE INITIAL WOUND AT THE INJECTION SITE MAY NOT APPEAR TO BE SERIOUS AT FIRST; BUT, IF LEFT UNTREATED, COULD RESULT IN DISFIGUREMENT OR AMPUTATION OF THE AFFECTED PART.

INGESTION:
IF SWALLOWED, THIS SUBSTANCE IS CONSIDERED PRACTICALLY NON-TOXIC TO INTERNAL ORGANS.

INHALATION:
NOT EXPECTED TO BE HARMFUL IF INHALED. CONTAINS A PETROLEUM-BASED MINERAL PROLONGED OR REPEATED INHALATION OF OIL MIST AT AIRBORNE LEVELS ABOVE THE RECOMMENDED MINERAL OIL MIST EXPOSURE LIMIT.

SIGNS AND SYMPTOMS OF EXPOSURE:
SKIN DEFATTING: MAY INCLUDE DRYING AND REDDENING OF THE SKIN.

FIRST AID MEASURES

EYE:
NO SPECIFIC FIRST AID MEASURES ARE REQUIRED BECAUSE THIS MATERIAL IS NOT EXPECTED TO CAUSE EYE IRRITATION. AS A PRECAUTION REMOVE CONTACT LENSES, IF WORN, AND FLUSH EYES WITH WATER.

SKIN:
REMOVE CONTAMINATED CLOTHING AND SHOES. USE A WATERLESS HAND CLEANER, MINERAL OIL, OR PETROLEUM JELLY TO REMOVE THE MATERIAL. THEN WASH SKIN WITH SOAP AND WATER. WASH OR CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE.

INGESTION:
NO SPECIFIC FIRST AID MEASURES ARE REQUIRED BECAUSE THIS MATERIAL IS NOT EXPECTED TO BE HARMFUL IF SWALLOWED. DO NOT INDUCE VOMITING. AS A PRECAUTION, GIVE THE PERSON A GLASS OF WATER OR MILK TO DRINK AND GET MEDICAL ADVICE. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

INHALATION:
IF EXPOSED TO EXCESSIVE LEVELS OF MATERIAL IN THE AIR, MOVE THE EXPOSED PERSON TO FRESH AIR. GET MEDICAL ATTENTION IF COUGHING OR RESPIRATORY DISCOMFORT OCCURS.

NOTE TO PHYSICIANS:
IN AN ACCIDENT INVOLVING HIGH-PRESSURE EQUIPMENT, THIS PRODUCT MAY BE INJECTED UNDER THE SKIN. SUCH AN ACCIDENT MAY RESULT IN A SMALL SOMETIMES BLOODLESS, PUNCTURE WOUND. HOWEVER, BECAUSE OF ITS DRIVING FORCE, MATERIAL INJECTED INTO A FINGERTIP CAN BE DEPOSITED INTO THE PALM OF THE HAND. WITHIN 24 HOURS, THERE IS USUALLY A GREAT DEAL OF SWELLING, DISCOLORATION, AND INTENSE THROBBING PAIN. IMMEDIATE TREATMENT AT A SURGICAL EMERGENCY CENTER IS RECOMMENDED.

FIRE FIGHTING MEASURES

FIRE CLASSIFICATION:
CLASSIFICATION (29 CFR 1910.1200): NOT CLASSIFIED BY OSHA AS FLAMMABLE OR COMBUSTIBLE.

FLAMMABLE PROPERTIES:
FLASH POINT: (COC) >455F (>235C)
AUTOIGNITION: NDA
FLAMMABILITY LIMITS (% BY VOLUME IN AIR): LOWER: NA UPPER: NA
EXTINGUISHING MEDIA: CO2, DRY CHEMICAL, FOAM AND WATER FOG.
NFPA RATINGS: HEALTH 1, FLAMMABILITY 1, REACTIVITY 0.

FIRE FIGHTING INSTRUCTIONS:
THIS MATERIAL WILL BURN ALTHOUGH IT IS NOT EASILY IGNITED.

COMBUSTION PRODUCTS:
NORMAL COMBUSTION FORMS CARBON DIOXIDE, WATER VAPOR AND MAY PRODUCE OXIDES OF SULFUR, NITROGEN AND PHOSPHORUS. COMBUSTION MAY FORM OXIDES OF CALCIUM AND H2S. INCOMPLETE COMBUSTION CAN PRODUCE CARBON MONOXIDE.

ACCIDENTAL RELEASE MEASURES

CLEAN UP SPILLS IMMEDIATELY, OBSERVING PRECAUTIONS IN EXPOSURE CONTROLS/ PERSONAL PROTECTION SECTION.

HANDLING AND STORAGE

HANDLING & STORAGE: NO SPECIAL REQUIREMENTS.

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EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
CONSIDER THE POTENTIAL HAZARDS OF THIS MATERIAL (SEE HAZARDS IDENTIFICATION) APPLICABLE EXPOSURE LIMITS, JOB ACTIVITIES, AND OTHER SUBSTANCES IN THE WORK PLACE WHEN DESIGNING ENGINEERING CONTROLS AND SELECTING PERSONAL PROTECTIVE EQUIPMENT. IF ENGINEERING CONTROLS OR WORK PRACTICES ARE NOT ADEQUATE TO PREVENT EXPOSURE TO HARMFUL LEVELS OF THIS MATERIAL, THE PERSONAL PROTECTIVE EQUIPMENT LISTED BELOW IS RECOMMENDED. THE USER SHOULD READ AND UNDERSTAND ALL INSTRUCTIONS AND LIMITATIONS SUPPLIED WITH THE EQUIPMENT SINCE PROTECTION IS USUALLY PROVIDED FOR A LIMITED TIME OR UNDER CERTAIN CIRCUMSTANCES.

ENGINEERING CONTROLS:
USE IN A WELL-VENTILATED AREA. IF USER OPERATIONS GENERATE AN OIL MIST, USE PROCESS ENCLOSURES, LOCAL EXHAUST VENTILATION, OR OTHER ENGINEERING CONTROLS TO CONTROL AIRBORNE LEVELS BELOW THE RECOMMENDED MINERAL OIL MIST EXPOSURE LIMITS.

PERSONAL PROTECTIVE EQUIPMENT:
EYE/FACE PROTECTION:
NO SPECIAL EYE PROTECTION IS NORMALLY REQUIRED.
SKIN PROTECTION:
WEAR PROTECTIVE CLOTHING IF ENGINEERING CONTROLS OR WORK PRACTICES ARE NOT ADEQUATE TO PREVENT SKIN CONTACT. SELECTION PF PROTECTIVE CLOTHING MAY INCLUDE GLOVES, APRON, BOOTS, AND COMPLETE FACIAL PROTECTION DEPENDING ON OPERATIONS CONDUCTED. SUGGESTED MATERIALS FOR PROTECTIVE GLOVES INCLUDE: (NITRILE) (VITON) SILVER SHIELD).
RESPIRATORY PROTECTION:
NO RESPIRATORY PROTECTION IS NORMALLY REQUIRED. IF USER OPERATIONS GENERATE AN OIL MIST, DETERMINE IF AIRBORNE CONCENTRATIONS ARE BELOW THE RECOMMENDED MINERAL OIL MIST EXPOSURE LIMITS. IF NOT WEAR A NIOSH APPROVED RESPIRATOR THAT PROVIDES ADEQUATE PROTECTION FROM MEASURED CONCENTRATIONS OF THIS MATERIAL. USE THE FOLLOWING ELEMENTS FOR AIR-PURIFYING RESPIRATORS: PARTICULATE.

PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL DESCRIPTION:	GREEN GREASE
pH:	NDA
VAPOR PRESSURE:	NDA
VAPOR DENSITY	(AIR=1)
BOILING POINT:	NDA
FREEZING POINT:	NDA
MELTING POINT:	NDA
SOLUBILITY:	SOLUBLE IN HYDROCARBON SOLVENTS; INSOLUBLE IN WATER.
SPECIFIC GRAVITY:	1.02 @ 15.6/15.5C
EVAPORATION RATE	NA
VISCOSITY:	>100 SUS @ 100F
PRECENT VOLATILE (VOL):	NA

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STABILITY AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS:
NO DATA AVAILABLE.
CHEMICAL STABILITY:
STABLE.
CONDITIONS TO AVOID:
NO DATA AVAILABLE.
INCOMPATIBILITY WITH OTHER MATERIALS:
MAY REACT WITH STRONG OXIDIZING AGENTS, SUCH AS CHLORATES, PEROXIDES, ETC.
HAZARDOUS POLYMERIZATION:
POLYMERIZATION WILL NOT OCCUR.

TOXICOLOGICAL INFORMATION

EYE EFFECTS:
THE EYE IRRITATION HAZARD IS BASED ON DATA FOR A SIMILAR MATERIAL.
SKIN EFFECTS:
THE SKIN IRRITATION HAZARD IS BASED ON DATA FOR A SIMILAR MATERIAL.
ACUTE INHALATION EFFECTS:
THE ACUTE RESPIRATORY TOXICITY IS BASED ON DATA FOR A SIMILAR MATERIAL.
ADDITIONAL TOXICOLOGY INFORMATION:
THIS PRODUCT CONTAINS PETROLEUM BASE OILS WHICH MAY BE REFINED BY VARIOUS PROCESSES INCLUDING SEVERE SOLVENT EXTRACTION, SEVERE HYDROCRACKING, OR SEVERE HYDROTREATING. NONE OF THE OILS REQUIRES A CANCER WARNING UNDER THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200). THESE OILS HAVE NOT BEEN LISTED IN THE NATIONAL TOXICOLOGY PROGRAM (NTP) ANNUAL REPORT NOR HAVE THEY BEEN CLASSIFIED BY THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC) AS; CARCINOGNIC TO HUMANS (GROUP 1), PROBABLY CARCINOGENIC TO HUMANS (GROUP 2A), OR POSSIBLY CARCINOGENIC TO HUMANS (GROUP 2B).

ECOLOGICAL INFORMATION

ECOTOXICITY:
NO DATA AVAILABLE.
ENVIRONMENTAL FATE:
THIS MATERIAL IS NOT EXPECTED TO BE READILY BIODEGRADABLE.

DISPOSAL CONSIDERATIONS

OIL COLLECTION SERVICES ARE AVAILABLE FOR USED OIL RECYCLING OR DISPOSAL. PLACE CONTAMINATED MATERIALS IN CONTAINERS AND DISPOSE OF IN A MANNER CONSISTENT WITH APPLICABLE REGULATIONS. CONTACT YOUR LOCAL ENVIRONMENTAL OR HEALTH AUTHORITIES FOR APPROVED DISPOSAL OR RECYCLING METHODS.

TRANSPORT INFORMATION

TRANSPORTATION INFORMATION:
THE DESCRIPTION SHOWN MAY NOT APPLY TO ALL SHIPPING SITUATIONS. CONSULT 49CFR, OR APPROPRIATE DANGEROUS GOODS REGULATIONS, FOR ADDITIONAL DESCRIPTION REQUIREMENTS (E.G. TECHNICAL NAME AND MODE-SPECIFIC OR QUANTITY-SPECIFIC SHIPPING REQUIREMENTS.

DOT SHIPPING NAME:	NONE	DOT HARZARD CLASS:	NONE
DOT IDENTIFICATION #:	NONE	DOT PACKING GROUP:	N/A

ADDITIONAL INFO: PETROLEUM LUBRICATING GREASE - NOT HAZARDOUS BY US DOT. ADR/RID HAZARD CLASS - NOT APPLICABLE.

REGULATORY INFORMATION

SARA 311 CATEGORIES:	1. IMMEDIATE (ACUTE) HEALTH EFFECTS:	NO
	2. DELAYED (CHRONIC) HEALTH EFFECTS:	NO
	3. FIRE HAZARD:	NO
	4. SUDDEN RELEASE OF PRESSURE HAZARD:	NO
	5. REACTIVITY HAZARD:	NO

FOOD CONTACT STATUS

USDA: H-2 STATUS: THIS PRODUCT IS ACCEPTABLE TO THE USDA FOR USE AS A LUBRICATE IN OFFICIAL MEAT AND POULTRY ESTABLISHMENTS PROVIDED THERE IS NO POSSIBILITY OF THE LUBRICANT OR LUBICATED PART CONTACTING EDIBLE PRODUCTS.

OTHER INFORMATION

NFPA RATINGS: HEALTH 1; FLAMMABILITY 1, REACTIVITY 0,
HMIS RATINGS: HEALTH 1, FLAMMABILITY 1, REACTIVITY 0,
(0-LEAST, 1-SLIGHT, 2-MODERATE, 3-HIGH, 4-EXTREME, PPE: - PERSONAL PROTECTION EQUIPMENT INDEX RECOMMENDATION - CHRONIC EFFECT INDICATOR). THESE VALUES ARE OBTAINED USING THE GUIDELINES OR PUBLISHED EVALUATIONS PREPARED BY THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) OR THE NATIONAL PAINT AND COATING ASSOCIATION (FOR HMIS RATINGS).

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV -	THRESHOLD LIMIT VALUE	TWA	- TIME WEIGHTED AVERAGE
STEL -	SHORT-TERM EXPOSURE LIMIT	TPQ	- THRESHOLD PLANNING QUANTITY
RQ -	REPORTABLE QUANTITY	PEL	- PERMISSIBLE EXPOSURE LIMIT
C -	CEILING LIMIT	CAS	- CHEMICAL ABSTRACT SERVICE NUMBER
A1-5 -	APPENDIX A CATEGORIES	0	- CHANGE HAS BEEN PROPOSED
NDA -	NO DATA AVAILABLE	NA	- NOT APPLICABLE

Kerby Saunders

KERBY SAUNDERS
PRESIDENT

ISSUED: AUGUST 16, 2000
SUPERSEDES: MARCH 13, 2000

THE ABOVE INFORMATION IS BASED ON THE DATA OF WHICH WE ARE AWARE AND IS BELIEVED TO BE CORRECT AS OF THE DATE HEREOF. SINCE THIS INFORMATION MAY BE APPLIED UNDER CONDITIONS BEYOND OUR CONTROL AND WITH WHICH WE MAY BE UNFAMILIAR AND SINCE DATA MADE AVAILABLE SUBSEQUENT TO THE DATE HEREOF MAY SUGGEST MODIFICATION OF THE INFORMATION, WE DO NOT ASSUME ANY RESPONSIBILITY FOR THE RESULTS OF ITS USE. THIS INFORMATION IS FURNISHED UPON CONDITIONS THAT THE PERSON RECEIVING IT SHALL MAKE HIS OWN DETERMINATION OF THE SUITABILITY OF THE MATERIAL FOR HIS PARTICULAR PURPOSE.

APPENDIX G

OP1002-Drilling Safety

OPERATING PROCEDURE: OP1002

DRILLING SAFETY

PREPARATION AND APPROVALS

VERSION	AUTHORED/DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	CLM/ Dec. 2002	CSO/June 2003	TWN/Sep. 2003	JPD/Sep. 2003	SRK/Oct. 2003

Total Pages: 20

HALEY & ALDRICH

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(Continued)

OPERATING PROCEDURE: OP1002

DRILLING SAFETY

1. PURPOSE

This OP defines the responsibilities of Haley & Aldrich (H&A) staff members and drilling subcontractors with regard to safety during execution of drilling programs as required by governing regulations and standard contractual agreements. In addition, this document provides an outline of safety-related issues and guidance toward safe operations during site investigations with drilling equipment in common practice.

1.1 Discussion

Familiarity with basic drilling safety is an essential component of all drilling projects. Potential hazards related to drilling operations include, but are not limited to encountering underground or overhead utilities, traffic and heavy equipment, hoisting heavy tools, steel impacts, open rotation entanglement, and the use or unexpected encountering of toxic or hazardous substances. While H&A staff members do not operate drilling equipment, they may work in close proximity to operating drilling equipment and may be exposed to many of the same hazards as the drilling subcontractor.

Haley & Aldrich may be held responsible by regulatory agencies and others for personal injuries or property damage as a result of drilling related accidents. It is the responsibility of the H&A Field Staff to be knowledgeable of, and in conformance with Federal (OSHA) regulations applicable to worker safety and to adhere to company health and safety (H&S) policies and procedures. Deviation from applicable safety regulations and established guidelines by H&A Field Staff and subcontractors is not permitted. Failure to adhere to these regulations, policies and procedures is grounds for disciplinary action or termination.

1.2 Application

The following procedures apply to all Haley & Aldrich projects that include mechanical drilling activities where drilling rigs are used for soil and rock drilling, boring advancement, subsurface sample collection, groundwater monitoring well or instrumentation installation, and in-situ testing.

2. EQUIPMENT & SUPPLIES

A project or site specific Health & Safety Plan (HASP) may be developed to address the particular concerns of a given project. The HASP must always be referred to prior to assembling safety and monitoring equipment in preparation for fieldwork. In the absence of a HASP, Field Staff must consult with project team leaders and the Health & Safety Coordinator for guidance.

2.1 Standard Required Personnel Protective Equipment (PPE)

- Hard Hat
- Safety Glasses
- Sound Dampeners
- Steel Toe Boots
- Protective Gloves
- Work Clothing (Denim Blue Jeans or Equivalent, Short or Long Sleeve Shirt)
- Rain Gear
- Reflective Safety Vest
- First Aid Kit/Eye Wash Kit

2.2 Additional Personnel Protective Equipment (PPE) as Required

- Tyvek or Saranex Coveralls/Sleeves/Apron

- Latex/Nitrile Inner Gloves/Boot Covers

- Air-Purifying Respirator & Spare Cartridges (Type Varies with Contaminants commonly Type GMC or Type H)

- Personnel Flotation Device (PFD)

- Safety Harness

2.3 Required Contractor-Provided Safety Equipment

- Fire Extinguishers
- First Aid Kit/Eye Wash Kit
- Traffic Controls (Safety Cones, Lighting & Signs)
- Caution Tape (Flagging for Exclusion Zones)

2.4 Required Air Quality Monitoring Equipment

Most environmental fieldwork will have extensive equipment requirements specifically related to the project needs. The following list is a representative list of air quality monitoring equipment that may be used in order to comply with requirements set forth in the HASP or project contract documents. A comprehensive list of environmental equipment and PPE must be developed for each project in coordination with the Project Manager (PM) and Health & Safety (H&S) Coordinator prior to the start of the field program.

2.4.1 Air Quality Monitoring Equipment

- Photo-Ionization Detector (PID)
- Flame Ionization Detector (FID)
- Organic Vapor Analyzer (OVA)
- Combustible Gas Meter-LEL/O2
- Dust Monitor
- Multigas Meter-HCn/Methane/H2S
- Gas Pointer
- Draeger Tube Sampling Kit
- Radiation Survey Meter

3. PROCEDURE

3.1 Underground Hazards

Haley & Aldrich staff members must ensure that permission has been gained from the property owner to access the property prior to site entry and before marking any proposed exploration or drilling locations. On public property the estimated location of utility installations, such as gas, electric, water, sewer, telephone, fuel, or any other underground installation that may be expected to be encountered during drilling work, will be identified by the appropriate authority. Appropriate authorities include client representatives, utility companies, nonprofit organizations (e.g. "Dig-Safe"), and others. A list of all state "utility locators" is posted on the Health and Safety Homepage under "Guidance Documents".

> *Note: It is important to note that not all utilities participate in the "one-call" agency or process. As such, inquiries must be made with the "one-call" agency to determine which entities do not participate, so they can be contacted independently.*
>
> *Also, most stake-outs or markings have a limited time period for which they remain valid, typically 2 to 3 weeks. It is critical that this time period be taken into account to prevent expiration of clearance prior to completion of the invasive activities. If the utility clearance period expires before completion, the clearance process must be repeated.*

Utility companies or owners of underground installations shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of drilling. Note that it is H&A policy is to have the drilling subcontractor call in to utility owners and any required authority or utility locating service.

Completion of the utility clearance is not a guarantee that underground facilities will not be encountered in the boreholes. Utility locators and owners of underground installations do not accept the liability for damage or losses if a utility is encountered or an accident occurs. In addition, utility owners and utility locating service firms do not typically conduct clearances on private properties. Accordingly, Haley & Aldrich Field Staff are required to review all available utility plans and conduct a thorough site walkover with the drillers to view all proposed boring locations prior to the start of any drilling. H&A Field Staff and subcontractors must walk along all utility alignments to identify gate boxes and manholes, open all manholes and identify utility depths and alignment, sight along alignments, use existing plans and measure existing features (manholes etc.) to determine accuracy of plans with as-builts. Using any information that can be obtained, the site should be viewed in detail for physical evidence of buried lines or structures. Evidence of surface elements of buried utilities should be documented, such as manholes, gas or water valves, catch basins, patched pavement cuts, etc. If on private property, onsite facilities personnel must be contacted to obtain utility plans.

It is expected that caution will be exercised while drilling in the uppermost 5 feet below the ground surface in the event the clearance has failed to identify an existing utility. Hand-excavation, vacuum pre-excavation or probing may be necessary to confirm the location of shallow utilities when utility companies or owners cannot respond to a request to locate underground utilities or cannot establish the exact location of these installations. Geophysical techniques, such as ground penetrating radar and magnetometry can also be utilized to locate potential underground hazards.

No subsurface drilling activities will be allowed until efforts described above have been made to have utilities properly located and marked.

Proposed boring locations can be marked using spray paint on the ground, stakes, or other similar method. All markings of proposed locations shall be made in white, in accordance with the generally accepted universal color code for facilities identification (AWMA 4/99).

White:	Proposed excavation or drilling location
Pink:	Temporary Survey Markings
Red:	Electrical, Power Lines, Cables, Conduit, and Lightning Cables.
Yellow:	Gas, Oil, Steam, Petroleum, and Gaseous Materials.
Orange:	Communications, Alarm, or Signal Lines, Cables, and Conduits.
Blue:	Potable Water.
Purple:	Reclaimed Water, Irrigation, and Slurry Lines.
Green:	Sewers and Drain Lines.

The public and private utility entities generally only mark the locations of their respective underground facilities within public rights-of-way. Determination of utility locations on private property is the responsibility of the property owner. It is incumbent on Haley & Aldrich and the drilling subcontractor to exercise caution and use good judgement when faced with uncertainty.

3.2 Subcontractor Safety Requirements

All H&A subcontractors must conform to applicable OSHA regulations governing worker safety including the wearing of hard hats, eye protection, sound protection, suitable work clothing, gloves, steel toe boots and additional PPE such as air-purifying respirators and Tyvek suits as necessary. All equipment must be designed for the purpose for which it is to be used, maintained in good condition and have current licenses and inspection certificates. Drillers must be qualified to operate the equipment and experienced in the activities conducted. Certificates of training or applicable licensure must be available upon request. Personnel will conduct themselves in a professional manner and be safety conscious at all times.

3.2.1 Power Lines

The subcontractor shall note the location of overhead power lines and other overhead electrical sources. Drilling must not occur near these areas unless precautions are taken to prevent contact. Under no circumstances is the drilling rig to be moved with the mast raised. The drilling rig mast must maintain at least 35 feet of clearance from all energized power lines. Power lines can be deenergized or shielded and the drill rig may be grounded when working within the 35-foot clearance distance. Contact the utility company to find out their requirements when working within the 35-foot clearance minimum.

3.2.2 Lightning

Because of the high potential for lightning strike on the mast of a drilling rig, drilling must cease when thunder and lightning storms approach and workers should take shelter away from the rig. If possible, the mast should be lowered prior to the onset of lightning storms. This decision should be a joint decision between the Haley & Aldrich field representative and the subcontractor. Typically work should be suspended if lightning is visible in two directions or is estimated to be less than 2 miles away.

3.2.3 Setting up and Blocking the Drilling Rig

It is the drilling rig operator's responsibility to ensure that the rig is properly set up. The stability of the drilling rig is critical to assure safe drilling operations. Whenever possible, the operator shall choose a dry, level and reasonably smooth drilling site. The operator shall make sure the rig's emergency brake is engaged and that the wheels which will remain on the ground are chocked. Blocking the rig will help to provide a more stable drilling structure by distributing the weight of the rig evenly. If the rig is equipped with jacks or outriggers, they will be extended from the rig to the ground, raising the rig partially or entirely off the ground. Proper blocking of the rig will prevent differential settling which could result in the rig toppling sideways. Blocks should be placed between the jack swivel and the ground to provide more support area under the pad.

3.2.4 Operation of the Drilling Rig

Haley & Aldrich staff members must never operate any of the subcontractor's vehicles or equipment. The drilling subcontractors are solely responsible for the safe operation of the drilling rig and for handling the equipment associated with the drilling. Drillers and H&A personnel must be aware of the location and operation of the drill rig's emergency shut off (kill switch) which cuts the power to the rig in the event of an entanglement. The kill switch must be maintained in working order at all times.

The driller should never leave the controls of the drilling rig while the tools are rotating.

3.2.5 Precautions Against Entanglement

All staff members who will work in the vicinity of the drilling rig should secure all loose clothing to prevent them from becoming caught in the drilling mechanism. Only employees necessary to run the rig are allowed in close proximity, except during essential sampling and other activities. Personnel will not reach into or near the borehole or the rotating equipment, unless the drilling rig has been shut down. For the same reasons, a long handled shovel or other similar device should be used to clear the drill cuttings away from the borehole and from rotating tools. Hands and/or feet should not be used to clear cuttings.

3.2.6 Work on the Mast

Drill rig operators shall not climb the mast to conduct repairs if the mast can be lowered. If the mast cannot be lowered to conduct repairs, workers may utilize a ladder or may climb the mast if fall protection, such as a harness and attached lanyard, is available. Fall protection devices, in the form of a harness and lanyard, will be used where workers must climb to 6 feet or greater in height. No one should climb the mast to conduct repairs while the drilling rig is operating.

3.2.7 Hoisting Safety

Worn or misused cables and rope are potentially the most dangerous pieces of equipment on the drilling rig. When a steel cable or fiber rope breaks under significant tension it has a tendency to snap like a rubber band. Be constantly aware of the condition of all cables and rope being used to hoist drill pipe or other heavy objects. Any cable or rope used for such purposes which has begun to fray, stretch or unravel, or which has a number of breaks in the same strand must be replaced. Use of thumb clips or clevis pins on hoisting hooks is required.

3.2.8 Equipment Safety Inspections

Drill rig operators are responsible for ensuring rigs are properly inspected. All drilling rigs and related support equipment and vehicles shall be scheduled for a periodic safety inspection. The inspections shall be the responsibility of the owner/operator of the equipment. The inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, drill controls, etc. The kill switches must be operable from various locations on the rig. Certification of inspection may be required from the driller upon request.

The driller in charge shall inspect the rig on a regular basis covering all major systems. If potentially hazardous deficiencies are found during the inspections, the rig may be shut down until the deficiencies are corrected and potential hazards are addressed or repaired. If Haley & Aldrich Field Staff believe that equipment is unsafe, the project manager must be informed so that a decision can be made on whether the drilling should be stopped until the owner/operator can confirm that the rig is safe to operate.

3.2.9 General Housekeeping

The work area around the drill area must be kept clean and orderly at all times. Items such as hand tools, rakes, shovels, etc. shall not be left lying on the ground to pose a trip hazard. Excess pipe, augers, connections, etc., should be stored in a rack or on the rig and not left lying around the rig. Remove and dispose of empty bags or other containers which have held drilling mud, cement or other dust producing materials.

Preventive measures must be in place to contain all drill fluids and cuttings. Spray, spills and run-off of drilling fluid must be arrested and recovered immediately in order to prevent the escape of potentially contaminated fluids into the environment or to avoid exposing passers by to a potential slipping hazard. During freezing weather salt or sand must be scattered on the ground surface within the work zone and the surrounding area to provide traction against slipping hazards.

3.3 H&A Field Staff Safety Requirements

All H&A Field Staff must conform to applicable OSHA regulations governing worker safety including the wearing of hard hats, eye protection, sound protection, suitable work clothing, gloves, steel toe boots and additional PPE such as air-purifying respirators and Tyvek suits as necessary. Personnel will conduct themselves in a professional manner and be safety conscious at all times.

A fundamental approach to minimizing one's personal risk of exposure to a variety of potential hazards is to plan ahead of the execution of activities and to set up a work space outside the immediate area of drilling or other traffic. The added distance from the drilling activities serves to provide a safety zone from vehicular traffic, falling objects, bursting hoses, vapors and fumes.

Many activities require Field Staff to enter into close proximity to the drill rig during operation. At such moments one should never become preoccupied or distracted from the drilling operation. Make certain of the drillers next move at all times and be aware of the hazards of hoisted objects falling and open rotation entanglement. Close to the drill rig there is a greater potential for eye damage from hammering steel splintering, bursting hydraulic lines and other solids or fluids associated with either the rotating drill stem or the borehole. Dangerous sound levels are common as well.

There are many visual and audible cues to an imminent hazard around the drill rig and any number of unsafe drilling practices to be aware of such as excessive stacking of drill rods, excessive rotation speeds, lifting overweight objects, and loose ropes, cables or chains near the rotation.

Take care against disrupting the driller's concentration or approaching him when he's hoisting or adjusting feed. Do not allow the drillers to rush their activities and suggest they take a break if frustration is an issue.

Whenever possible exercise engineering controls to minimize low level exposure to engine or borehole vapors by working up-wind. Exhaust pipe extensions and fans may be necessary to provide adequate ventilation when working in an interior or confined area. Near continuous air quality monitoring in the breathing zone may be required on both environmental and non-environmental projects. Consult with the Project Manager and the

H&S Officer for compound-specific guidelines for detection and the proper response actions according to company policy.

Use latex gloves in order to minimize low level exposure to soils. Use disposable boot covers to prevent small amounts of soil from boots from contaminating your personal vehicle and potentially exposing those you interact with, including your children, to harmful doses of lead or other contaminants.

Setting up exclusion zones around the work area may be necessary to ensure public safety. In some cases this may be done using caution tape and reflective cones or steel drums. Depending upon the hazard it may be necessary to install a temporary chain-link fence around the work area.

Setting up a decontamination area is a common practice to effectively recover contaminated wash water and materials while decontaminating equipment and PPE. H&S protocols are most easily followed when field decontamination practices are properly executed.

For environmental projects, the practical implications of having on hand and utilizing all of the required PPE, decontamination, sampling and monitoring equipment require use of a rented or company-owned vehicle of sufficient capacity and design to adequately transport and effectively access the equipment at the work site. In addition to the above, it may be necessary to have the applicable Material Safety Data Sheets (MSDS) for the various decontamination chemicals and environmental preservatives.

General field safety calls for attention to a variety of factors including physical stress due to extreme heat and cold as well as potential exposure to any number of hazards. Night drilling in urban neighborhoods may present security risks sufficient to warrant a police escort. Drilling over water or near water poses special hazards addressed in OP 1008 necessitating use of personal flotation devices (PFD) and other safety requirements. Highway projects and large-scale construction sites typically involve working around vehicular traffic and heavy equipment where high visibility reflective safety vests are necessary. Railway and airport projects may involve a number of special protocols including the use of defined communications and the completion of a specialized training program. Working in and around quarries, deep excavations and tunnels may require use of safety harnesses to guard against falls. Rural and undeveloped areas may present risks from poison ivy, ticks or snakes and limited access to medical attention in the event of an accident.

3.3.1 Basic Personal Protective Equipment (PPE)

Certain personal protective equipment (PPE) must be worn because of the physical hazards posed by the drilling operation. As a minimum on Haley & Aldrich field projects, hard hats, steel-toed work shoes, and safety eyewear must be worn at all times within the vicinity of the mast of the drilling rig. Hearing protection devices, such as ear plugs and ear muffs, shall be worn as required when the noise exposure is 85 dB (A) or greater over an 8-hour workday. Although noise levels vary with the type of drilling equipment utilized, potentially hazardous noise levels are likely to be generated during split spoon sampling and air drilling. Typically, speech at normal conversational levels becomes difficult at 2 to 3 feet when noise levels are in excess of 85 dB (A). Be aware of any addiotional personal protective equipment that may be required by the client. Though H&A is not responsible for issuing subcontractor PPE or the use of it, we must be diligent of our client's requirements and work closely with our drillers to ensure conformance with the site requirements. All protective equipment shall be provided by respective employer(s).

3.3.2 Special Precautions for Drilling in Landfills

In addition to the usual physical hazards of drilling, staff members drilling in landfills may experience an increased hazard from methane gas. Methane, a decomposition product of organic materials is a very flammable gas, which may accumulate in the borehole or in the general work area. To help reduce the hazards due to the presence of methane while drilling in landfills, the following procedures shall be implemented:

- No one shall smoke within 75 feet from the drilling area.
- The drilling rig must be diesel powered and equipped with a spark-arresting muffler.
- All ignition sources shall be placed at least 75 feet from the borehole and, if possible the rig should be located upwind of the borehole.
- Methane concentrations shall be monitored as frequently as possible using a Combustible Gas Indicator (CGI). The frequency of monitoring must be established on the health and safety plan (HASP). The meter should be kept near the rig. Results of the monitoring data should be entered on the field log.
- H&A policy requires that all work stop if gases are detected at 10% or greater of the lower explosive limit (LEL) in the hole being drilled or in the work area surrounding the hole. Under such circumstances it may become necessary to inert, ventilate, or flood the borehole with water during drilling to reduce the risk of downhole explosions.

3.3.3 Other Fire and Explosion Hazards

Flammable and/or combustible materials are typically present at drilling sites. These materials include gasoline, diesel fuel, polyethylene, wood, weeds, and others. To help prevent these materials from igniting, Haley & Aldrich staff members should first and foremost ensure that all sources of ignition (e.g., matches, lighters, etc.) have been identified and maintained at a safe distance from flammable and combustible materials.

Smoking, open flames or spark-producing equipment are not permitted within 75 feet of drilling rigs open wells, gasoline-driven pumps, or fuel storage areas. Flammable liquids (includes empty/full cans) shall not be stored or left within 50 feet of drilling rigs, pumps, or other related machinery. A fire extinguisher shall be located on, or within 10 feet, of any operating drilling rig. Equipment engines shall be shut off during fueling. Containers used for fuel shall be bonded and grounded during dispensing to prevent the discharge of static electricity. Safety fuel cans shall be returned to a designated safe storage area after fueling is completed.

3.3.4 Special Precautions for Drilling in Contaminated Soils

A Site Specific Health and Safety Plan (HASP) must be developed for all drilling operations when environmental contamination is reasonably expected. Follow the requirements of the HASP to safely manage exposure to contaminated soils. In the event environmental contamination is encountered unexpectedly, work must be suspended until the Project Manager and Health & Safety Officer can be contacted to develop a Site Specific Health and Safety Plan.

All contaminated equipment shall be properly decontaminated prior to leaving the general location of the drilling activities. Improperly decontaminated equipment returned to the H&A storeroom is not permitted. Subcontractors are expected to ensure that there will be no cross-contamination of the property and offsite locations as a result of the sampling event.

3.3.5 Lighting

Lighting around a drilling operation should be sufficient to provide illumination at all times of at least:

- An average of 5-foot candle (fc) power in the immediate drilling area, with no less than 3-fc power at any point.

- A minimum of 3 fc power on all other walking and working surfaces.

Work shall be suspended until additional lighting is provided should either H&A or the Subcontractor personnel feel that work site lighting is inadequate.

NOTE: The above are minimum OSHA requirements. Under certain circumstances higher lighting values may be warranted.

3.3.6 Training

Staff members working in the proximity of an operating drilling rig and the support equipment required should be thoroughly familiar with the operational hazards involved and the applicable work safety regulations. For environmental projects, H&A staff members must have undergone the 40-hour OSHA (Hazwoper) training and shall read, sign and comply with the provisions of the site-specific HASP drafted for the project. For other projects, standard regulations and H&S precautions must be followed. Drilling subcontractors shall have a similar level of training and a HASP when required. Heavy equipment operators in most states must be certified or licensed. If at any time there may be a question about competency in regards to safe operations, the Project Manager should request training records.

3.3.7 Personal Hygiene Requirements

To help limit the potential for ingestion of contaminants, eating, drinking, chewing, applying cosmetics or smoking is not allowed when working in the immediate vicinity of the drilling rig or in any restricted work areas (i.e., exclusion and decontamination zones). A break area outside the restricted work areas shall be established with a hand and face washing facility. Before eating, drinking, or smoking, all staff members shall thoroughly wash their hands and face.

3.4 Responsibilities

3.4.1 Project Manager

The Haley & Aldrich project manager (PM) is responsible for:

- Assuring that provisions specified in this OP are followed by Haley & Aldrich staff members and that the drilling subcontractor adheres to the provisions of the OP.
- Assuring that a HASP is developed for the project if it involves drilling in anticipated or unexpectedly encountered contaminated soils or significant safety hazards.
- Assuring that Haley & Aldrich staff members do not operate or handle the drilling subcontractor's equipment and that they remain clear of the drilling rig when their presence is not necessary.
- Assuring that all required personal protective equipment, for example hard hats, steel-toed shoes, and/or safety glasses are worn within the restricted work areas during the drilling operation. Hearing protection may be required in some instances.
- Confirming that the utility owner and/or property owner has located overhead and underground utilities/hazards.

3.4.2 Drilling Subcontractor

The drilling subcontractor is responsible for:

- Identifying any overhead and underground utilities/hazards prior to the start of drilling activities and, if necessary, arranging to have electrical lines de-energized prior to the start of drilling. In California, this might be a contractual/work scope responsibility for H&A.
- Making the final decision as to where they feel they can safely drill all borings.
- Safely operating the drilling rig and handling all equipment associated with the drilling operation.
- Maintaining the drilling rig and equipment in accordance with standard industry practices and safety standards.

- Containing generated material and preventing contamination from being spread as a result of drilling activities.

- Responding to the Haley & Aldrich staff (or field health and safety officer) requests to correct deficiencies related to unsafe conditions or practices.

3.4.3 Field Staff

On-site Haley & Aldrich staff members are responsible for:

- Complying with the provisions of this OP.

- Working in a safe manner.

- Notifying subcontractors/contractors of potentially unsafe conditions.

- Notifying the Haley & Aldrich PM or Local Health and Safety Coordinator (LHSC) of any unsafe acts or conditions in the workplace.

- Notifying the PM of any work-related injuries or illnesses that incur during work at the site.

- Conforming with the provisions outlined in applicable site-specific H&A plans.

APPENDIX A
REFERENCES

- OSHA standard, 29 CFR 1910.134, "Respiratory Protection"

- OSHA Hazardous Waste Operations and Emergency Response (Hazwoper) standard (i.e., 29 CFR 1910.120)

- "Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities" published by NIOSH/OSHA/USCG/EPA, October 1985

- Occupational Health and Safety Regulations (OSHA) and United States Coast Guard (USCG) 29 CFR 1926 Subpart C, General Safety and Health Provisions; 29 CFR 1926 Subpart E, Personal Protective Equipment; 29 CFR 1926.106, Working Over or Near Water; 33 CFR Part 151, Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water; 46 CFR Parts 25 and 26, Uninspected Vessels

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

OP1003	Utility Clearance
OP1004	Operation/Calibration of PID Photoionization Detector
OP1005	Operation/Calibration of FID Flame Ionization Detector
OP1006	Operation of Draeger Gas Detector Pump
OP1007	Field Monitoring for Volatile Organics (breathing space-work zone)
OP1008	Operations Over, Near, or On Water
OP1009	Medical Surveillance Program
OP1010	Health and Safety Plans
OP1015	Heat and Cold Stress
OP1016	Recordkeeping and Reporting
OP1022	Health and Safety
OP2000	Monitoring Field Explorations

APPENDIX C
FORMS

- See the Health and Safety Home Page (H&A Intranet) for a copy of the HASP and other applicable forms

APPENDIX D
GLOSSARY

- **Air Drilling**- A method of rotary drilling that uses compressed air as its circulation medium to remove cuttings from the borehole.

- **Bit** - The cutting or boring element used in drilling wells. Most bits used in rotary drilling are roller-cone bits. The bit consists of the cutting elements and the circulating element. The circulating element permits the passage of drilling fluid and utilizes the hydraulic force of the fluid stream to improve drilling rates.

- **Casing** - Steel or PVC pipe placed in a well during the drilling process to prevent the wall of the hole from caving in during drilling and after installation.

- **Cuttings** - The fragments of rock and soil dislodged by the bit and brought to the surface in the drilling mud.

- **Drill Stem** - All members in the assembly used for drilling by the rotary method from the swivel to the bit, including the kelly, drill pipe and tool joints, drill collars, stabilizers, and various subsequent items.

- **Driller** - The staff member of the drilling company directly in charge of a drilling rig and crew. His/her main duty is operation of the drilling rig and hoisting equipment, but he/she is also responsible for the downhole condition of the well, operation of downhole tools, and pipe measurements.

- **Drilling Fluid** - Circulating fluid, one function of which is to force cuttings out of the borehole and to the surface. While a mixture of clay, water, and other chemical additives is the most common drilling fluid, boreholes can also be drilled using air, gas, or water as the drilling fluid.

- **Grouting** - To fill the annulus between the casing and borehole with liquid slurry of grout (cement or bentonite) and water to support the casing and prevent fluid migration between permeable zones.

- **Mast** - A portable derrick capable of being erected as a unit, as distinguished from a standard derrick, which cannot be raised to a working position as a unit.

- **Mud** – A liquid fluid that may be used to circulate through the borehole during rotary drilling and workover operations. It functions to bring cuttings to the surface, to cool and lubricate the bit and drill stem, to protect against blowouts by holding back subsurface pressures and to deposit a mud cake on the wall of the borehole to prevent loss of fluids to the formation. The mud used in modern drilling operations is a complex, three-phase mixture of liquids, reactive solids, and inert solids. The liquid phase may be freshwater, diesel, oil, or crude oil and may contain one or more conditioners.

- **Rig** - The mast, drawworks, and attendant surface equipment of a drilling unit.

- **Rotary Drilling** - A drilling method in which a hole is drilled by a rotating bit to which a downward force is applied. The bit is fastened to and rotated by the drill stem, which also provides a passageway through which the drilling fluid is circulated. Additional joints of drill pipe and added as drilling progresses.

- **Borehole** - The hole drilled by the bit. A borehole may have casing in it or may be open (i.e., uncased), or a portion of it may be cased and a portion of it may be open.

- **Well Head** - The equipment installed at the surface of the borehole when a well is installed in the borehole. A well head may include such equipment as the casing head and tubing head.

APPENDIX H

OP1009-Medical Surveillance Program

OPERATING PROCEDURE: OP1009

MEDICAL SURVEILLANCE PROGRAM

PREPARATION AND APPROVALS

VERSION	AUTHORED/ DATE	REVIEWED / DATE	REVIEWED / DATE	REVIEWED / DATE	APPROVED / DATE
Ver. 0.0	CLM/ 2002	MPD/ Feb. 03	ABB/ Feb. 03	GJM / Aug. 03	JAK / Aug. 03
		Dr. Greaney/Aug. 03	CLM/Aug. 03		

Total Pages: 22

HALEY & ALDRICH

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OPERATING PROCEDURE: OP1009

MEDICAL SURVEILLANCE PROGRAM

1. PURPOSE

To establish a Medical Surveillance Program that applies to Haley & Aldrich staff members whose activities pose the potential for overexposure to toxic substances or physical agents or may require the use of respiratory protection. The medical surveillance program has been specifically designed to:

- Provide pre-placement baseline medical examinations to determine the medical suitability of, and to establish a "medical baseline" for, newly hired staff members covered by the program;
- Provide annual examinations to detect medical conditions or changes, which may affect medical suitability for unrestricted work;
- Provide interim and post exposure examinations, as necessary, based on types of projects and materials handled;
- Provide exit examinations for staff members covered by the program whose employment with Haley & Aldrich has been terminated;
- Minimize the potential for occupational illness through early detection of exposures and subclinical disease states and promote good health through risk factor reduction; and
- Comply with applicable Occupational Safety and Health Administration (OSHA) standards that require the provision of medical surveillance examinations.
- Determine suitability to wear respiratory protection as outlined in OSHA standard, 29 CFR 1910.134, “Respiratory Protection”, and other state equivalent regulations.

In addition, this OP has been developed to provide information on the requirements for a recordkeeping system for staff exposure monitoring (industrial hygiene area and staff member’s surveys*)* and medical records retention which comply with U.S. Department of Labor regulations in regard to accessibility and confidentiality.

1.1 Discussion

Various OSHA regulations address requirements for medical surveillance. The OSHA Hazardous Waste Operations and Emergency Response (Hazwoper) standard (i.e., 29 CFR 1910.120) requires that a medical surveillance program be instituted by the employer for staff members engaged in operations covered by section (a)(1) of the standard who:

- May be exposed to hazardous substances or health hazards at or above the permissible exposure limit (PEL) for 30 days or more a year, or

- Wear a respirator for 30 or more days a year.

Haley & Aldrich has made the commitment to follow a more rigorous protocol than that listed above. This protocol is outlined in Attachment A of this OP.
The Hazwoper standard requires that medical surveillance examinations be made available on the following schedule:

- prior to assignment;

- at least annually thereafter;

- at termination of employment; and

- as soon as possible after a staff member has been injured, become ill, or developed signs or symptoms due to possible overexposure involving hazardous substances or health hazards.

The OSHA Respiratory Protection standard (i.e., 29 CFR 1910.134) specifies that staff members shall not be assigned to tasks requiring the use of respiratory protection until a physician or other licensed health care professional has determined that they are physically able to perform the work and use the equipment.

The OSHA Occupational Noise Exposure standard (i.e., 29 CFR 1910.95) requires that audiometric examinations be provided to staff members whose noise exposure equals or exceeds an eight hour time weighted average of 85 Db (A). In addition, many OSHA substance-specific standards, including the standards regulating exposure to asbestos, lead, benzene and formaldehyde, have requirements for the provision of medical examinations for staff members exposed to these substances.

Haley & Aldrich conducts chemical exposure monitoring and medical surveillance on behalf of its staff members and in compliance with OSHA standards. Staff member records, as set forth in this OP, are maintained and retained for the duration of an staff member's employment with H&A plus thirty years.

1.2 Application

The Medical Surveillance Program applies only to Haley & Aldrich staff members whose job involves activities that pose the potential for overexposure to toxic substances or physical agents or that may require the use of respiratory protection. Staff members engaged in the following activities should be considered for inclusion into the Medical Surveillance program:

- hazardous waste site investigations or remediations;
- performing operations and maintenance tasks in a hazardous environment;

- air toxics monitoring activities;
- work in an environmental laboratory;
- hazardous material sampling;
- other activities involving exposure to toxic substances or physical agents or activities requiring the use of respiratory protection.

Therefore, staff members whose job function requires that they perform these activities will normally be included in the Medical Surveillance Program. In addition, staff members who regularly perform laboratory activities that involve environmental contaminants will be included in the Medical Surveillance Program. The need for initial participation in the program (i.e., baseline examination) will be determined by the Local Health and Safety Coordinator (LHSC), based on the staff member's job function, as described above. The need for continued participation in the program (i.e., annual/interim examinations) will be determined by the LHSC based upon the staff member's work history during the time period since the previous examination. Forms have been developed to assist the LHSC and others in making these determinations.

2. EQUIPMENT & SUPPLIES

None Required

3. PROCEDURE

3.1 Baseline Examination

The baseline examination is designed to determine the medical suitability of newly hired staff members, whose job will involve activities that pose the potential for overexposure to toxic substances or physical agents or may require the use of respiratory protection. The need for a given staff member to become an active participant in the Medical Surveillance Program and receive a baseline examination will be determined by the staff member's job function. As a general rule, all new staff members, whose primary job function will include those activities specified in Section 3.0 of this OP, should receive a baseline examination.

3.1.1 Restrictions and Timing of Medical Exams Prior to Pre-Employment

As a consequence of the examination, a medical/physical activity restriction (e.g., avoidance of physically stressful work, lifting restrictions, unsuitability to wear respiratory protection, avoidance of exposure to certain types of chemicals, etc.) may be determined, by a medical doctor or other health care professional, to be necessary. Where such restrictions will make the staff member medically unsuitable for a prospective job assignment, it is required that the baseline examination be completed, and the staff member medically cleared by the medical provider prior to an employment offer. If this is not possible, the employment offer must be made contingent on passing the medical examination. The latter option should not be used unless absolutely necessary.

The recommendation to provide the medical exam and have results available prior to the employment offer is made to assure that the applicant is medically suitable for the job for that they are applying and that this is known by both Haley & Aldrich and the applicants prior to their resignation from their current jobs.

When the issuance of a physical activity restriction will not create a problem or when a baseline examination cannot be scheduled prior to the date of hire, the examination must be completed as soon as possible after the start date. In such circumstances, Human Resources and the staff member's staff manager must be prepared to deal with any medical restrictions, which may limit a staff member's ability to perform certain physical activities or work with certain chemicals, which may be determined during the baseline examination.

3.1.2 Examination Scheduling

The baseline examination must be completed, and the staff member medically cleared by the examining physician, before the staff member is assigned to activities involving potential exposure to toxic substances or physical agents or which may require the use of respiratory protection.

Each office will rely on the LHSC to assist in the scheduling of medical surveillance examinations. Once scheduled, the staff member or prospective staff member will receive notification from the LHSC informing them of the date and time of the examination and directions to the medical provider's clinic. A Baseline Medical History questionnaire will also be provided to the staff member by the LHSC. This H&A form is to be completed prior to arrival at the clinic. These forms can be retrieved from the Health and Safety Homepage or from the LHSC.

In addition, a copy of the Record Disclosure Statement will be provided to the staff member at this time. This Notice is to be completed by the staff member and submitted to their LHSC as soon as possible. The disclosure form is a notice to the staff member informing them that they have allowed H&A to use the data in medical examinations to determine medical fitness and condition.

3.1.3 Prior Medical Examinations

If possible, newly hired staff members, who have received medical surveillance examinations from previous employers, should arrange to have a complete copy of the examination results sent via their LHSC to a H&A consulting physician for evaluation of content, timeliness, and potential utilization in lieu of an Haley & Aldrich baseline examination. The previous employers exam must have been completed within the past year and contain the same elements as the Haley & Aldrich annual exam.

3.2 Annual Examination

The annual examination has been designed, per OSHA recommendations, to detect medical conditions or changes, which may affect the medical suitability of a staff member who performs activities that pose the potential for overexposure to toxic substances or physical agents or that may require the use of respiratory protection.

3.2.1 Annual Examination Evaluation

The need for a given staff member to remain an active participant in the Medical Surveillance Program and receive an annual examination will be determined based upon the staff member's work history during the time period since the previous examination. Staff members who have completed a baseline or annual examination within the past year will receive an Annual Medical Surveillance Questionnaire (Form #005) from their LHSC approximately one month prior to their due date. This questionnaire requests information regarding exposure to toxic substances and physical agents and the use of personal protective equipment since the last examination. This form is to be returned to the LHSC as soon as possible, in which, it will be forwarded to WorkCare for their review. The annual medical surveillance procedure must be initiated at least one month prior to the staff member's due date, to assure that the examination can be scheduled and completed prior to the due date.

3.2.2 Scheduling

If, upon review of the completed questionnaire (Form #005), the physician along with input from the LHSC determines that an annual examination will be required, the LHSC and WorkCare will assist in scheduling the exam with the local medical provider. An H&A Annual Medical History questionnaire will also be provided to the staff member at this time by the LHSC. This form is to be completed prior to arrival at the clinic.

3.2.3 Inactive Participants

If it is determined by the LHSC, based on the staff member's response to the questionnaire, that they no longer perform activities that require their participation in the Medical Surveillance Program, the staff member may be placed on "Inactive Status". The staff member will receive a written notification from their LHSC/WorkCare informing them that they are being designated as an "Inactive Participant" and that an annual examination will not be required at this time. They will also be required to notify their LHSC should their job function change in the future such that they will once again be involved in activities requiring participation in the Medical Surveillance Program. Prior to assignment to a project, Project Managers are required to ask the staff member of their current status in the medical surveillance program to allow for adequate time for an exam to be conducted if needed.

3.2.4 Interim Examination from Overexposure

If it is believed that a staff member has developed signs or symptoms indicating possible overexposure to a toxic substance or physical agent, the LHSC should be notified immediately by the staff member's manager or project manager. If it is determined that an interim examination is necessary, one will be scheduled for the staff member as soon as possible. In addition to the examination, a "Chemical Exposure Incident Report (Safety Form #005)" must be filled out and forwarded to the LHSC and Corporate Health and Safety Manager (CHSM). This form is available on the H&S Homepage. This form must be maintained as part of the staff member's medical records.

3.3 Exit Examination

Personnel terminating employment with Haley & Aldrich, who are active participants in the Medical Surveillance Program and who have not had an examination within the last six months, will receive an Exit Examination Questionnaire (Form #001) from WorkCare or the LHSC at the time their termination is announced. This questionnaire requests information regarding exposure to toxic substances and physical agents and the use of personal protective equipment since the last examination. This form is to be returned to WorkCare as soon as possible. If it is determined by WorkCare that an exit examination will be required, the staff member will be provided the date and time of the examination. An Annual Medical History Questionnaire, for completion prior to arrival at the clinic, will also be provided to the staff member. This exit examination evaluation procedure should be activated on the day the staff member announces their resignation. The examination must be scheduled prior to the staff member's last day of work. See the following section if the staff member elects to waive their rights to an exit examination.

3.3.1 Waiving the exit exam

It is the staff members legal right to waive the exit exam. However, the staff member agrees that the results of the past exam will be used to satisfy the results of an exit exam. An Exit Examination Physical Waiver (Form #004) must be completed and signed by the staff member. The original signed form will be sent to Corporate Human Resources in Boston and a copy will maintained by the WorkCare.

3.4 Examination Content

The general content of the medical examination(s) is as follows:

- ***Physician's Examination** - Review medical, interim and exposure histories; complete physical examination; review and discuss test results with staff member; provide medical clearance for use of respiratory protection; rate staff member's ability to perform field work; identify personal risk factors and educate regarding risk factor reduction; and refer staff member to their personal physician when indicated

- ***General Physical Examination** - Measurement of height, weight, temperature, blood pressure, pulse and respiratory rate; tetanus immunization when recommended by physician; collection of blood and urine specimen as required

- ***Pulmonary Function Testing** - Measurement of forced vital capacity, forced expiratory volume at 1 second, FEV1/FVC ratio, forced expiratory flow rates at 25-75% volume, and maximum voluntary ventilation

- **Electrocardiogram (EKG)** - Resting, 12-lead electrocardiogram. A "stress test" may be administered at the discretion of the physician, particularly where heat stress may be a concern.

- **Vision Testing** - Test for near and distant visual acuity, color vision, vertical and lateral phoria, and stereopsis
- ***Audiometry** - Test for sound thresholds at minimally, 500, 1000, 2000, 3000, 4000 and 6000 Hz
- ***Blood Tests** - Chemistry Panel (e.g., Chem-20 minimum) and Complete Blood Count
- ***Urine Tests** – Urinalysis
- **Chest X-Ray** - PA (single view) chest x-ray read by a radiologist. A 14 x 17-inch posterior/anterior view chest X-ray, with lateral and oblique views only if indicated by the physician.

Note: These tests are based on the "Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities" published by NIOSH/OSHA/USCG/EPA, October 1985.
All components listed above are completed in the baseline medical examination and in the exit examination performed at termination of employment.

As a general rule, only those components marked with an asterisk (*) are completed at the time of the annual surveillance examinations. The others are taken between a set interval determined by the physician. However, the physician may add, or may be requested to add, additional tests, including specific biological monitoring tests, at the time of the baseline or annual exam, depending upon the medical and/or exposure history of the examinee. Breast and rectal exams, as a rule, are not part of the H&A examination protocols. .

3.5 Medical Recordkeeping

3.5.1 Required Forms

The following forms are utilized in the Haley & Aldrich Medical Surveillance Program:
(Note: All of the following forms may be retrieved from the Health and Safety Homepage on the Company Intranet under "Medical Surveillance Program and Forms".)

- **Medical Termination Medical Surveillance Questionnaire – Form #001**
  A one-page form signed by the staff member to assist the LHSC with the determination of the need for an Exit Examination. The LHSC provides this form to the staff member at the time the exit documentation is filled out. It should be completed by the staff member and submitted to their LHSC. This is different than an exit waiver.

- **Medical Surveillance Program Participation Acknowledgment – Form #002**
  A one-page form describing Haley & Aldrich's and the staff member's access to the medical information generated during the examination. The LHSC provides this form to the staff member at the time of the baseline examination notification. It should be completed by the staff member and submitted to their LHSC prior to each medical examination.

- **Records Disclosure Statement**
  A one-page form signed by the employee allowing full access and use of the employee's medical data generated by H&A for general medical purposes. It should be completed by the staff member and submitted to their LHSC and maintained by HR in Boston prior to each medical examination.

- **Exit Examination Waiver – Form #004**
  A one-page form signed by the staff member waiving their rights to an exit exam. The previous exam will be used as the exit exam.

- **Annual Medical Surveillance Questionnaire – Form #005**
  A one-page form signed by the staff member to assist the LHSC with the determination of the need for continued participation in the program. This will be filled out one month prior to the staff member's anniversary date of their medical exam. Based on the criteria and answers selected and signed by the staff member, this form will be used to help the LHSC determine whether the staff member should remain active or be "inactive" in the medical monitoring program. It should be completed by the staff member and submitted to their LHSC prior to scheduling an annual medical examination.

- **Medical History Questionnaire**
  This form is used for baseline and annual exams. A multi-page form designed to obtain information from the examinee on family and personal medical history in addition to occupational exposure history. This form will be provided to the staff member at the time of scheduling and should be completed prior to arrival at the clinic.

- **Respirator Medical Evaluation Questionnaire**
  A multi-page form designed to obtain information from the examinee on various information about past personal exposure history (smoking), family and personal medical history, and occupational exposure history. This form will be provided to the staff member at the time of scheduling and should be completed prior to arrival at the clinic. This form is used in conjunction with the Pulmonary Function Test and reviewed by a PLHCP to determine the need for additional training and whether that staffs member may don a respirator.

- **Work Status Report**
  A one-page form signed by the examining physician which summarizes the results of the examination by either medically clearing the staff member or specifying any job *restrictions* required based on the staff member's medical condition. The clinic should have a similar form; however, we prefer that the clinic use the H&A form. This form will be forwarded to the LHSC and reviewed for restrictions when received. If there are restrictions, the WorkCare physician will consult with the patient.

3.5.2 Provision of Medical Records to Haley & Aldrich

After the completion of the examination and receipt and interpretation of any test results, a copy of the Work Status Report is to be retained in the staff member's training/medical file, maintained by WorkCare. This form will be filled out by the examining physician and will be the only medical record that will not be considered confidential.

A copy of all medical records generated, including all test results, the forms specified above, and original radiographs, are maintained by WorkCare for permanent retention. The examining physician may also maintain copies of all medical records at the medical clinic. To assure confidentiality, access to the copies of these medical records is limited to H&A's Consulting Physician.

3.5.3 Preservation of Records

Each employee will be required to complete a Record Disclosure Statement. This will be included with your initial WorkCare exam and be part of the Medical History Questionnaire. This form is designed to meet all HIPAA confidentiality requirements.

Records shall be preserved and retained as follows:

3.5.3.1 Staff Member Medical Records

Medical records for each staff member shall be preserved and maintained by the designated custodian for at least the duration of employment, plus thirty years, except that the following types of records need not be retained for any specified period:

- Health insurance claims records maintained separately from the employer's medical program and its records,
- First aid records (not including medical histories) of one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and the like which do not involve medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job, if made on-site by a non-physician and if maintained separately from the employer's medical program and its records, and
- The medical records of staff members who have worked for less than one year for the employer need not be retained beyond the term of employment if they are provided to the staff member upon the termination of employment.

3.5.3.2 Staff Member Exposure Records

Each staff member's exposure record shall be preserved and maintained by the LHSC for at least thirty years, except that:

- Background data to environmental (workplace) monitoring or measuring, such as laboratory reports and worksheets, need only be retained for one year as long as the sampling results,

- the collection methodology (sampling plan), a description of the analytical and mathematical methods used, and a summary of other background data relevant to interpretation of the results obtained, are retained for at least thirty years; and

- Material safety data sheets and records concerning the identity of a substance or agent need not be retained for any specified period as long as some record of the identity (chemical name, if known) of the substance or agent, where it was used, and when it was used is retained for at least thirty years; and

- Biological monitoring results designated as exposure records by specific occupational safety and health standards shall be preserved and maintained as required by the specific standard.

3.5.4 Analysis Using Exposure or Medical Records

Each analysis using exposure or medical records shall be preserved and maintained for at least thirty years.

3.5.5 Transfer of Records

In the event that Haley & Aldrich ceases to do business, all records subject to this section shall be transferred to the successor employer. If there is no successor employer to receive and maintain the records subject to this standard, Haley & Aldrich shall notify affected current staff members of their rights of access to records at least three months prior to the cessation of business and shall:

- Transfer the records to the Director of the National Institute for Occupational Safety and Health (NIOSH), if so required by a specific occupational safety and health standard; or

- Notify the Director of NIOSH in writing of the impending disposal of records at least three months prior to the disposal of the records.

3.6 Use of Medical Providers

Each location has been given the option to select their own medical provider for their office based on their specific expectations from their medical provider, providing that the medical provider meet the requirements of WorkCare. Before any change is made, WorkCare and the CHSM must be consulted. €When choosing a Medical Provider, offices should consider the following criteria:-

- Use of occupational medical physicians and their understanding our core business and hazards
- Availability and accessibility to doctors

- Location of clinic
- Business hours
- Cost of downtime for staff members to travel to/from clinic
- Professional etiquette with staff members
- Medical data is received in a timely manner
- Willingness to maintain records on site

3.6.1 Qualifications

Examinations required by the Medical Surveillance Program will be conducted by, or under the direction of, physicians certified as occupational medicine specialists by the American Board of Preventive Medicine.

3.6.2 Contractual Agreement

To assure that medical surveillance services are provided to Haley & Aldrich in accordance with the requirements of this SOP and appropriate regulations, a Medical Surveillance Agreement will be entered into by Haley & Aldrich and WorkCare.

3.6.3 Misconduct by Examining Physician or Medical Staff

If a staff member believes that there has been any type of misconduct or they believe a medical staff member of the medical provider has violated them in anyway, they are expected to contact HR immediately. It is imperative that these allegations be taken serious and forwarded to H&A management for further investigation.

3.7 Medical Evaluation for Respirator Use

This section of the procedure only applies to staff members who are not in the Medical Surveillance Program and are required to wear a respirator, at any frequency or duration, for work activities other than Hazwoper projects. . Staff members in the medical surveillance program based on 29 CFR1910.120, as outlined in Section 2.0 “Discussions”, will have satisfied their medical evaluation for the Respirator Standard, 29 CFR1910.134.

Using a respirator may place a physiological burden on staff members that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the staff member. Accordingly, this section of the procedure specifies the minimum requirements for medical evaluation that Haley & Aldrich must implement to determine the staff member's ability to use a respirator.

Haley & Aldrich will provide a medical evaluation to determine the staff member's ability to use a respirator, before the staff member is fit tested or required to use the respirator in the workplace. Haley & Aldrich may discontinue a staff member's medical evaluations when the staff member is no longer required to use a respirator.

A Physician or other licensed health care professional (PLHCP) is the appropriate reference for this section. The OSHA Respirator Standard allows for licensed health care professionals to administer portions of the examination. Unlike the other sections of this procedure, a licensed physician must administer and have direction of the medical examination and testing, a PLHCP may conduct a medical evaluation for respirator use.

3.7.1 Medical evaluation procedure

Haley & Aldrich will identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a Respirator Medical Evaluation Questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

The medical evaluation will obtain the information requested by the Medical History questionnaire or by the Respirator Medical Evaluation Questionnaire. These forms will be reviewed by WorkCare. They will review the questionnaire to determine if additional medical evaluation is required to wear a respirator.

They will provide a written statement that either clears the staff member for respirator us or place restrictions on the use.

3.7.2 Follow-up medical examination

WorkCare will ensure that a follow-up medical examination is provided for a staff member who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of the Respirator Medical Evaluation Questionnaire.

The follow-up medical examination will include any medical tests, consultations, or diagnostic procedures that WorkCare deems necessary to make a final determination on the ability to wear a respirator.

3.7.3 Administration of the medical questionnaire and examinations

The Respirator Medical Evaluation Questionnaire will be filled out by the staff member and can be obtained from the Safety Home Page on the company Intranet or from the LHSC. The completed form must be faxed or forwarded to WorkCare for review.

The medical questionnaire and examinations will be administered confidentially during the staff member's normal working hours or at a time and place convenient to the staff member.
Haley & Aldrich will provide the staff member with an opportunity to discuss the questionnaire and examination results with WorkCare and the PLHCP.

3.7.4 Supplemental Information for the PLHCP

The following information must be provided to WorkCare before the PLHCP makes a recommendation concerning a staff member's ability to use a respirator:

- The type and weight of the respirator to be used by the staff member;
- The duration and frequency of respirator use (including use for rescue and escape);
- The expected physical work effort;
- Additional protective clothing and equipment to be worn; and
- Temperature and humidity extremes that may be encountered.

Any supplemental information provided previously to WorkCare regarding a staff member need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

Haley & Aldrich is expected to provide WorkCare with a copy of the written respiratory protection program and a copy of this section.

Note : When Haley & Aldrich replaces a PLHCP, Haley & Aldrich must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have staff members medically reevaluated solely because a new PLHCP has been selected.

3.7.5 Medical Determination for Respirator Use

In determining the staff member's ability to use a respirator, Haley & Aldrich will:

Obtain a written recommendation regarding the staff member's ability to use the respirator from the PLHCP. The recommendation will provide only the following information:

- Any limitations on respirator use related to the medical condition of the staff member, or relating to the workplace conditions in which the respirator will be used, including whether or not the staff member is medically able to use the respirator;

- The need, if any, for follow-up medical evaluations; and

- A statement that the PLHCP has provided the staff member with a copy of the PLHCP's written recommendation.

If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the staff member's health at increased risk if the respirator is used, Haley & Aldrich will provide a powered air purifying respirator (PAPR) if the PLHCP's medical evaluation finds that the staff member can use such a respirator. If a subsequent medical evaluation finds that the staff member is medically able to use a negative pressure respirator, then Haley & Aldrich is no longer required to provide a PAPR.

3.7.6 Additional medical evaluations

Medical evaluations, as required by OSHAs "Respiratory Protection" standard, are not an annual requirement. This is a different requirement of the Hazwoper standard. At a minimum, Haley & Aldrich will provide additional medical evaluations that comply with the requirements of the OSHA Respiratory Protection Standard if:

- A staff member reports medical signs or symptoms that are related to ability to use a respirator;
- A PLHCP informs Haley & Aldrich that a staff member needs to be reevaluated;
- Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for staff member reevaluation; or
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, and temperature) that may result in <u>a substantial increase in the physiological burden</u> placed on a staff member.

3.8 Responsibilities

3.8.1 Local Health and Safety Coordinator

- Will administer the Medical Surveillance Program at the local level;
- Will assure that all staff members within their location, whose jobs involve potential overexposure to toxic substances or physical agents or which require the use of respiratory protection, are included in the Medical Surveillance Program;
- Will notify staff members within their location at least one month in advance when they are due for their annual examination;
- Will assist scheduling with medical surveillance examinations for staff members within their location ;
- Will provide staff members with a copy of the appropriate (i.e., baseline, annual, or respirator evaluation) forms

3.8.2 Staff Managers and Project Managers

- Project Managers will only used qualified personnel on their projects who have met their medical surveillance requirements;

- Project Managers will not use staff members who have not successfully completed and passed a medical evaluation or examination for use of a respirator.

- Will assure that all staff members under their supervision, who are covered by the Medical Surveillance Program, are active participants in the program;

- Will assure that all new staff members under their supervision, who are covered by the Medical Surveillance Program, have completed a baseline examination and been medically cleared by the examining physician, before assigning such staff members to activities involving

- potential overexposure to toxic substances or physical agents or activities requiring the use of respiratory protection; and

- Will assure that staff members report all chemical exposures on the appropriate forms.

3.8.3 Staff Members

- Will promptly respond to any annual and exit termination examination questionnaires received by them;

- Complete the Medical History Questionnaires provided to them by WorkCare or the LHSC prior to their arrival at the medical provider's clinic;

- Complete the Medical Surveillance Program Participation Acknowledgement (Medical Form #002) Notice provided to them and submit the signed copy to their LHSC;

- Report all exposures to the project manager and complete the appropriate exposure forms (Supervisor Accident Incident Report Form #004) when there has been a chemical overexposure.

3.8.4 Human Resources/Corporate Support

- Will assure, whenever possible, that baseline examinations for prospective new hires for whom medical restrictions will pose a problem, are completed before an offer of employment is made; and

- Will provide a copy of the Termination Medical Surveillance Questionnaire (Medical Form # 001*)* to all active participants in the Medical Surveillance Program who are terminating employment with Haley & Aldrich.

3.8.5 Medical Records Retention Designee

- Will maintain all records in a confidential and secure manner; and
- Will not compromise the confidentiality of any personnel information that is present on personnel medical files.

APPENDIX A
REFERENCES

- OSHA standard, 29 CFR 1910.134, “Respiratory Protection”
- OSHA Hazardous Waste Operations and Emergency Response (Hazwoper) standard (i.e., 29 CFR 1910.120)
- “Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities” published by NIOSH/OSHA/USCG/EPA, October 1985

APPENDIX B
RELATED HALEY & ALDRICH PROCEDURES

- OP1010 Health and Safety Plans
- OP1013 Radiation Safety Program
- OP1022 Health and Safety
- OP1023 Respiratory Program

APPENDIX C
FORMS

See the Health and Safety Home Page (H&A Intranet) for:

- Medical Termination Medical Surveillance Questionnaire – Form #001
- Medical Surveillance Program Participation Acknowledgment – Form #002
- Records Disclosure Statement
- Exit Examination Waiver – Form #004
- Annual Medical Surveillance Questionnaire – Form #005
- Medical History Questionnaire
- Respirator Medical Evaluation Questionnaire
- Work Status Report

APPENDIX I

Historic Site Analytical Data

TABLE 1
SOIL ANALYTICAL RESULTS
NYSEG - SENECA FALLS

Location ID			SFSS00020201	SFSS00020201	SFSS00020202	SFSS00020203
Sample ID			SFSS00020201	SFSS00020204DUP	SFSS00020202	SFSS00020203
Matrix			Soil	Soil	Soil	Soil
Depth Interval (ft)			0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled			11/26/02	11/26/02	11/26/02	11/26/02
Parameter	Units	Criteria*		Field Duplicate (1-1)		
Polychlorinated Biphenyls						
Aroclor 1016	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1221	UG/KG	1000	42 U	41 U	43 U	54 U
Aroclor 1232	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1242	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1248	UG/KG	1000	22 U	21 U	22 U	28 U
Aroclor 1254	UG/KG	1000	120	120	88 J	15 J
Aroclor 1260	UG/KG	1000	22 U	21 U	22 U	28 U
Metals						
Aluminum	MG/KG	SB	7,550	7,850	7,700	13,500
Antimony	MG/KG	SB	13.4 UJ	11.3 UJ	1.8 BJ	15 UJ
Arsenic	MG/KG	7.5 or SB	8.7 B	7.6 B	15.4	8 B
Barium	MG/KG	300 or SB	120	94.9	1,070	114
Beryllium	MG/KG	0.16 or SB	2.3 U	0.52 B	0.6 B	2 B
Cadmium	MG/KG	1 or SB	3.4 U	2.9 U	2.4 B	3.9 U
Calcium	MG/KG	SB	32,200 J	51,800 J	17,500 J	2,930 J
Chromium	MG/KG	10 or SB	15.4	13.1	17.9	13.8
Cobalt	MG/KG	30 or SB	7.0	6.4	8.2	16.1
Copper	MG/KG	25 or SB	93.5	96.6	87.9	74.1
Iron	MG/KG	2000 or SB	21,700	17,300	13,000	3,900
Lead	MG/KG	SB	221	182	2,150	41.1
Magnesium	MG/KG	SB	11,100	11,300	5,420	317
Manganese	MG/KG	SB	437	406	287	34.9
Mercury	MG/KG	0.1	0.73 B	0.49 B	0.45 B	0.1 B

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels: HWR-94-4046 January 24, 1994 (Revised) - Recommended Soil Cleanup Objective.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria.

SB - Site Background MDL - Method Detection Limit

J - The reported concentration is an estimated value.

B (metals only) - The reported concentration is above the method detection limit but below the quantitation limit.

U - Not detected above the reported quantitation limit. UJ - Not detected. The reported quantitation limit is an estimated value.

Detection Limits shown are PQL

TABLE 1
SOIL ANALYTICAL RESULTS
NYSEG - SENECA FALLS

Location ID			SFSS00020201	SFSS00020201	SFSS00020202	SFSS00020203
Sample ID			SFSS00020201	SFSS00020204DUP	SFSS00020202	SFSS00020203
Matrix			Soil	Soil	Soil	Soil
Depth Interval (ft)			0.0-0.2	0.0-0.2	0.0-0.2	0.0-0.2
Date Sampled			11/26/02	11/26/02	11/26/02	11/26/02
Parameter	Units	Criteria*		Field Duplicate (1-1)		
Metals						
Nickel	MG/KG	13 or SB	17.2	16.2	18.9	26.5
Potassium	MG/KG	SB	2,420 J	2,630 J	1,710 J	1,490 J
Selenium	MG/KG	2 or SB	18.4 UJ	15.5 UJ	2.3 BJ	20.5 UJ
Silver	MG/KG	SB	3.4 U	2.9 U	0.42 B	3.9 U
Sodium	MG/KG	SB	140	186	157	234
Thallium	MG/KG	SB	25.2 U	21.3 U	24.6 U	28.2 U
Vanadium	MG/KG	150 or SB	23.5	19.1	25.1	31.2
Zinc	MG/KG	20 or SB	183	167	1,650	53.9
Miscellaneous Parameters						
Cyanide	UG/KG	-	631 U	599 U	203 B	788 U
Cyanide, Amenable To Chlorination	UG/KG	-	631 U	599 U	203 B	788 U
Phenolics, Total Recoverable	MG/KG	-	1.7	2.9	1.4	0.74

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised) - Recommended Soil Cleanup Objective.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria.

SB - Site Background MDL - Method Detection Limit

J - The reported concentration is an estimated value.

B (metals only) - The reported concentration is above the method detection limit but below the quantitation limit.

U - Not detected above the reported quantitation limit. UJ - Not detected. The reported quantitation limit is an estimated value.

Detection Limits shown are PQL

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TABLE 2

SEMI-VOLATILE ORGANIC, AND INORGANIC COMPOUNDS
DETECTED IN STREAMBED SEDIMENTS AT THE SENECA FALLS, NEW YORK SITE

	(CONCENTRATIONS IN PPM)			
ELEMENT	SE-1	SE-2	SE-3	TYPICAL BACKGROUND CONCENTRATION AT SIMILAR SITES
SEMI-VOLATILE ORGANICS				
Bis(2-ethylhexyl)phthalate	--	0.53J	--	
Dibenzofuran	--	0.38J	5.10	
2-Methylnaphthalene	--	--	2.50J	
NON-CARCINOGENIC PAHS				
Acenaphthene	--	0.78J	7.10	
Acenaphthylene	0.15J	0.62J	1.80J	
Anthracene	0.45J	3.30	14.00	
Fluoranthene	7.90	1.60J	52.00	
Fluorene	--	0.60J	6.60	
Naphthalene	--	--	6.90	
Phenanthrene	1.20	7.60	60.00	
Pyrene	3.30	5.60	25.00	
TOTAL	13.00	20.10	173.40	10.00(1)
CARCINOGENIC PAHS				
Benzo(a)anthracene	4.30	11.00	22.00	
Benzo(b)fluoranthene	4.10	10.00	13.00	
Benzo(k)fluoranthene	0.95J	1.00J	1.40J	
Benzo(g,h,i)perylene	2.10	2.70	8.00	
Benzo(a)pyrene	3.30	6.20	14.00	
Chrysene	2.90	8.00	15.00	
Dibenzo(a,h)anthracene	0.43J	0.73J	1.40J	
Indeno(1,2,3-cd)pyrene	3.10	3.60	12.00	
TOTAL	21.18	43.23	86.80	10.00(1)
INORGANICS				BACKGROUND CONCENTRATIONS
Antimony	180.00	--	--	<1.00(2)
Arsenic	14.00	7.50	13.00	2.60(2)
Calcium	20,000	23,000	74,000	5,200(2)
Copper	1,400	*	*	10.00(2)
Lead	1,900	*	780.00	700.00(2)
Manganese	*	*	780.00	700.00(2)
Mercury	--	0.63	9.10	0.13(2)
Nickel	*	25.00	*	15.00(2)
Cyanide	--	--	--	

-- 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)

TABLE 3

SEMI-VOLATILE ORGANIC, AND INORGANIC COMPOUNDS DETECTED IN SURFACE SOILS AT THE SENECA FALLS, NEW YORK SITE

	(CONCENTRATIONS IN PPM)			
ELEMENT	SS-1	SS-2	SS-3	TYPICAL BACKGROUND CONCENTRATION AT SIMILAR SITES
SEMI-VOLATILE ORGANICS				
NON-CARCINOGENIC PAHS				
Acenaphthylene	1.70J	4.00J	2.50J	
Anthracene	4.60J	6.10J	7.50J	
Fluoranthene	34.00	51.00	56.00	
Fluorene	–	1.60J	1.90J	
Naphthalene	–	0.96J	–	
Phenanthrene	12.00	12.00	16.00	
Pyrene	20.00	24.00	27.00	
TOTAL	72.30	99.66	110.90	10.00(1)
CARCINOGENIC PAHS				
Benzo(a)anthracene	20.00	27.00	39.00	
Benzo(b)fluoranthene	18.00	19.00	37.00	
Benzo(k)fluoranthene	8.00J	3.70J	4.60J	
Benzo(g,h,i)perylene	11.00	2.90J	12.00	
Benzo(a)pyrene	18.00	20.00	25.00	
Chrysene	21.00	21.00	25.00	
Dibenzo(a,h)anthracene	2.70J	2.60J	3.90J	
Indeno(1,2,3-cd)pyrene	15.00	13.00	17.00	
TOTAL	113.70	109.20	163.50	10.00(1)
INORGANICS				BACKGROUND CONCENTRATIONS
Arsenic	5.50	3.30	7.90	2.60(2)
Calcium	43,000	29,000	13,000	5,200(2)
Mercury	–	0.13	0.97	0.13(2)
Nickel	16.00	*	*	15.00(2)
Selenium	–	0.84	–	0.50(2)
Cyanide	–	3.80	6.60	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)