ARCADIS

Infrastructure, environment, buildings

Imagine the result

National Fuel Gas Distribution Corporation

Site Characterization Work Plan

Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

August 2009

ARCADIS

Terry W. Young, P.E.
Principal-In-Charge

Scott A. Powlin
Sr. Geologist

Site Characterization Work Plan

Dunkirk Former Manufactured Gas Plant Site
Dunkirk, New York

Prepared for:
National Fuel Gas Distribution Corporation

Prepared by:
ARCADIS
6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.446.8053

Our Ref.:
B0023301.0000. 00001

Date:
August 2009

Table

Figures

Appendices

1. Introduction

1.1 General

At the request of National Fuel Gas Distribution Corporation (National Fuel), ARCADIS has prepared this work plan for conducting a Site Characterization (SC) at the Dunkirk Former Manufactured Gas Plant (MGP) Site (the "site") in Dunkirk, New York. This SC Work Plan was prepared in response to the New York State Department of Environmental Conservation's (NYSDEC's) December 2, 2008 letter to National Fuel that requested that National Fuel submit a SC Work Plan for the Dunkirk Former MGP site. This SC Work Plan was prepared in general conformance with the NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation.

A draft SC Work Plan was submitted to the NYSDEC in February 2009 and the NYSDEC provided comments on the draft Work Plan that were documented in the following correspondence:

- May 11, 2009 draft comment letter from the NYSDEC
- June 22, 2009 e-mail from ARCADIS in response to the NYSDEC's May 11 comments
- July 22, 2009 e-mail from the NYSDEC requesting one additional boring east of the retorts
- July 30, 2009 e-mail from the NYSDEC requesting potential step-out borings
- July 30, 2009 e-mail from ARCADIS in response to the NYSDEC's July 22 and July 30 requests
- August 4, 2009 e-mail from the NYSDEC accepting the July 30 responses and requesting that National Fuel finalize the Work Plan

This version of the SC Work Plan incorporates the agreements made during the above correspondence and supersedes the February 2009 draft version of the Work Plan.

This SC Work Plan is organized as follows:

- **Section 1: Introduction** — Discusses the SC Objectives, Site Description and History, and a Summary of Previous Investigations and Remedial Activities.
- **Section 2: Soil Investigation** — Describes the tasks to be performed and general methods to be followed to meet the soil investigation objectives.
- **Section 3: Groundwater Investigation** — Describes the tasks to be performed and general methods to be followed to meet the groundwater investigation objectives.
- **Section 4: Survey, Decontamination, and Waste Handling** — Describes general field procedures for survey, waste handling, and decontamination.
- **Section 5: Project Schedule and Reporting** — Provides the anticipated schedule for completing the SC field work and submitting the SC Report.
- **Table 1: Site Characterization Work Plan** — Provides a discussion of the rationale for each of the investigative components.
- **Appendix A: Field Sampling Plan (FSP)** — Contains detailed field procedures and protocols that will be followed during the SC.
- **Appendix B: Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP)** — Presents the analytical methods and procedures that will be used to analyze soil and groundwater samples collected during the SC.
- **Appendix C: Health and Safety Plan (HASP)** — Presents the health and safety procedures, methods, and requirements that will apply to field personnel during implementation of the field work.
- **Appendix D: DNAPL Contingency Plan** — Describes procedures to be followed during drilling to limit the potential for remobilizing dense non-aqueous phase liquid (DNAPL), if encountered.

1.2 SC Objectives

The overall objectives of the SC are to:

- assess whether MGP-related residual materials are present at the site related to the operation of the former MGP.
- determine whether MGP-related residual materials, if present at the site, have a potential to pose a significant threat to public health or the environment.
- determine whether a Remedial Investigation (RI) of the site is appropriate.

The balance of this section describes the site and its history, the previous investigation performed at the site, and the site's geologic setting. Together these form the conceptual site model, or CSM. The CSM provides a standard means to summarize what is known about the site, and to identify what additional information is necessary to characterize the nature and extent of any site-related constituents of interest (COIs), and, if necessary, the risks posed to receptors (if any).

The CSM was used to develop the technical approach to address the above objectives. The CSM identifies potential source areas, such as the former holders, and subsurface hydrogeologic conditions which could play a role in the fate and transport of MPG-related constituents. The technical approach is provided in Sections 2 and 3, and in Table 1.

1.3 Site Description and History

1.3.1 Site Description

The approximately 3 acre site is located at 31 West 2nd Street at the southeastern corner of the intersection of Swan Street and West 2nd Street in Dunkirk, Chautauqua County, New York (Figure 1). The site comprises a generally rectangular piece of land that is now located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south (see Figure 2).

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline. The current site structures are shown on Figure 2.

The site is generally flat-lying and is largely paved with asphalt. A gravel-covered area used for staging gas distribution supplies is found in the southern approximately 1/3 of the site. Small strips of grass areas are located in the rights-of-way along the perimeter of the site and in the northeast corner of the site. A grassy area also exists on the southern edge of the site, near the railroad. The southern property boundary of the site is denoted by a fence that runs between the site and the railroad.

1.3.2 Site History

The MGP operated from the late 1800s to approximately 1910. National Fuel currently owns the site (NFG, 2008). Based on a review of available Sanborn Fire Insurance Maps from 1888 to 1964, at its peak, the MGP consisted of three gas holders (which for the purpose of this Work Plan are numbered sequentially from east to west as holder 1 to holder 3), a retort house, a purifier house, a coal shed, and an oil tank. With the exception of holder 3, (the furthest to the west), the plant structures all existed in the northeast corner of the site. The current Service Center Building sits over at least a portion of holder 2, the retort house, the purifier house, and the coal shed. Figure 2 shows the locations of the former MGP structures as they relate to present-day features. Limited information is available regarding gas production at the Dunkirk MGP; however, a review of the publication “Survey of Town Gas and By-Product Production and Locations in the U.S.” indicates that approximately 7, 23, and 26 million cubic feet of gas was produced at the MGP in 1890, 1900, and 1910 (Radian Corporation, 1985).

Coal was the primary feedstock for the manufactured gas process at the site (Radian Corporation, 1985). This method of producing gas, known as the coal carbonization method, consisted of heating bituminous coal in a sealed chamber (i.e., retorts), with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned (or purified), and distributed while coke was removed and sold or used. The main byproducts of the coal carbonization method were tars, oils, coke, ammoniacal liquor, ash and clinker, and residuals associated with the gas purification process (purifier wastes). The tars were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from a later gas producing process known as the carbureted water-gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

1.4 Summary of Previous Investigation and Remediation Activities

National Fuel has conducted investigation and remediation work to address the presence of petroleum-related materials in the western area of the site, to the immediate west of the Service Center building. A chronology of this work is provided below based on a review of available information. Figure 1 shows the approximate locations of the current and former underground storage tanks (USTs) and impacted soil that was removed.

November 1986 – Reported spill associated with one 6,000 gallon UST. The spill was recorded as Spill #9609959.

1987 – The 6,000 gallon underground storage tank was removed. Petroleum-related materials were observed in the immediately surrounding soil and a quantity of soil was excavated and disposed of along with the tank. The NYSDEC's notes indicate that approximately 80 tons of soil may have been removed during the excavation.

November 1996 – During excavation of a clay tile sewer pipe, employees detected strong petroleum odors from water released from a break in the pipe. The surrounding soils did not appear to contain petroleum-related materials prior to the pipe break, so it was assumed that the odors originated from the pipe break. The NYSDEC and the NYS Department of Health (NYSDOH) were notified. Sampling results indicated concentrations of constituents above the NYSDEC Spill Technology and Remediation Series (STARS) guidance values.

February 1997 – On behalf of National Fuel, Marcor Environmental Remediation, Inc (Marcor) completed an investigation in the area of the broken sewer pipe by using a Geoprobe to advance 16 soil borings and collect soil samples for headspace screening and visual/olfactory characterization. Five soil samples were sent to a laboratory for analysis of USEPA Method 8021 STARS and USEPA Method 8270 STARS. Four of the five samples contained concentrations of petroleum compounds above the STARS guidance values. Marcor concluded that the petroleum related materials were related to releases from the former USTs or piping. Marcor also recommended that the affected soils be remediated.

August 1997 – On behalf of National Fuel, International Waste Removal, Inc. conducted remedial activities to remove the affected soils delineated by Marcor. NYSDEC's notes for this work indicate that the 6,000 gallon UST may have been located in the middle of a "roundhouse foundation". This roundhouse foundation may be the foundation for former holder 3 of the MGP. Post excavation samples still exceeded STARS guidance values, but in a December 29, 1997 letter to National Fuel, the NYSDEC indicated additional work was not necessary because the remaining soil concentrations were low. The NYSDEC stated that the site would be listed as inactive.

April 2002 – On behalf of National Fuel, SLC Environmental Services, Inc. (SLC) conducted a subsurface investigation to delineate the extent of petroleum-related impacts in soil caused by a leaking UST that contained gasoline. SLC advanced 14 soil borings and collected soil samples during the investigation.

July 2002 – SLC removed the above noted UST and approximately 400 tons of non-hazardous petroleum-containing soil. Confirmatory soils samples collected from the sidewalls and bottom of the excavation did not contain detectable concentrations of petroleum constituents. A grab groundwater sample collected from the bottom of the excavation contained trace levels of petroleum-related constituents.

November 2002 – SLC injected Oxygen Releasing Compound (ORC) in a grid of 11 injection points located around the former UST. Three water table monitoring wells were also installed during the program, but the wells were destroyed during plowing activities during the winter of 2002-2003 and could not be sampled.

October 2003 – SLC advanced three soil borings near the three former monitoring wells and collected grab groundwater samples from the open boreholes. Each soil boring was drilled to approximately 11 feet below grade. The results of the sampling indicated that petroleum-related constituents still exist in groundwater, but at levels much lower than levels detected before the remediation work.

1.5 Geologic Setting

Topographic relief at the site is slight, with the land surface gently sloping to the north, in the direction of Lake Erie. The land-surface elevation is approximately 600 feet above mean sea level (AMSL). Given the proximity to the lake and the relatively flat, low-lying topography, the depth to water at the site is expected to be approximately 3 to 5 feet below ground surface. Available boring logs for the previously completed investigations indicate the presence of saturated soils at these depths. Given the proximity to Lake Erie, groundwater flow from the site is expected to be north, in the direction of the lake.

The City of Dunkirk is located along the northern edge of the Erie Lowlands physiographic province of New York State. The Erie Lowlands province is characterized by low plains with little relief. Glacial processes have shaped the geomorphology of the region. The area was buried by glacial ice during the Wisconsin glaciation, which ended approximately 12,500 years ago. During the glaciations and subsequent glacial retreats, glacial ice eroded soil material and bedrock, which were ultimately re-deposited as a mixture of unconsolidated glacial sediment.

The surficial glacial sediments in the area of the site have been mapped as glacio-lacustrine or glacial till deposits which are primarily composed of silts and clays (Cadwell, et al., 1986). Silts and clays were encountered below fill materials in some of the previous borings at depths of approximately 3 to 12 feet below grade. It is likely that these sediments were either deposited in proglacial lakes (glaciolacustrine) which formed on the margin of retreating ice sheets or at the base of an over-riding glacier (glacial till). The permeability of these glacial deposits is expected to be low due to their fine-grained nature. The bedrock beneath the overburden glacial deposits has been mapped as the Upper Devonian age (formed 370 million years ago) Dunkirk Shale (Rickard and Fisher 1970). The bedrock surface can be locally uneven. Previous soil borings were completed to depths between 7 and 12 feet below grade. As such, bedrock is expected to be encountered at depths of at least 12 feet below grade.

2. Soil Investigation

2.1 Soil Investigation Objectives

The objectives of the soil investigation are to:

- assess whether MGP-related residual materials are present in subsurface soil in and around former MGP structures.

- preliminarily assess the depths of former MGP structures and the presence/absence of potential MGP-related residual materials within/near these structures.

- better characterize the nature and distribution of the upper approximately 20 feet of underlying geologic materials.

2.2 Geophysical Survey

In support of the soil investigation, a geophysical survey will be performed using electromagnetic (EM-31) and Ground Penetrating Radar (GPR) surveys in accessible areas of the site and inside the high-bay garage area of the Service Center. The objectives of the geophysical survey are to:

- locate below-grade remnants of former MGP structures (particularly the former holders).

- assess the location of possible underground utilities.

- evaluate the depth to and configuration of the bedrock surface (if the bedrock surface is less than approximately 15 feet below grade).

- fine-tune the locations of soil borings and monitoring wells to be installed during the SC.

The geophysical survey will be the first field task completed during the SC.

2.3 Soil Boring Drilling and Sampling

Two soil borings (SB-1 and SB-2) will be drilled to confirm the presence/absence and depth to the bottom of holders 1 and 2 and to assess the presence/absence of MGP residuals in and around these holders. One soil boring (SB-3) will be drilled to assess the potential presence of MGP-related residual material in the western area of the site. Three soil borings (SB-4, SB-5 and SB-8) will be drilled to investigate potential MGP-related impacts within/near the former retort house. Two soil borings (SB-6 and SB-7) will be drilled to investigate potential MGP-related impacts within/near the former purifier house.

Two soil borings (SB-9 and SB-10) will serve as contingency soil borings and will be positioned between former MGP structures and occupied buildings that are either located on-site or off-site. These borings will be drilled if MGP-related impacts are observed in soil recovered from the initial borings (SB-1 through SB-8). SB-9 would be installed between former gas holder #1 and the Service Center Buildings. SB-10 would be installed between former gas holders #1 and #2 and the Good Hope Baptist Church.

All soil borings will be drilled using a conventional drilling rig and standard hollow-stem auger and split-spoon sampling techniques. Soil samples will be collected continuously at each boring location from grade to their final depth using a 2-inch diameter by 2-feet long split-spoon samplers. Soil recovered from each 2-foot interval will be visually characterized for color, texture, and moisture content in accordance with the Unified Soil Classification System, and headspace-screened with a photoionization detector (PID). The presence of visible staining, NAPL, and obvious odors encountered in the soil will be noted.

Each boring will be drilled to a depth of approximately 20 feet below grade, or until refusal is encountered, whichever is encountered first. Drilling will not be performed through any subsurface structures where significant quantities of NAPL are encountered, in an effort to limit the potential downward migration of NAPL.

Up to two soil samples from each boring will be submitted for laboratory analysis for Target Compound List (TCL) volatile organic compounds (VOCs), semi-VOCS (SVOCs), and total cyanide. Samples will be collected based on visual/olfactory observations and photoionization detector (PID) screening results and submitted to a NYSDOH ELAP approved laboratory. The locations of the proposed soil borings are shown on Figure 2 and the rationale for the proposed work described above is discussed in Table 1.

3. Groundwater Investigation

3.1 Groundwater Investigation Objectives

The objectives of the groundwater investigation are to:

- characterize the general shape of the water table, and develop a preliminary assessment of shallow groundwater flow patterns at the site.

- assess the hydraulic characteristics of the materials screened by the wells.

- determine the presence/absence of MGP-related constituents dissolved in groundwater and if present, whether they are at a concentration in excess of NYSDEC Class GA Standards.

The approach to address each of these objectives is briefly discussed below. Details of the groundwater investigation are presented in Table 1 and the proposed monitoring well locations are shown on Figure 2.

3.2 Groundwater Flow Patterns/Hydraulic Characteristics

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

- installing and developing four overburden water-table monitoring wells, using the methods described in the FSP.

- performing specific-capacity tests on the new monitoring wells during low-flow sampling (discussed below), if subsurface conditions allow.

- conducting two comprehensive fluid-level measurement rounds from all new wells.

The locations of the proposed monitoring wells are shown on Figure 2 and the rationale for the proposed work described above is discussed in Table 1.

3.3 Groundwater Quality Analysis

One round of groundwater samples will be collected from the four monitoring wells to determine the presence/absence of MGP-related constituents dissolved in groundwater. Groundwater samples will be collected from the monitoring wells using the low-flow sampling techniques described in the FSP. Groundwater samples will be submitted to a NYSDOH ELAP approved laboratory and analyzed for TCL VOCs, TCL SVOCs, and total cyanide. Field parameters measured during groundwater sampling will include pH, turbidity, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential (ORP).

4. Survey, Decontamination, and Waste Handling

4.1 Survey

While completing the SC field work, field personnel will mark all investigation locations. A New York State licensed surveyor will then survey the marked locations. Horizontal coordinates will be tied to New York State Plane Central (3102) coordinate system (NAD 83). All elevations will be established with respect to NAVD 1988.

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

4.2 Decontamination

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

4.3 Waste Handling

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

5. Project Schedule and Reporting

5.1 Project Schedule

National Fuel estimates that the field tasks outlined in this SC Work Plan will take approximately four weeks to complete. The soil borings will be completed first, followed by monitoring well installation, groundwater sampling, and water-level measurement. The table below shows the approximate project schedule. The actual project starting date will depend on obtaining NYSDEC's approval of this Work Plan.

Work Activity	Date	Duration
SC Work Plan Approval	August 2009	--
Implement SC Work Plan	October 2009	4 weeks
Submit Draft SC Report	January 2010	--
Submit Final SC Report	February 2010	--

5.2 Reporting

National Fuel will prepare a SC Report once field activities are completed and laboratory data are received. The SC Report will be prepared in general conformance with the NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation. The text of the SC Report will include a discussion of the following general topics:

- Site and project background.
- Field activities completed.
- Methodologies used to complete the field activities.
- Findings of the field activities.
- An understanding of the CSM, including the geologic and hydrogeologic site conditions.
- An understanding of the distribution of MGP-related constituents in the media sampled.
- Recommendations for future work, if any.

The text of the SC Report will be supported by subsurface logs, analytical data summary tables, and figures illustrating site-specific data, including a water-table map and constituent distribution. A Data Usability Summary Report (DUSR) of the laboratory analytical reports will also be prepared. The DUSR will be provided as an appendix in the SC Report.

6. References

Cadwell, et al. 1986. Surficial Geologic Map of New York: Finger Lakes Sheet. New York State Museum – Geological Survey.

Marcor Environmental Remediation, Inc., March 1997. Environmental Subsurface Investigation Report, National Fuel Gas Distribution Corporation, Dunkirk Service Center, 31 West 2nd Street, Dunkirk, NY.

National Fuel Gas Distribution Corporation, 2008. E-mail from Tanya Alexander of National Fuel to Terry W. Young of ARCADIS, dated December 4, 2008, which provided documents containing site information.

Radian Corporation, 1985. Survey of Town Gas and By-Product Production and Locations in the U.S. (1880-1950). USEPA Contract No. 68-02-3137.

Rickard, L. V. and Fisher, D. W., 1970. Geologic Map of New York – Finger Lakes Sheet. New York State Museum and Science Service.

SLC Environmental Services, Inc., October 22, 2003. Letter to National Fuel regarding Field Activities at the National Fuel Service Center Site, Dunkirk, NY.

United States Environmental Protection Agency (USEPA), 1988. U.S. Production of Manufactured Gases: Assessment of Past Disposal Practices. USEPA Contract No. 68-01-6826.

ARCADIS

TABLE

Table 1. Site Characterization Work Plan, National Fuel, Dunkirk Former MGP Site

Location/Activity	Action	Rationale
Geophysical Survey	Use Ground Penetrating Radar (GPR) and electromagnetic (EM-31) equipment to complete a gridded survey in accessible areas of the site and inside the high-bay garage of the Service Center.	GPR and EM-31will be used in an attempt to: • locate below-grade remnants of former MGP structures (particularly holders 1 and 3). • locate underground utilities. • evaluate the depth to and configuration of the bedrock surface (if the bedrock surface is less than approximately 15 feet below grade). • fine-tune the locations of soil borings and monitoring wells to be installed during the SC.
Soil Borings ***SB-1 (inside footprint of holder 1 foundation)*** ***SB-2 (inside footprint of holder 2 foundation)*** ***SB-3 (north of holder 3)*** ***SB-4 and SB-5 (inside footprint of former retort house)*** ***SB-6 and SB-7 (inside footprint of former purifier house)*** ***SB-8 (east of former retort house)*** **Contingent Soil Borings** ***SB-9 (between holder 1 and the Service Center Building)*** ***SB-10 (south of the Service Center Building between holders 1 and 2)***	Soil borings will be continuously-sampled using a conventional drill rig (hollow stem augers and split-spoon sampling). Soil samples will be collected using 2-inch diameter by 2-feet long split-spoon samplers. Soil recovered from each 2-foot interval will be visually characterized for color, texture, and moisture content. The presence of visible discoloration, NAPL, and obvious odors encountered in the soil will be noted. Each boring will be drilled to a depth of approximately 20 feet below grade or until refusal is encountered, whichever is encountered first. Drilling will not be performed through any subsurface structures (e.g., concrete or brick slabs) where significant quantities of NAPL are encountered, in an effort to limit the potential downward migration of NAPL. Drilling may continue to greater depths at such locations at an alternate boring located just outside the footprint of the subsurface structure. This will be determined in the field based on field observations. Submit up to two soil samples from each boring for laboratory analysis for VOCs, SVOCs, and total cyanide. Samples will be collected from interval(s) which contain the greatest indications of MGP related material (if any), based on visual/olfactory observations and photoionization detector (PID) screening results. Samples will also be collected from apparently “clean” intervals to provide information to define the “bottom” extent of impacted areas. If no impacts are observed in a soil boring, one soil sample will be collected near the water table and the other will be collected from the bottom of the boring.	Soil borings will be drilled and sampled for the following specific purposes: • **SB-1**: assess whether MGP-related impacts are present in and beneath holder 1. • **SB-2**: assess whether MGP-related impacts are present in and beneath holder 2. • **SB-3**: evaluate the potential presence of MGP-related impacts in the northwestern corner of the site, downgradient from holder 3. • **SB-4** and **SB-5**: investigate potential MGP-related impacts near/at the former retort house. • **SB-6** and **SB-7**: investigate potential MGP-related impacts near/at the former purifier house. • **SB-8**: investigate potential MGP-related impacts in the northeastern portion of the site, in the vicinity of the former retort house. • **SB-9** and **SB-10**: contingent borings that will be drilled between former MGP structures and occupied buildings if the initial borings encounter MGP-related impacts. In addition to assessing whether impacts are present in the subsurface soil, information from these borings will also be helpful for evaluating the physical soil conditions, such as grain size, content, potential confining units (e.g., clays and silts), and depth to the bedrock surface.

Table 1. Site Characterization Work Plan, National Fuel, Dunkirk Former MGP Site

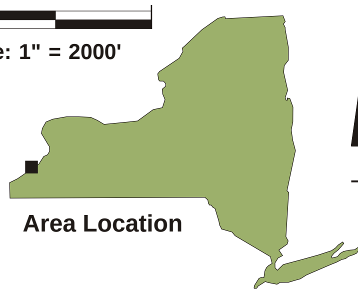
Location/Activity	Action	Rationale
<u>**Monitoring Wells**</u> ***MW-1 (between holder 1 and oil tank)*** ***MW-2 (north of holder 2)*** ***MW-3 (north of holder 3)*** ***MW-4 (southern portion of site, assumed upgradient direction)***	Install and sample groundwater from four water table monitoring wells. Monitoring wells will be constructed of two-inch diameter, schedule 40 PVC and 10-foot long, 0.010-inch slot wells screens. Well screens will be installed so that approximately 9-feet of screen are below the water table. Grouted sumps will be installed if NAPL is observed near the screened interval in quantities that suggest that it may be pooled. The water table is estimated to be encountered at approximately three feet below grade. As such, these wells are anticipated to be installed to approximately 12 feet below grade, assuming bedrock is not encountered shallower than 12 feet below grade. If bedrock is encountered shallower, then the base of the well will coincide with the top of the bedrock and the well screen will need to be shortened accordingly. Well borings will be drilled and sampled in the same manner as the soil borings (described above); however, soil samples will not be submitted for laboratory analysis. Monitoring wells will be developed by surging/purging the saturated portion of the screened interval. An attempt will be made to remove a minimum of 10 well volumes from each well, depending on the yielding capacity of the well. One round of groundwater samples will be collected from the monitoring wells using low-flow sampling techniques and specific-capacity test data will be measured at the new monitoring wells as water is purged during sampling. Groundwater samples will be analyzed for VOCs, SVOCs, and total cyanide. Field parameters measured during groundwater sampling will include pH, turbidity, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential (ORP).	Monitoring wells will be developed to help restore the hydraulic connection between the well screen and the surrounding geologic formation and to help remove fine sediment from the borehole wall and sand pack. Monitoring wells MW-1through MW-4 will be installed for the following specific purposes: • **MW-1**: assess whether dissolved-phase MGP-related impacts are present near and downgradient from holder 1 and the former oil tank. • **MW-2**: assess whether dissolved-phase MGP-related impacts are present downgradient from holder 2. • **MW-3**: assess whether dissolved-phase MGP-related impacts are present downgradient from holder 3. • **MW-4**: evaluate potential background (upgradient) dissolved-phase impacts. Specific-capacity data will be used to estimate the hydraulic conductivity of the saturated material screened by the monitoring wells.
<u>**Water-Level Measurement**</u>	Obtain two synoptic rounds of water-level measurements from the newly installed monitoring wells - one during a relatively wet period and the second during a relatively dry period.	Hydraulic head data will be used to depict the general configuration of the water table and evaluate shallow groundwater flow direction, hydraulic gradients, and seepage velocities at the site.
<u>**Survey**</u>	Determine location and elevation of new wells and soil borings using a licensed land surveyor. Information measured will include the horizontal location and vertical locations of the top of the protective casing, the top of the inner casing, and the ground surface adjacent to the well/piezometer and soil borings.	Provide the information necessary to determine groundwater elevations, location/elevation of subgrade soil horizons or encountered structures.

FIGURES

REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., DUNKIRK, NEW YORK, 1954, PHOTOREVISED 1979.

2000' 0 2000'

Approximate Scale: 1" = 2000'



Area Location

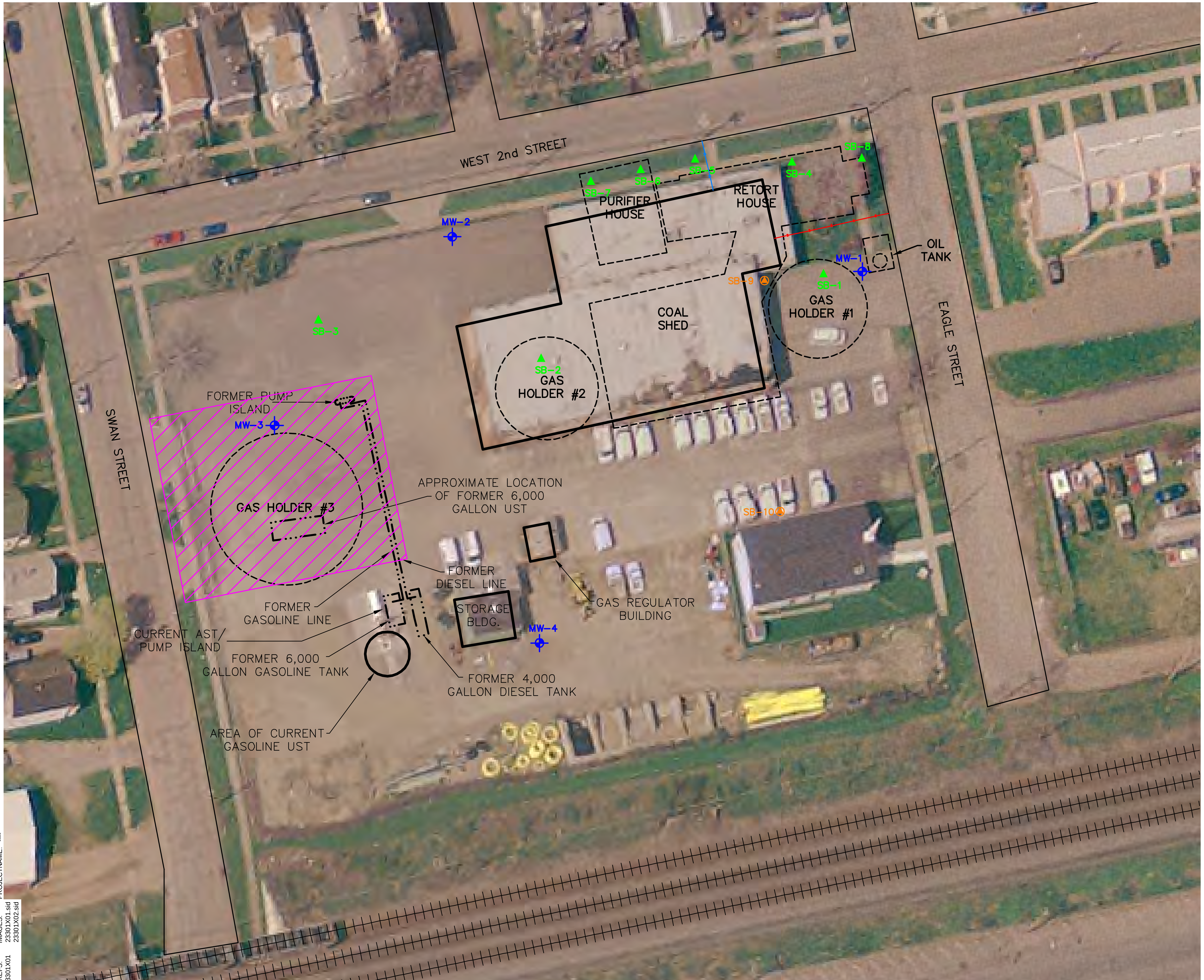
NATIONAL FUEL - DUNKIRK MGP
31 WEST SECOND STREET
DUNKIRK, NEW YORK, 14048

SITE LOCATION MAP

ARCADIS

FIGURE
1

01/29/09 SYRACUSE, NY-ENV/141-DJH
B0023301/0000/00001/CDR/23301N01.CDR



LEGEND:

- PROPOSED SOIL BORING
- CONTINGENT SOIL BORING
- PROPOSED MONITORING WELL
- FORMER MGP STRUCTURE
- FORMER PETROLEUM DISTRIBUTION STRUCTURES
- EXISTING BUILDING
- WATER LINE
- SEWER LINE
- APPROXIMATE EXTENT OF PETROLEUM REMEDIATION AREA

NOTES:

1. ALL LOCATIONS APPROXIMATE.
2. BASEMAP FROM NYS GIS CLEARINGHOUSE WEBPAGE FOR ORTHOIMAGERY. AERIAL PHOTOGRAPH FROM APRIL 2004.
3. APPROXIMATE EXTENT OF PETROLEUM REMEDIATION AREA BASED ON A HAND SKETCH MAP PROVIDED BY NATIONAL FUEL ON JANUARY 26, 2009. DATE OF REMEDIATION NOT DEFINED ON THAT MAP.
4. LOCATIONS OF GAS HOLDERS 2 AND 3 DIGITIZED FROM A MAY 10, 1956 DRAWING PROVIDED BY NATIONAL FUEL. ALL OTHER MGP STRUCTURES DIGITIZED FROM 1893 AND 1904 SANBORN FIRE INSURANCE MAPS.
5. LOCATIONS OF FORMER USTs, PUMP ISLAND, AND ASSOCIATED DISTRIBUTION LINES FROM MESCH ENGINEERING, P.C. DRAWING ENTITLED "SITE PLAN", ORIGINAL DRAWING DATED 9/17/87.

0 50' 100'

GRAPHIC SCALE

NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK
SITE CHARACTERIZATION

PROPOSED INVESTIGATION LOCATIONS

ARCADIS

FIGURE
2

CITY:Syracuse DIV/GROUP:Env-141 DB:AMS, W. JONES LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0023301\0000\00001\DWG\23301B03.dwg LAYOUT: 2SAVED: 8/11/2009 2:37 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: ----PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 8/11/2009 2:38 PM BY: POSENAUER, LISA
XREFS: 23301X01 IMAGES: 23301X01.sid 23301X02.sid PROJECTNAME: ----

ARCADIS

APPENDICES

ARCADIS

Appendix A

Field Sampling Plan

Imagine the result

National Fuel Gas Distribution Corporation

Appendix A
Field Sampling Plan

Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

August 2009

ARCADIS

Terry W. Young
Principal-in-Charge

Scott A. Powlin
Senior Geologist

Appendix A
Field Sampling Plan

Dunkirk Former Manufactured
Gas Plant Site
Dunkirk, New York

Prepared for:
National Fuel Gas Distribution Corporation

Prepared by:
ARCADIS
6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.446.8053

Our Ref.:
B0023301.0000.00001

Date:
August 2009

Table of Contents

Figures

Attachments

1. Introduction

1.1 General

This Field Sampling Plan (FSP) supports the Site Characterization (SC) Work Plan prepared by ARCADIS for the Dunkirk former Manufactured Gas Plant (MGP) Site (the "site") located in Dunkirk, New York. The investigation locations described in the SC Work Plan are shown on Figure 1 of the Work Plan. The SC Work Plan and this FSP were prepared on behalf of National Fuel Gas Distribution Corporation (National Fuel).

This FSP contains field procedures and sample collection methods to be used during implementation of the field activities described in the SC Work Plan. The FSP should be used in conjunction with the SC Work Plan, the Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP), and the Health and Safety Plan (HASP). The SC Work Plan presents the site background and defines the field sampling program. The QA/SAPP outlines the procedures that will be used during the SC to ensure that data collected and subsequent reports are of high enough quality to meet project objectives. The HASP presents the procedures and practices to be followed during the SC field work to help ensure the safety of workers, and is designed to prevent occupational injuries and worker exposures to chemical, physical and biological hazards. The QA/SAPP and HASP are provided in Appendix B and Appendix C, respectively, of the SC Work Plan.

1.2 Project Objectives

The overall objectives of the SC are to:

- assess whether MGP-related residual materials are present at the site related to the operation of the former MGP.
- determine whether MGP-related residual materials, if present at the site, have a potential to pose a significant threat to public health or the environment.
- determine whether a Remedial Investigation (RI) of the site is appropriate.

The technical approach to address the above objectives is provided in Table 1 of the SC Work Plan.

1.3 Overview of Investigation Field Activities

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

- Drilling soil borings
- Installing monitoring wells
- Measuring fluid levels
- Collecting soil samples during the advancement of the monitoring wells and soil borings
- Collecting groundwater samples
- Conducting a geophysical survey
- Conducting a site survey

The sampling locations and quantities for each field sampling activity are described in detail in the SC Work Plan, and therefore, are not further described in this FSP.

1.4 Site Description and History

1.4.1 Site Description

The approximately 3 acre site is located at 31 West 2nd Street at the southeastern corner of the intersection of Swan Street and West 2nd Street in Dunkirk, Chautauqua County, New York (see Figure 1 of the SC Work Plan). The site comprises a generally rectangular piece of land that is now located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south (see Figure 2 of the SC Work Plan).

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline. The current site structures are shown on Figure 2 of the SC Work Plan.

The site is generally flat-lying and is largely paved with asphalt. A gravel-covered area used for staging gas distribution supplies is found in the southern approximately ¼ of the site. Small strips of grass areas are located in the rights-of-way along the perimeter of the site and in the northeast corner of the site. A grassy area also exists on the southern edge of the site, near the railroad.

1.4.2 Site History

The MGP operated from the late 1800s to approximately 1910. National Fuel currently owns the site (NFG, 2008). Based on a review of available Sanborn Fire Insurance Maps from 1888 to 1964, at its peak, the MGP consisted of three gas holders (which for the purpose of this Work Plan are numbered sequentially from east to west as holder 1 to holder 3), a retort house, a purifier house, a coal shed, and an oil tank. With the exception of holder 3, (the furthest to the west), the plant structures all existed in the northeast corner of the site. The current Service Center Building sits over at least a portion of holder 2, the retort house, the purifier house, and the coal shed. Figure 2 of the SC Work Plan shows the locations of the former MGP structures as they relate to present-day features. Limited information is available regarding gas production at the Dunkirk MGP; however, a review of the publication "Survey of Town Gas and By-Product Production and Locations in the U.S." indicates that approximately 7, 23, and 26 million cubic feet of gas was produced at the MGP in 1890, 1900, and 1910 (Radian Corporation, 1985).

Coal was the primary feedstock for the manufactured gas process at the site (Radian Corporation, 1985). This method of producing gas, known as the coal carbonization method, consisted of heating bituminous coal in a sealed chamber (i.e., retorts), with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned (or purified), and distributed while coke was removed and sold or used. The main byproducts of the coal carbonization method were tars, oils, coke, ammoniacal liquor, ash and clinker, and residuals associated with the gas purification process (purifier wastes). The tars were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from a later gas producing process known as the carbureted water-gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

2. Field Activities

2.1 General Field Guidelines

All underground utilities will be identified prior to any drilling or subsurface sampling. Public and privately owned utilities will be located by contacting Dig Safely New York such that responsible agencies can mark their underground utilities at the site. Site access agreements will be obtained prior to conducting any field work on properties not owned by National Fuel. Other potential on site hazards such as traffic, overhead power lines, and building hazards will be identified during a site reconnaissance visit.

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

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

- Name of author, date of entry, and physical/environmental conditions during field activity
- Purpose of sampling activity
- Location of sampling activity
- Name of field crew members
- Name of any site visitors
- Sample media (soil, sediment, 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
- Any field measurements made, such as pH, temperature, conductivity, water-level, etc.

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

2.2 Sample Labeling, Packing, and Shipping

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

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

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

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

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

- One-to-two inches of vermiculite or bubble wrap on the bottom of the cooler
- Water ice packaged in re-sealable plastic bags
- Sufficient vermiculite or bubble wrap to fill in the remaining area
- The completed COC in a re-sealable plastic bag, taped in place on the inside cover of the cooler

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

2.3 Equipment Decontamination

2.3.1 Drill Rig Decontamination

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

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

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

- 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 manufacturer's 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 every entry into each borehole, all non dedicated bowls, spoons, hand augers, bailers, and filtering equipment will be washed with potable water and a detergent (such as Alconox). Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, etc. The sampling equipment will then be rinsed with potable water, followed by a 10% “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% “ultra pure-grade” nitric acid followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. At no time will washed equipment be placed directly on the ground. Equipment will be either be used immediately or wrapped in plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location.

2.4 Drilling Procedures

The drilling and geological logging methods to be used during the subsurface investigation are as follows:

- Boreholes in the overburden will be drilled using hollow stem auger or direct push techniques. If difficult drilling conditions are encountered in the subsurface soils, alternate drilling methods may be used.

- Boreholes drilled using hollow stem augers will be advanced using a drill rig equipped with 3- or 4-inch hollow stem augers. Soil samples will be collected continuously to the bottom of the borings using 2-foot-long, 2-inch diameter discrete split spoon samplers advanced 2 feet per sampling run. Sampling method ASTM D1586-84 (Standard Method for Penetration Test and Split-Barrel Sampling of Soils) will be followed, unless otherwise authorized by the Field Manager/Site Supervisor.

- Boreholes drilled using direct push techniques will be advanced using either a truck or tractor mounted push/percussion drill rig. Soil samples will be collected continuously to the bottom of the borings using 2- or 4-foot-long, 2-inch diameter Macrocore® samplers, equipped with disposable PVC liners, advanced 2 to 4 feet per sampling run.

- For samples that may be submitted for chemical analysis, split spoons will be decontaminated, as specified in Section 2.3.2, between uses. Sample descriptions, photoionization detector (PID) readings, and location will be recorded in the field book.

- Upon completion of each boring, the borehole will be sealed with a bentonite/cement grout tremied in place from the bottom of the borehole up.

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

- Cuttings will be placed in a drum or roll off supplied by National Fuel or the drilling subcontractor. Decontamination water will be placed in drums or plastic tanks supplied by National Fuel 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.

Pertinent notes regarding the drilling work will be recorded in the field book.

2.5 Sample Description

Collected samples will be described by persons who have been trained in ARCADIS soil description procedures and have a degree in geology or a geology-related discipline. The procedure that will be followed for describing soils is contained in Attachment A-1.

2.6 Subsurface Soil Analytical Sampling Procedure

Subsurface soils collected from the unconsolidated fill and soils beneath the site using split spoon or Macrocore® sampling methods 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.
- the discretion of the field manager.

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. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel tray or bowl with a decontaminated stainless steel trowel or disposable scoop. Laboratory-supplied sample containers for other analytes will then be filled. Duplicate samples will be collected at the frequency detailed in the QA/SAPP (Appendix B) by alternately filling two sets of sample containers.

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

- Site
- Boring number
- Interval sampled
- Date
- Initials of sampling personnel

2.7 Monitoring Well Installation and Development

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

2.7.1 Monitoring Well Specifications

Figure A-2 shows details of a typical monitoring well construction for shallow wells installed in unconsolidated soils that do not penetrate a presumed confining layer. The overburden monitoring wells will be installed according to the following specifications:

- PVC 2-inch diameter, threaded, flush-joint casing and 10-foot-long, 0.010-inch or 0.020-inch slot screens will be installed, depending on the grain size of the material being screened.

- A sump, 2 feet in length and grouted in place with cement, may be attached to the bottom of the screen for potential collection of dense non-aqueous phase liquids (DNAPLs), if present.

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

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

- An approximately 2-foot-thick (depending on conditions) 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 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 be protected at the surface with a 4-inch steel casing containing a locking cap. The protective casing will extend approximately 1 to 2 feet below ground surface (bgs) and be set in concrete. In some areas, it may be necessary to provide flush-mounted surface completions.

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

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

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

- Sealant placement method
- Well development procedure
- Type of protective well cap
- Detailed drawing of well (including dimensions)

2.7.2 Monitoring Well Development

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

2.8 Fluid-level Measurements

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

- Decontaminate the water level probe or oil/water interface probe (for wells expected to contain non-aqueous phase liquids [NAPLs]).

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

The measurements will be made in as short a timeframe as practical to minimize temporal fluctuations in hydraulic conditions.

2.9 Low-Flow Groundwater Sampling Procedures for Monitoring Wells

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

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

- Sample pump
- Sample tubing
- Power source (i.e., generator, battery)
- 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
- 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
- COC forms
- Indelible ink pens
- Site map with well locations and groundwater contours maps
- Keys to wells

The following 21 steps detail the monitoring well sampling procedures:

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

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

3. Label all sample containers using an appropriate label.

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

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

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

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

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

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

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

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

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 200 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, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) 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):

    $\pm$0.1 for pH

    $\pm$3% for specific conductance (conductivity)

    $\pm$10 mV for ORP

    $\pm$10% for turbidity and DO

    Note that turbidity and DO usually require the longest time to achieve stabilization. As such, sampling may be allowed prior to stabilization of turbidity and/or DO if all other parameters have stabilized. The decision to sample under this scenario must be agreed to by the Project Manager.

    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 parameters may be taken using a flow-thru cell or in a clean container such as a glass beaker. Measurements of DO should be taken from a sample collected using an in-line tee fitting installed before the tubing outlet, prior to connection to the flow-through cell (if one is being used). DO measurements should be measured using a field test kit (e.g., colorimetric).

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

16. After the groundwater quality parameters have stabilized as discussed above, obtain the groundwater sample needed for analysis directly from the sampling device in the appropriate container and tightly screw on the caps. Note that groundwater samples collected for analysis of VOCs cannot be collected using a peristaltic pump. If purging the well using a peristaltic pump, collect all other types of samples (e.g., SVOCs, inorganics, etc.) prior to collecting the sample for VOC analysis. Once other samples are collected, remove the peristaltic pump tubing and collect the VOC samples using a new disposable polyethylene bailer. The bailer should be gently lowered to the approximate depth that the pump intake was set, and then retrieved.

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

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

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

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

21. Complete the procedures for packaging, shipping, and handling with associated COC forms.

2.10 Geophysical Survey

A geophysical investigation will be performed to assist in the delineation of subsurface structures (e.g., former holder structures, foundation walls, utility locations, etc.) that may be present at the site, and could influence the distribution of MGP-related material. The geophysical investigation will consist of ground penetrating radar (GPR) and electromagnetic (EM) surveys. These surveys will be performed following the general procedures provided below.

2.10.1 EM Survey

The EM survey will be conducted on a 10-foot grid across the accessible areas of the site. This survey is designed to identify anomalies that may be associated with buried former MGP structures and/or areas that have decreased or elevated ground conductivity (as compared to background values), which could represent MGP-related structures or materials.

The EM survey will be performed using a Geonics EM-31 frequency-domain conductivity meter equipped with a digital data recorder. The EM survey data will be collected using vertical dipole orientation with both quadrature (apparent conductivity) and inphase (metal sensitivity) modes. The EM-31 uses a fixed intercoil spacing of 12.1 feet to provide an exploration depth of approximately 16 feet. This exploration depth should be adequate for evaluating subsurface features of interest at the site.

The EM data will be reduced, contoured and evaluated at the site and compared with historic information to determine if any anomalies that are present are associated with past activities. Areas of decrease or elevated EM measurements will be further investigated using GPR. A contour map of the EM measurements will be generated for the geophysical letter report.

2.10.2 Ground Penetrating Radar Survey

The Ground Penetrating Radar (GPR) survey will be performed to further investigate the EM anomalies and any additional locations of interest at the site as identified from historical site information, to characterize subsurface structures. The GPR data will be used to help identify potential locations for confirmatory test pits and/or soil borings.

The GPR survey will be performed using Subsurface Interfacing Radar (SIR) System 3000, manufactured by Geophysical Survey Systems, Inc. (GSSI). The GPR system transmits high-frequency electromagnetic waves into the ground and detects the energy reflected to the surface. Energy is reflected along boundaries of subsurface interfaces that have different electrical properties. Reflections typically occur at lithologic contacts or at changes in subsurface material having high electrical contrasts, including metal objects, concrete structures, and utility pipes. These reflections are detected by an antenna and processed into an electrical signal that is used to create an image of the subsurface feature. The GPR data will be evaluated in the field to determine the location of subsurface features of interest. Subsurface features considered to be of significant interest will be located and marked in the field for potential investigation using intrusive methods (test pits and/or soil borings).

2.11 Air Monitoring

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

The PID and dust monitor readings will be recorded in the field book during trenching and drilling activities. The instruments will be calibrated at least once each day, and more frequently if needed. A detailed procedure for the PID calibration is included as Attachment A-3.

3. Field Instruments

At a minimum, all field screening equipment will be calibrated immediately prior to each day's use. Additional calibration may be required if measurements appear erroneous. The calibration procedures will conform to the manufacturer's standard instructions. Records of all instrument calibration will be maintained by the field personnel. Copies of all of the instrument manuals will be maintained on site by the field personnel.

3.1 Portable Photoionization Analyzer

The photoionization analyzer will be a Photovac MicroTip (or equivalent), equipped with a 10.6 eV lamp or 11.7 eV lamp, depending on the requirements of the HASP. The Photovac is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73% of the TCL VOCs. Calibration will be performed according to the procedures outlined in Attachment A-3.

3.2 Dust Monitor

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

3.3 pH Meter

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

3.4 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 5% to be acceptable.

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.

ARCADIS

Appendix A
Field Sampling Plan

FIGURES

ARCADIS

Figure A-1

Sample Chain-of-Custody Form

ARCADIS
Infrastructure, environment, facilities

ID#: 11999

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:	
Contact & Company Name:	Telephone:
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State):	Project #:
Sampler's Printed Name:	Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:
SO - Soil, SE - Sediment, NL - NAPL/Oil
W - Water, SL - Sludge, SW - Sample Wipe
T - Tissue, A - Air, Other: ______

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix								REMARKS

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: ______	Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by BBL

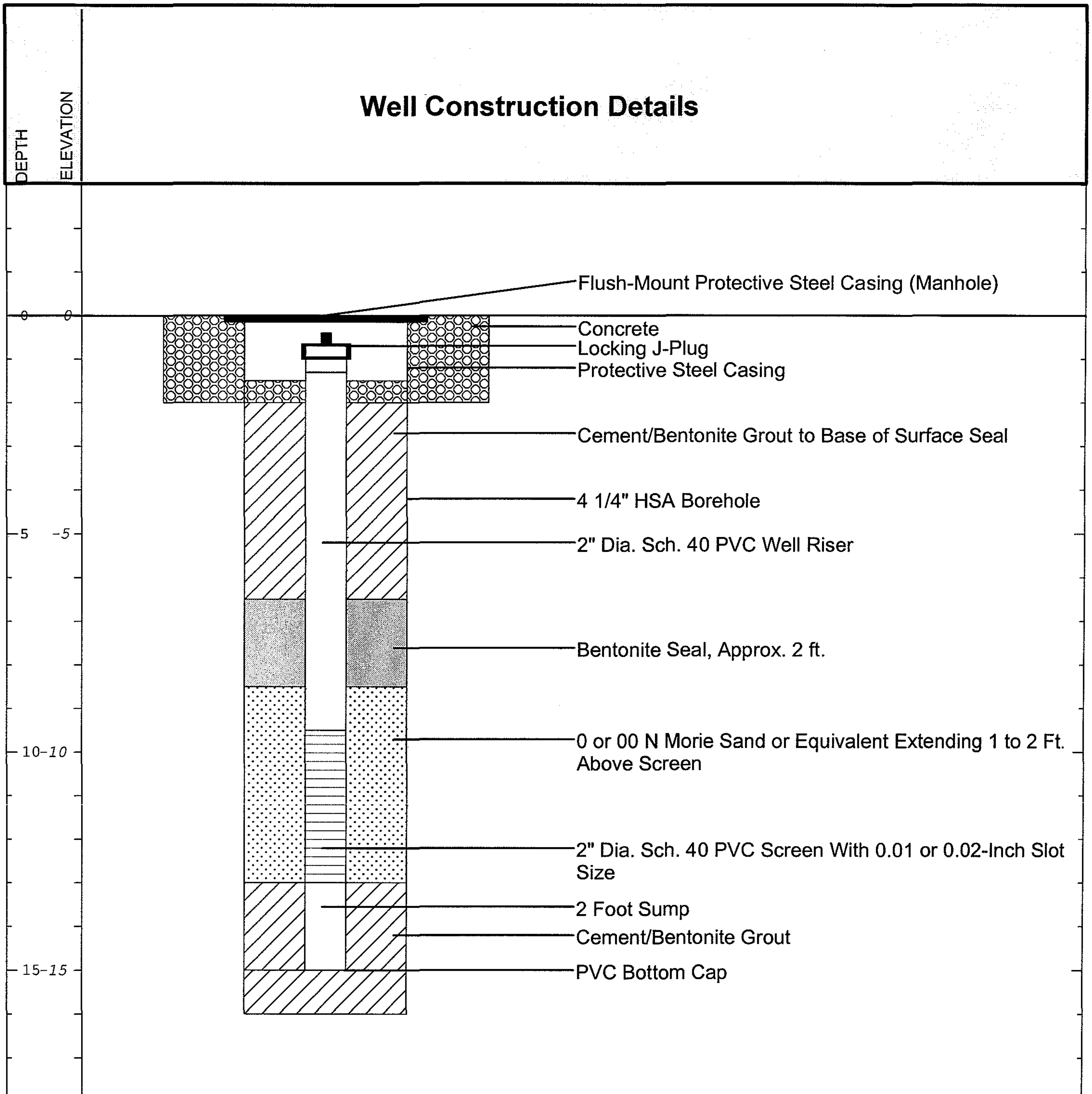
ARCADIS

Figure A-2

Monitoring Well Construction Diagram

Date Start/Finish: **Drilling Company:** **Driller's Name:** **Drilling Method:** **Bit Size:** **Auger Size:** **Rig Type:** **Sampling Method:**	**Northing:** NA **Easting:** NA **Casing Elevation:** NA **Borehole Depth:** **Surface Elevation:** **Descriptions By:**	**Well ID:** **EXAMPLE WELL 1** **Client:** **Location:**

Well Construction Details



ARCADIS BBL
Infrastructure, environment, facilities

Remarks:

ARCADIS

Appendix A
Field Sampling Plan

ATTACHMENTS

Attachment A-1

Soil Description Procedures

Infrastructure, environment, facilities

Imagine the result

Soil Description

Rev. #: 0

Rev Date: May 20, 2008

Approval Signatures

Prepared by: ______________________ Date: 5/22/08

Reviewed by: ______________________ Date: 5/22/08
(Technical Expert)

Reviewed by ______________________ Date: 5/22/08
(Technical Expert)

I. Scope and Application

This ARCADIS standard operating procedure (SOP) describes proper soil description procedures. This SOP should be followed for all unconsolidated material unless there is an established client-required specific SOP or regulatory-required specific SOP. In cases where there is a required specific SOP, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-ARCADIS SOP, additional information required by this SOP should be included in field notes with client approval.

This SOP has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;
- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This SOP incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This SOP does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other ARCADIS SOPS, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

II. Personnel Qualifications

Soil descriptions will be completed only by persons who have been trained in ARCADIS soil description procedures. Field personnel will complete training on the ARCADIS soil description SOP in the office and/or in the field under the guidance of an experienced field geologist. For sites where soil descriptions have not previously been well documented, soil descriptions should be performed only by trained persons with a degree in geology or a geology-related discipline.

III. Equipment List

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this SOP for Soil Descriptions and any project-specific SOP (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera.

IV. Cautions

Drilling and drilling-related hazards including subsurface utilities are discussed in other SOPs and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

V. Health and Safety Considerations

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

VI. Procedure

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, Lexan or acetate sleeves for dual-tube direct push, etc.

2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.

3. Examine all of each individual soil sample (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:

- depth interval;
- principal component with descriptors, as appropriate;
- amount and identification of minor component(s) with descriptors as appropriate;
- moisture;
- consistency/density;
- color; and
- additional description or comments (recorded as notes).

The above is described more fully below.

DEPTH

To measure and record the depth below ground level (bgl) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.

2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).

3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.

4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth's scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the field gauge card that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves s recommended to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is recommended for determining presence and estimating percentage of clay and silt.

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be “Pebbles”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “Fine to coarse Sand” or for a sample that was 40% silt and 45% clay the principal component would be “Clay and Silt”.

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the ARCADIS Soil Description Field Guide.

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

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (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.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Nonplastic	A $^{1}/_{8}$ inch (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 rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.

- Smooth the ball in the palm of one hand with a small spatula.

- Shake horizontally, striking the side of the hand vigorously with 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 not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

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.

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25 % silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 5) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for the silt and clay. Dilatancy should be provided for silt and silt-sand mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. ARCADIS prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

- Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes)

- Poorly sorted – a wide range of particle sizes are present

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

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

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. For SPT blow counts the N-value is used. The N-value is the blows per foot for the 6" to 18" interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6" to12", the third interval is 12" to 18", the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- **Odor -** You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH "Pocket Guide to Chemical Hazards", e.g. "pungent" or "sweet" and should not indicate specific chemicals such as "phenol-like" odor or "BTEX" odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts)
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy
- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance)
- Reaction with HCl (typically used only for special soil conditions)
- Origin, if known (capital letters: LACUSTRINE; FILL; etc.)

EXAMPLE DESCRIPTIONS

51.4 to 54.0’ Clay, some silt, medium to high plasticity; trace small to large pebbles, subround to subangular up to 2” diameter; moist; stiff; dark grayish brown (10YR 4/2) NOTE: Lacustrine; laminated 0.01 to 0.02 feet thick, laminations brownish yellow (10 YR 4/3).

32.5 to 38.0’ Sand, medium to Pebbles, coarse; sub-round to sub-angular; trace silt; poorly sorted; wet; grayish brown (10YR5/2). NOTE: sedimentary, igneous and metamorphic particles.

Unlike the first example where a density of cohesive soils could be estimated, this rotosonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose Sand and Pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth

- Principal Components
    - Angularity for very coarse sand and larger particles
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

VII. Waste Management

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

VIII. Data Recording and Management

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. Two examples of standard boring logs are presented below.

The general scheme for soil logging entries is presented above; however, depending on task/project DQOs, specific logging entries that are not applicable to task/project goals may be omitted at the project manager's discretion. In any case, use of a consistent logging procedure is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or log book and a label showing this information in the photo is useful.

ARCADIS Page ____ of ____

Sample Log

Well/Boring ____________ Project Name and No. ____________

Site Location ____________ Drilling Started ____________ Drilling Completed ____________

Total Depth Drilled ________ feet Hole Diameter ________ inches Sampling Interval ________ feet

Length and Diameter of Sampling Device ____________ Type of Sampling Device ____________

Drilling Method ____________ Drilling Fluid Used ____________

Drilling Contractor ____________ Driller ____________ Helper ____________

Prepared By ____________ Hammer Weight ____________ Hammer Drop ________ Inches

Sample Depth (feet below land surface) From	To	Sample Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample Description	PID (ppm)

http://team/Sites/Offices/North/Northeast Area/Northeast Area Geoscience Forms/Sample Core Log XLS - Sheet1

IX. Quality Assurance

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

X. References

ARCADIS Soil Description Field Guide, 2008 (in progress)

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 “Munsell® Color Soil Color Charts

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 “Sand Grain Sizing Folder”

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48

NIOSH Pocket Guide to Chemical Hazards

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63

ARCADIS

Attachment A-2

Field Sampling Log

Site | Event

GROUND-WATER SAMPLING LOG

Sampling Personnel: | **Well ID:**
Client / Job Number: | **Date:**
Weather: | **Time In:** | **Time Out:**

Well Information

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

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

Purging Information

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

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

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

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

Sampling Information

Analyses	#	Laboratory
Sample ID:		Sample Time:
MS/MSD:	Yes	No
Duplicate:	Yes	No
Duplicate ID		Dup. Time:
Chain of Custody Signed By:		

Problems / Observations

ARCADIS

Attachment A-3

MicroTIP Photoionization Detector Calibration, Operation, and Maintenance Procedures

Attachment A-3. Photovac MicroTIP Photoionization Detector Calibration, Operation & Maintenance Procedures

I. Introduction

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

II. Materials

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

III. Calibration Procedures

1. Turn on the MicroTIP and monitor the ambient air. If there is any doubt of the air quality, then zero grade gas will be obtained.
2. Connect the regulator to the span gas cylinder. Hand-tighten the fittings.
3. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
4. Attach the gas bag to the regulator. Hand-tighten the fittings.
5. Turn the regulator knob counterclockwise half a turn to start the gas flow.

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

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

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

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

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

11. When MicroTIP's display reverts to normal, the MicroTIP is calibrated and ready to use. Remove the Span Gas from the inlet.

12. After seven hours of use, recharge the battery pack. Record the time the battery pack was charged on the MicroTIP Calibration and Maintenance Log.

13. Record the date, time, your initials, calibration gas, and concentration on the Micro TIP Calibration and Maintenance Log.

IV. Operation Procedures

1. Use the health and safety equipment as required by the Health and Safety Plan.

2. Calibrate the instrument as described in subsection III of this Appendix.

3. Measure and record the background PID reading.

4. If the PID will be used for more than seven hours during optimal weather conditions (50º or greater), or during extreme cold or precipitation, have a fully charged battery available for use.

5. In the event of precipitation, fully cover the instrument, leaving the probe accessible for measurements.

6. Measure and record PID reading.

V. Maintenance Procedures

1. At the end of each day or when the battery is fully discharged, recharge batteries overnight.

2. Store the instrument in the protective case when not in use.

3. Keep records of operation, maintenance, calibration problems, and repairs.

4. A replacement instrument will be available on site or ready for overnight shipment, if necessary.

5. The MicroTIP will be sent back to the manufacturer for service if needed.

ARCADIS

Appendix B

Quality Assurance Sampling and Analysis Project Plan

Infrastructure, environment, facilities

Imagine the result

National Fuel Gas Distribution Corporation

Appendix B
Quality Assurance Sampling and Analysis Project Plan

Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

August 2009

ARCADIS

Terry W. Young
Principal-in-Charge

Scott A. Powlin
Senior Geologist

Dennis K. Capria

Dennis Capria
Quality Assurance Manager

Appendix B
Quality Assurance Sampling and Analysis Project Plan

Dunkirk Former Manufactured Gas Plant Site
Dunkirk, New York

Prepared for:
National Fuel Gas Distribution Corporation

Prepared by:
ARCADIS
6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.446.8053

Our Ref.:
B0023301.0000.00001

Date:
August 2009

Table of Contents

Tables

Preface

This Quality Assurance Sampling and Analysis Project Plan (QASAPP) presents the sampling and analytical methods and procedures that will be used during implementation of the Site Characterization Work Plan (SC) at the Dunkirk Former Manufactured Gas Plant (MGP) Site in Dunkirk, New York. The QASAPP should be used in conjunction with the SC Work Plan, the Field Sampling Plan (FSP), and the Health and Safety Plan (HASP). The SC Work Plan presents the site background and defines the field sampling program. The FSP contains field procedures and sample collection methods to be used during implementation of the SC Work Plan. The HASP provides a mechanism for establishing safe working conditions at the site. The FSP and HASP are provided in Appendix A and Appendix C, respectively, of the SC Work Plan.

This QASAPP was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) "Test Methods for Evaluating Solid Waste, SW-846" (USEPA, 1996).

- The USEPA's guidance document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Operations, "EPA-QA/R-5 (USEPA, 2001), which replaces QAMS-005/80 "Interim Guidance and Specifications for Preparing Quality Assurance Project Plans" (USEPA, 1980).

- The National Enforcement Investigations Center (NEIC) Policies and Procedures Manual (USEPA, 1991).

Information contained in this QASAPP has been organized into the following sections:

Section	Content
Project Management	
1	Project Organization
2	Project Background
3	Project Description
4	Quality Objectives and Criteria for Measurement Data
5	Specialized Training Requirements/Certification
6	Documentation and Records

Section	Content
Measurement/Data Acquisition	
7	Sampling Process Design
8	Sampling Method Requirements
9	Sample Handling and Custody Requirements
10	Analytical Method Requirements
11	Quality Control Requirements
12	Instrument/Equipment Testing, Inspection, and Maintenance Requirements
13	Instrument Calibration and Frequency
14	Inspection/Acceptance Requirements for Supplies and Consumables
15	Data Acquisition Requirements for Nondirect Measurements
16	Data Management
Assessment/Oversight	
17	Assessment and Response Actions
18	Reports to Management
Data Validation and Usability	
19	Data Review, Validation, and Verification
20	Validation and Verification methods
21	Reconciliation with User Requirements

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

1. Project Organization and Responsibilities

1.1 Project Organization

The Dunkirk Former Manufactured Gas Plant (MGP) Site in Dunkirk, 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 in Section 2.2.

1.1.1 Overall Project Management

ARCADIS, on behalf of National Fuel Gas Distribution Corporation (National Fuel), has overall technical responsibility for the Site Characterization (SC). ARCADIS personnel will perform the tasks and subtasks presented in Section 3 and will be responsible for evaluating resultant investigation data, and preparing the SC deliverables specified in the Work Plan. Project direction and oversight will be provided by National Fuel personnel. A listing of project management personnel and their responsibilities is provided below.

Title	Company/ Organization	Name	Phone Number
Project Manager	National Fuel	Tanya B. Alexander, CHMM, REM	716.857.7410
Principal in Charge	ARCADIS	Terry W. Young	315.446.9120
Project Manager	ARCADIS	Scott A. Powlin	315.446.9120
Field Activities Task Manager	ARCADIS	TBD	NA

1.1.2 Analytical Laboratory Services and Subcontractors

Subcontractors for the analytical and drilling work have not yet been selected; however, laboratory subcontractors will be ELAP-approved, and drilling subcontractor will be licensed in New York State.

Title	Company/ Organization	Name	Phone Number
Laboratory Project Manager	TBD	NA	NA
Driller	TBD	NA	NA

1.1.3 Quality Assurance Staff

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

Title	Company/ Organization	Name	Phone Number
Quality Assurance Manager	ARCADIS	Dennis Capria	315.446.9120
Quality Assurance Officer	TBD	NA	NA

1.2 Team Member Responsibilities

This section of the QASAPP discusses the responsibilities and duties of the project team members.

1.2.1 National Fuel

<u>Project Manager</u>

1. Overall direction of the SC

2. Review of ARCADIS work products

1.2.2 ARCADIS

<u>Principal in Charge</u>

1. Oversight of the ARCADIS SC work products

2. Provide ARCADIS approval for major project deliverables

<u>Project Manager</u>

1. Management and coordination of all aspects of the project as defined in the SC Work Plan with an emphasis on adhering to the project objectives

2. Reviews SC Report and all documents prepared by ARCADIS

3. Assures corrective actions are taken for deficiencies cited during audits of the SC activities

Field Activities Task Manager

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

Field Personnel

1. Perform field procedures associated with the tasks and subtasks presented in 1.3.1 (above)
2. Perform field analyses and collect QA samples

3. Calibrate, operate, and maintain field equipment

4. Reduce field data

5. Maintain sample custody

6. Prepare field records and logs

<u>Quality Assurance Manager</u>

1. Review laboratory data packages

2. Oversee and interface with the analytical laboratories

3. Coordinate field QA/QC activities with task managers, including audits of SC activities, concentrating on field analytical measurements and practices to meet DQOs

4. Review field reports

5. Review audit reports

6. Prepare QA/QC report which includes an evaluation of field and laboratory data and data validation reports

1.2.3 Laboratory Subcontractor

General responsibilities and duties include:

1. Perform sample analyses

2. Supply sample containers and shipping cartons

3. Maintain laboratory custody of samples

4. Strictly adhere to laboratory protocols

Laboratory Project Manager

1. Serve as primary communication link between ARCADIS and laboratory staff

2. Monitor workloads and ensure availability of resources

3. Oversee preparation of analytical reports

4. Supervise in-house chain-of-custody

Quality Assurance Officer

1. Supervise technical staff in QA/QC procedures

2. Conduct audits of all laboratory activities

Data Validator

1. Provide independent validation of analytical data

File Custodian

1. Responsible for maintaining project file with original and pertinent documentation

Database Administrator

1. Responsible for maintaining project database

Drilling Subcontractor

1. Performance of groundwater monitoring well installations and test borings in accordance with the SC protocols

2. Decontamination of drilling and sampling equipment

2. Project Background

The following summarizes background information for the site. Additional information can be found in the SC Work Plan.

2.1 Site Description and History

2.1.1 Site Description

The approximately 3 acre site is located at 31 West 2nd Street at the southeastern corner of the intersection of Swan Street and West 2nd Street in Dunkirk, Chautauqua County, New York (see Figure 1 of the SC Work Plan). The site comprises a generally rectangular piece of land that is now located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south (see Figure 2 of the SC Work Plan).

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline. The current site structures are shown on Figure 2 of the SC Work Plan.

The site is generally flat-lying and is largely paved with asphalt. A gravel-covered area used for staging gas distribution supplies is found in the southern approximately ¼ of the site. Small strips of grass areas are located in the rights-of-way along the perimeter of the site and in the northeast corner of the site. A grassy area also exists on the southern edge of the site, near the railroad.

2.1.2 Site History

The MGP operated from the late 1800s to approximately 1910. National Fuel currently owns the site (NFG, 2008). Based on a review of available Sanborn Fire Insurance Maps from 1888 to 1964, at its peak, the MGP consisted of three gas holders (which for the purpose of this Work Plan are numbered sequentially from east to west as holder 1 to holder 3), a retort house, a purifier house, a coal shed, and an oil tank. With the exception of holder 3, (the furthest to the west), the plant structures all existed in the northeast corner of the site. The current Service Center Building sits over at least a portion of holder 2, the retort house, the purifier house, and the coal shed. Figure 2 of the SC Work Plan shows the locations of the former MGP structures as they relate to present-day features. Limited information is available regarding gas production at the Dunkirk MGP; however, a review of the publication "Survey of Town Gas and By-Product Production and Locations in the U.S." indicates that approximately 7, 23, and 26 million cubic feet of gas was produced at the MGP in 1890, 1900, and 1910 (Radian Corporation, 1985).

Coal was the primary feedstock for the manufactured gas process at the site (Radian Corporation, 1985). This method of producing gas, known as the coal carbonization method, consisted of heating bituminous coal in a sealed chamber (i.e., retorts), with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned (or purified), and distributed while coke was removed and sold or used. The main byproducts of the coal carbonization method were tars, oils, coke, ammoniacal liquor, ash and clinker, and residuals associated with the gas purification process (purifier wastes). The tars were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from a later gas producing process known as the carbureted water-gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

2.2 SC Objectives

The overall objectives of the SC are to:

- assess whether MGP-related residual materials are present at the site related to the operation of the former MGP.
- determine whether MGP-related residual materials, if present at the site, have a potential to pose a significant threat to public health or the environment.
- determine whether a Remedial Investigation (RI) of the site is appropriate.

The technical approach to address the above objectives is provided in Table 1 of the SC Work Plan.

3. Project Description

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

- Soil Investigation
- Groundwater Investigation
- Geophysical Survey

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

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

3.1 Soil Investigation

The objectives of the soil investigation are to:

- assess whether MGP-related residual materials are present in subsurface soil in and around former MGP structures.

- preliminarily assess the depths of holders 1 and 2 and the presence/absence of potential MGP-related residual materials within the holders.

- better characterize the nature and distribution of the upper approximately 20 feet of underlying geologic materials.

3.2 Groundwater Investigation

The objectives of the groundwater investigation are to:

- characterize the general shape of the water table, and develop a preliminary assessment of shallow groundwater flow patterns at the site.

- assess the hydraulic characteristics of the materials screened by the wells.

- determine the presence/absence of MGP-related constituents dissolved in groundwater and if present, whether they are at a concentration in excess of NYSDEC Class GA Standards.

3.3 Geophysical Survey

A geophysical survey will be performed using electromagnetic (EM-31) and Ground Penetrating Radar (GPR) surveys in accessible areas of the site and inside the high-bay garage area of the Service Center. The objectives of the geophysical survey are to:

- locate below-grade remnants of former MGP structures (particularly the former holders).

- assess the location of possible underground utilities.

- evaluate the depth to and configuration of the bedrock surface (if the bedrock surface is less than approximately 15 feet below grade).

- fine-tune the locations of soil borings and monitoring wells to be installed during the SC.

The geophysical survey will be the first field task completed during the SC.

4. Quality Objectives and Criteria for Measurement Data

The DQO process, as described in the USEPA QA/G-5 QASAPP instructions document (USEPA, 2002b), 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 USEPA QA/G-5 QASAPP DQO process.

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

Step 1: State the Problem

The SC will be conducted at the site to evaluate the presence and extent of MGP and/or non-MGP constituents of concern 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: Identify the Goal of the Study

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 exposure 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: Identify Information Inputs

Decision inputs incorporate both concentration and distribution of constitutes of concern in site media. 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 evaluate whether there are unacceptable risks to human health and the environment at the site.

The data will be evaluated for completeness, general conformance with requirements of this QASAPP and consistency among data sets, and with historical data, as appropriate.

Step 4: Define the Boundaries of the Study

The boundaries of the study area include the site (property owned by National Fuel) which is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad to the south.

Step 5: Develop the Analytical Approach

The decision on whether data can be used in the pre-qualification and post-excavation confirmation evaluation will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions noted. The Sampling and Analysis Plan (SAP) has been devised so that the loss of any single data point will not hinder description of the distribution of constitutes of concern or the development of a risk assessment. Given this, a reasonable decision rule would be that 90 percent of the data points not be rejected and deemed unusable for exposure evaluation purposes. Applicable actions would be evaluated, if needed, based on the results of the exposure evaluation.

Step 6: Specify Performance or Acceptance Criteria

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 QASAPP has been designed to meet both specifications for this step. The sampling and analysis program has been developed based on a review of previous site data and knowledge of present site conditions. Corrective actions are described elsewhere in this QASAPP and in the appended documents. The representative nature of the sampling design has been determined by discussions among professionals familiar with the site and the appropriate government agencies.

Step 7: Develop the Plan for Obtaining Data

The overall QA objective is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting that will provide results to support the evaluation of site data consistent with National Contingency Plan requirements. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, data reporting, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QASAPP.

The SAP 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.

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

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

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

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

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

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

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

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

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

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

The analytical methods to be used during the SC will be USEPA SW-846 methods with New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP) Revision 2005, QA/QC requirements and Category B reporting deliverables.

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

- Task 1 – Soil Sampling
- Task 2 – Groundwater Sampling

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

4.1 DQOs for Task 1 – Soil Sampling

As described in the SC Work Plan, numerous soil borings will be drilled to investigate the MGP structures and the nature of the native and fill materials. Numerous surface and subsurface soil samples will be collected and submitted for laboratory analysis for the following:

- Method 8260 for TCL VOCs
- Method 8270 for TCL SVOCs
- Method 9010 or 9012 for cyanide

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

4.2 DQOs for Task 2 – Groundwater Sampling

This task involves the installation of monitoring wells and collecting one round of groundwater samples from the monitoring wells. The resulting groundwater-quality data will be used to determine the presence and level of potentially MGP-related constituents dissolved in groundwater. The number of samples that will be collected, including QA/QC samples, is summarized in Table B-1. Table B-2 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

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

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

Groundwater samples will be analyzed according to the following methods:

- Method 8260 for TCL VOCs
- Method 8270 for TCL SVOCs
- Method 9010 or 9012 for cyanide

5. Special Training Requirements/Certification

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

6. Documentation and Records

6.1 General

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

6.2 Field Documentation

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

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

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

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

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

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

- 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

6.3.1 Laboratory Project Files

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

6.3.2 Laboratory Logbooks

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

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

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

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

6.3.3 Computer Tape and Hard Copy Storage

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

6.4 Data Reporting Requirements

6.4.1 Field Data Reporting

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

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

6.4.2 Laboratory Data Reporting

The laboratory is responsible for preparing ASP Category B data packages for all VOC, SVOC, and TAL Inorganic (including cyanide and total organic carbon), reduced data packages, and case narratives for all other analyses.

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

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

- Laboratory name and address
- Date of sample receipt
- Cross reference of laboratory identification number to contractor sample identification
- Analytical methods used
- Deviations from specified protocol
- 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
- 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 TCL VOC, TCL SVOC, and total cyanide analyses will be expanded to include all supporting documentation necessary to provide a Category B package. This additional documentation will include, but is not limited to, all raw data required to recalculate any result, including printouts, chromatograms, and quantitation reports. The report also will include: standards used in calibration and calculation of analytical results; sample extraction; digestion; and other preparation logs; standard preparation logs, instrument run logs; and moisture content calculations.

6.5 Project File

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

1. Agreements (file chronologically)

2. Correspondence (filed chronologically)

3. Memos (file chronologically)

4. Notes and Data (filed by topic)

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

7. Sampling Process Design

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

8. Sampling Method Requirements

Surface and subsurface soil, groundwater, soil vapor, and sediment samples will be collected as described in the SC Work Plan and the FSP. The FSP also contains the procedures that will be followed to collect split-spoon samples; install monitoring wells; measure water levels; install soil vapor points; conduct sediment probing; perform field measurements; and handle, package, and ship collected samples.

9. Sample Handling and Custody Requirements

9.1 Sample Containers and Preservation

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

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

9.2 Packing, Handling, and Shipping Requirements

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

Samples will be packaged for shipment as outlined below:

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

- Ice layer.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place COC forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock, and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating "this side up." Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

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

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

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

9.3 Field Custody Procedures

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

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

9.3.1 Field Logbooks

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

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

- Person to whom the logbook is assigned
- Logbook number
- Project name
- Project start date
- End date

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

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

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

9.3.2 Sample Labeling

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

- Project
- Date collected
- Time collected
- Location
- Sampler
- Analysis to be performed
- Preservative
- Sample number

9.3.3 Field Chain-of-Custody Forms

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

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

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

9.4 Management of Investigation-Derived Materials and Wastes

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

9.5 Laboratory Procedures

9.5.1 General

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

9.5.2 Sample Receipt and Storage

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

9.5.3 Sample Chain-of-Custody and Documentation

Laboratory chain-of-custody and documentation will follow procedures consistent with Exhibit F of the NYSDEC ASP 2005.

9.5.4 Sample Analysis

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

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

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

9.5.5 Sample Storage Following Analysis

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

10. Analytical Procedures

10.1 Field Analytical Procedures

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

10.2 Laboratory Analytical Procedures

Laboratory analytical requirements presented in the sub-sections below include a general summary of requirements, specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. SW-846 methods with NYSDEC, ASP, 2005 Revision, QA/QC and reporting deliverables requirements will be used for all analytes.

10.2.1 General

The following tables summarize general analytical requirements:

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

10.2.2 SC Sample Matrices

10.2.2.1 Surface/Subsurface Soil and Sediments

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

10.2.2.2 Groundwater

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

10.2.2.3 Soil Vapor

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

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 2005 Revision, QA/QC and reporting deliverables requirements. Detailed information regarding quality control procedures including matrix spike, matrix spike duplicates, matrix spike blanks, and surrogate recoveries is provided in NYSDEC, ASP 2005 Revision, Exhibit E.

11. Quality Control Requirements

11.1 Quality Assurance Indicators

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

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

1. Representativeness

2. Comparability

3. Completeness

4. Precision

5. Accuracy

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

11.1.1 Representativeness

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

11.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between this investigation, and to the extent possible, with existing data will be maintained through consistent sampling and analytical methodology set forth in the FSP and this QASAPP, SW-846 analytical methods with NYSDEC ASP Revision 2005 QA/QC requirements and Category B reporting deliverables, and through use of QA/QC procedures and appropriately trained personnel.

11.1.3 Completeness

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

11.1.4 Precision

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

11.1.5 Accuracy

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

11.2 Field Quality Control Checks

11.2.1 Field Measurements

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

11.2.2 Sample Containers

Certified-clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2005 (Eagle Picher pre-cleaned containers or equivalent) will be supplied by the laboratory.

11.2.3 Field Duplicates

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

11.2.4 Rinse Blanks

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

11.2.5 Trip Blanks

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

11.3 Analytical Laboratory Quality Control Checks

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

11.3.1 Method Blanks

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

11.3.2 Matrix Spike/Matrix Spike Duplicates

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

11.3.3 Surrogate Spikes

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

11.3.4 Laboratory Duplicates

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

11.3.5 Calibration Standards

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

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

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

11.3.6 Internal Standards

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

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

11.3.7 Reference Standards/Control Samples

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

11.4 Data Precision Assessment Procedures

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

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

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

The RPD can be calculated by the following equation:

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

Where:

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

Precision objectives for matrix spike duplicate and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2005.

11.5 Data Accuracy Assessment Procedures

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

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

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

Where:

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

This formula is derived under the assumption of constant accuracy over the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for matrix spike recoveries and surrogate recovery objectives are identified in the NYSDEC ASP, 2005 Revision.

11.6 Data Completeness Assessment Procedures

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

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

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

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

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

12.1 Field Instruments and Equipment

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

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

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

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

12.2 Laboratory Instruments and Equipment

12.2.1 General

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

12.2.2 Instrument Maintenance

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

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

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

12.2.3 Equipment Monitoring

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

13. Instrument Calibration and Frequency

13.1 Field Equipment Calibration Procedures and Frequency

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

13.2 Laboratory Equipment Calibration Procedures and Frequency

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

<u>Volatile Organics, Semivolatile Organics, Cyanide (total) and Total Organic Carbon (TOC)</u>

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit E.

<u>Total Organic Carbon</u>

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

14. Inspection/Acceptance Requirements for Supplies and Consumables

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

15. Data Acquisition Requirements for Nondirect Measurements

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

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

- Identification of analytical levels
- Evaluation of QC data, when available
- Development of conclusions regarding the acceptability of the data for intended uses

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

16. Data Management

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

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

The data management plan has five elements:

1. Sample designation system

2. Field activities

3. Sample tracking and management

4. Data management system

5. Document control and inventory

16.1 Sample Designation System

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

16.2 Field Activities

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

16.2.1 Field Documentation

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

- Field logs
- Instrument calibration records
- Chain-of-custody forms

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

<u>Field Logs</u>

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

<u>Instrument Calibration Records</u>

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
- Information on calibration success or failure

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

Chain-of-Custody Forms

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

16.2.2 Data Security

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

16.3 Sample Management and Tracking

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

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

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

16.4 Data Management System

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

16.4.1 Computer Hardware

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

16.4.2 Computer Software

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

16.4.3 Surveying Information

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

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

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

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

16.4.4 Analytical Results

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

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

Following completion of the data validation, the digital files will be used to populate the appropriate database tables. An example of the format of electronic data deliverable (EDD) format is included in Table B-5. This format specifies one data record for each constituent for each sample analyzed. Specific fields include:

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

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

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

16.4.5 Data Analysis and Reporting

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

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

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

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

16.5 Document Control and Inventory

ARCADIS maintains project files in its Syracuse, New York office. Each client project is assigned a file/job number. Each file is then broken down into the following subfiles:

- #1- Agreements and Contracts - all agreements and contracts involving the off-site investigations

- #2- Correspondence - all external correspondence, including reports

- #3- Memoranda - all internal and external memoranda
- #4- Notes and Data - notes and data from field, laboratory, and internal calculations
- #5- News Clippings - local newspapers, regulatory publications, and technical publications are sources of articles

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

17. Assessment and Response Actions

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

17.1 Field Audits

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

17.1.1 Performance Audits

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

17.1.2 Internal Systems Audits

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

17.2 Laboratory Audits

The laboratory will perform internal audits consistent with NYSDEC ASP, 2005 Revision, Exhibit E.

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

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

17.3 Corrective Action

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

17.3.1 Field Procedures

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

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

1. Protocols as defined by this QASAPP, the FSP, or the Work Plan have not been followed.

2. Equipment is not in proper working order or properly calibrated.

3. QC requirements have not been met.

4. Issues resulting from performance or systems audits.

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

17.3.2 Laboratory Procedures

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

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

1. Specific laboratory analytical protocols have not been followed.

2. Predetermined data acceptance standards are not obtained.

3. Equipment is not in proper working order or calibrated.

4. Sample and test results are not completely traceable.

5. QC requirements have not been met.

6. Issues resulting from performance or systems audits.

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

18. Reports to Management

18.1 Internal Reporting

The analytical laboratory will submit analytical reports to ARCADIS for review. If required, ARCADIS will, in turn, submit the reports to the data validator for review. Supporting data (i.e., historic data, related field or laboratory data) will also be reviewed to evaluate data quality, as appropriate. The ARCADIS 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 the ARCADIS Project Manager. If required, this report will be filed in the project file at ARCADIS' 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

4. Analytical data validation report

18.2 SC Reporting

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

19. Data Review, Validation, and Verification

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

1. Validation of the data

2. Reduction or manipulation of the data mathematically or otherwise into meaningful and useful forms

3. Organization, interpretation, and reporting of the data

19.1 Field Data Reduction, Validation, and Reporting

19.1.1 Field Data Reduction

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

19.1.1.1 Task 1 – Soil Investigation

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

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

19.1.1.2 Task 2 – Groundwater Investigation

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

1. Calculation of water elevations by subtracting the depth-to-water data from the surveyed elevation of the measuring point

2. Production of hydrogeologic contour maps by contouring lines of equal water elevations using known elevation points

19.1.2 Field Data Validation

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

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

19.1.3 Field Data Reporting

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

19.2 Laboratory Data Reduction, Review, and Reporting

19.2.1 Laboratory Data Reduction

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

19.2.2 Laboratory Data Review

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

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 ARCADIS Project Manager.

20. Validation and Verification Methods

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

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

ARCADIS will validate all 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 QASAPP. Any deviations from the analytical method or any special reporting requirements apart from that specified in this QASAPP 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 exceedences, should they occur, will be documented. Data for all 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.

- 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
- 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 the ARCADIS QAC at this point.

1. Data validation reports will be kept in the project file at the ARCADIS office in Syracuse, New York.

21. Reconciliation with User Requirements

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

- Retrieval of missing information
- Request for additional explanation or clarification
- Reanalysis of sample from extract (when appropriate)
- Recalculation or reinterpretation of results by the laboratory

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

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

- Extrapolation of missing data from existing data points
- Use of historical data
- 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, then the following action must be taken:

- Additional sample collection and analysis

ARCADIS

Acronyms

ASTM	American Society for Testing and Material
ARCADIS	ARCADIS
ASP	Analytical Services Protocol
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CSV	Comma Separated Value
DUP	Duplicate
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable GC Gas Chromatography
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
mg/kg	Milligram per kilogram
mg/L	Milligrams per liter
mS/cm	Millisiemens per centimeter
MS	Matrix Spike
MSD	Matrix Spike Duplicate

NEIC	National Enforcement Investigations Center
ng	Nanogram
NIST	National Institute of Science and Technology
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PNP	Paranitrophenol
PPE	Personal Protective Equipment
ppb	Parts per billion
ppm	Parts per million
QAM	Quality Assurance Manager
QASAPP	Quality Assurance Sampling and Analysis Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation Recovery Act
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SC	Site Characterization
SDG	Sample Delivery Group
SOP	Standard Operating Procedures

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

References

American Society for Testing and Materials. Annual Book of ASTM Standards. American Society for Testing and Materials. West Conshohochkton, PA. (1996).

United States Environmental Protection Agency. *NEIC Policies and Procedures Manual*. EPA-330/9-78-001R. National Enforcement Investigations Center. (May 1978, Revised August 1991).

United States Environmental Protection Agency. *Interim Guidance and Specifications for Preparing Quality Assurance Project Plans*. QAMS-005/80. Office of Research and Development. (December 1980).

United States Environmental Protection Agency. *Methods for Chemical Analysis of Water and Waste*. EPA-600/4-79-020, Revised. EMSL-Cincinnati. (March, 1983).

United States Environmental Protection Agency. *Test Methods for Evaluating Solid Waste*. SW-846 3rd Edition, Update 3. Office of Solid Waste (December 1996).

United States Environmental Protection Agency. *EPA Requirements for Quality Assurance Project Plans for Environmental Operations*. EPA-QA/R-5. Quality Assurance Division. (March 2001).

United States Environmental Protection Agency. 2002b. *Guidance for Quality Assurance Project Plans*. EPA-QA/G-5. Office of Environmental Information. December 2002.

United States Environmental Protection Agency. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*. EPA-QA/G-4. Office of Environmental Information. February, 2006.

United States Environmental Protection Agency. 2002a. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA-540/R-01-008 July 2002.

United States Environmental Protection Agency. 1999a. *Compendium of Methods for the Determination of Organic Compounds in Ambient Air*. January 1999.

United States Environmental Protection Agency. 1999b. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA-540/R-99-008 October 1999.

ARCADIS

Appendix B
Quality Assurance Sampling and Analysis Project Plan

TABLES

Table B-1. Environmental and Quality Control Analyses, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Environmental Sample Matrix/ Laboratory Parameters	Estimated Environmental Sample Quantity	Field QC Analyses							Laboratory QC Analyses[1,2]						Estimated Overall Total
		Trip Blank		Field Duplicate		Rinse Blank[3]		Est. Matrix Total	MS		MSD		Lab Duplicate		
		Freq	No.	Freq	No.	Freq	No.		Freq	No.	Freq	No.	Freq	No.	
Soils															
Volatile Organics Method 8260	10	1/day	4	1/20	1	1/20	1	16	1/20	1	1/20	1	--	--	18
Semivolatile Organics Method 8270	10	--	--	1/20	1	1/20	1	12	1/20	1	1/20	1	--	--	14
Total Cyanide Method 9012	10	--	--	1/20	1	1/20	1	12	1/20	1	--	--	1/20	1	14
Groundwater															
Volatile Organics Method 8260	4	1/day	1	1/20	1	--	--	6	1/20	1	1/20	1	--	--	8
Semivolatile Organics Method 8270	4	--	--	1/20	1	--	--	5	1/20	1	1/20	1	--	--	7
Cyanide (total) Method 9012	4	--	--	1/20	1	--	--	5	1/20	1	--	--	1/20	1	7

Notes:

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

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

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

MS = Matrix spike.
MSB = Matrix spike blank.
MSD = Matrix spike duplicate.

Table B-2. Method Reporting Limits and Action Limits, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

	Water (ug/L)		Soil (ug/kg)		
Analyte	Laboratory MDL	Laboratory RL	Laboratory MDL	Laboratory Low Level RL	Laboratory Medium RL
Volatile Organic Compounds 8260 [1]					
1,1,1,2-Tetrachloroethane	0.35	1.0	0.31	5	500
1,1,1-Trichloroethane	0.26	1.0	0.36	5	500
1,1,2,2-Tetrachloroethane	0.48	1.0	0.33	5	500
1,1,2-Trichloroethane	0.42	1.0	0.25	5	500
1,1-Dichloroethane	0.27	1.0	0.58	5	500
1,1-Dichloroethene	0.29	1.0	0.61	5	500
1,2 Dichloroethane	0.46	1.0	0.25	5	500
1,2,3-Trichloropropane	0.32	1.0	0.51	5	500
1,2-Dibromo-3-chloropropane (DBCP)	0.47	1.0	0.37	5	500
1,2-Dibromoethane (EDB)	0.42	1.0	0.19	5	500
1,2-Dichlorobenzene	0.4	1.0	0.32	5	500
1,2-Dichloropropane	0.33	1.0	0.26	5	500
1,3-Dichlorobenzene	0.33	1.0	0.3	5	500
1,4-Dichlorobenzene	0.37	1.0	0.23	5	500
2-Butanone (MEK)	1.3	5.0	0.81	25	500
2-Chloroethyl vinyl ether	0.96	1.0	6.25	5	500
2-Hexanone	1.3	5.0	6.3	25	500
4-Methyl-2-pentanone (MIBK)	1.3	5.0	6.3	25	500
Acetone	1.3	5.0	1.1	5	500
Acrylonitile	1.39	5	25	200	500
Benzene	0.35	1.0	0.55	5	500
Bromochloromethane	0.4	1.0	0.36	5	500
Bromoform	0.26	1.0	0.46	5	500
Bromomethane	0.28	1.0	0.46	5	500
Carbon Disulfide	0.23	1.0	0.43	5	500
Carbon Tetrachloride	0.27	1.0	0.68	5	500
Chlorobenzene	0.32	1.0	0.51	5	500
Chloroethane	0.32	1.0	0.36	5	500
Chloroform	0.34	1.0	0.31	5	500
cis-1,2-Dichloroethene	0.22	1.0	0.25	5	500
cis-1,3-Dichloropropene	0.32	1.0	0.29	5	500
Dibromochloromethane	0.34	1.0	0.28	5	500
Dichlorobromomethane	0.39	1.0	0.26	5	500
Ethylbenzene	0.45	1.0	0.35	5	500
Iodomethane	0.27	1.0	0.61	5	500
Methyl Chloride	0.35	1.0	0.3	5	500
Methylene Chloride	0.44	1.0	2.2	5	500
Styrene	0.31	1.0	0.25	5	500
Tetrachloroethene	0.36	1.0	0.3	5	500
Toluene	0.51	1.0	0.85	5	500
Total Xylenes	0.93	1.0	2.9	15	500
trans-1,2-Dichloroethene	0.33	1.0	0.52	5	500
trans-1,3-Dichloropropene	0.37	1.0	0.64	5	500
trans-1,4-Dichloro-2-butene	2.12	5	0.36	5	500
Trichloroethene	0.32	1.0	0.35	5	500
Trichlorofluoromethane	0.15	1.0	0.55	5	500
Vinyl Acetate	1.29	5	0.36	5	500
Vinyl Chloride	0.24	1.0	0.2	10	500
Semivolatile Organic Compounds 8270 [1]					
1,2,4-Trichlorobenzene	0.11	10	4.83	330	330
1,2-Dichlorobenzene	0.14	10	3.23	330	330
1,3-Dichlorobenzene	0.14	10	3.02	330	330
1,4-Dichlorobenzene	0.16	10	2.22	330	330
2,4,5-Trichlorophenol	0.99	10	37	330	330
2,4,6 Trichlorophenol	0.99	10	11	330	330
2,4-Dichlorophenol	0.79	10	8.8	330	330
2,4-Dimethylphenol	0.96	10	46	330	330
2,4-Dinitrophenol	2.2	10	59	830	800
2,4-Dinitrotoluene	0.45	10	26	330	330
2,6 Dinitrotoluene	0.51	10	41	330	330
2-Chloronaphthalene	0.08	10	11	330	330
2-Chlorophenol	0.51	10	8.6	330	330
2-Methylnaphthalene	0.08	10	2	330	330
2-Methylphenol	0.23	10	5.1	330	330
2-Nitroaniline	0.5	10	54	830	800
2-Nitrophenol	0.6	10	7.7	330	330
3,3'-Dichlorobenzidine	0.37	10	148	330	600

See Notes on Page 2.

Table B-2. Method Reporting Limits and Action Limits, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

	Water (ug/L)		Soil (ug/kg)		
Analyte	**Laboratory MDL**	**Laboratory RL**	**Laboratory MDL**	**Laboratory Low Level RL**	**Laboratory Medium RL**
Semivolatile Organic Compounds 8270 [1] (Cont'd.)					
3-Nitroaniline	1.5	10	39	830	800
4-Bromophenyl-phenylether	0.9	10	54	330	330
4-Chloro-3-Methylphenol	0.6	10	6.9	330	330
4-Chloroaniline	0.33	10	50	330	330
4-Chlorophenyl-phenylether	0.17	10	3.6	330	330
4,6-Dinitro-2-methylphenol	0.23	10	58	830	800
4-Methylphenol	0.35	10	9.4	330	330
4-Nitroaniline	0.46	10	19	830	800
4-Nitrophenol	1.5	10	41	830	800
Acenaphthene	0.11	10	2	330	330
Acenaphthylene	0.05	10	1.4	330	330
Anthracene	0.06	10	4.3	330	330
Benzo(a)anthracene	0.06	10	2.9	330	330
Benzo(b)fluoranthene	0.06	10	3.3	330	330
Benzo(k)fluoranthene	0.07	10	1.9	330	330
Benzo (g,h,i,) Perylene	0.08	10	2	330	330
Benzo(a)pyrene	0.09	10	4.1	330	330
Benzyl alcohol	0.29	10	8.06	330	330
bis(2-Chloroethoxy)methane	0.38	10	9.2	330	330
bis(2-chloroethyl)ether	0.18	10	15	330	330
bis(2-chloroisopropyl)ether	0.42	10	17.6	330	330
bis(2-Ethylhexyl) phthalate	4.8	10	54	330	330
Butyl benzyl phthalate	1.7	10	45	330	330
Chrysene	0.27	10	1.7	330	330
Di-n-butyl phthalate	0.3	10	58	330	330
Di-n-octyl phthalate	0.24	10	3.9	330	330
Dibenzo(a,h)anthracene	0.2	10	2	330	330
Dibenzofuran	0.1	10	1.8	330	330
Diethyl phthalate	0.11	10	5.1	330	330
Dimethylphthalate	0.3	10	4.4	330	330
Fluoranthene	0.1	10	2.4	330	330
Fluorene	0.07	10	2.4	330	330
Hexachlorobenzene	0.44	10	8.4	330	330
Hexachlorobutadiene	2.6	10	8.6	330	330
Hexachlorocyclopentadiene	2.5	10	51	330	330
Hexachloroethane	2.8	10	13	330	330
Indeno(1,2,3-cd)pyrene	0.15	10	4.7	330	330
Isophorone	0.32	10	8.4	330	330
N-Nitrosodimethylamine	1	10	12	330	330
N-Nitroso-di-n-propylamine	0.45	10	13	330	330
N-Nitrosodiphenylamine	0.26	10	9.2	330	330
Naphthalene	0.12	10	2.8	330	330
Nitrobenzene	0.54	10	7.5	330	330
Pentachlorophenol	5.1	10	58	830	800
Phenanthrene	0.11	10	3.5	330	330
Phenol	0.45	10	18	330	330
Pyrene	0.07	10	1.1	330	330
Inorganics - 9010B/9012A[1]					
Cyanide	5	10	870	1000	1000

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. The target reporting limits are based on wet weight. The actual reporting limits will vary based on sample weight and moisture content.
3. The reporting limits listed are the Maximum Concentration of Contaminants for the Toxicity Characteristic (Fed. Reg.).

Table B-3. Sample Containers, Preservation, and Holding Time Requirements, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Parameter	Container	Preservation	Maximum Holding Time from VTSR
Groundwater Samples			
Volatile Organics	(2) 40-ml Teflon-lined septa (glass)	Cool 4ºC HCl to pH <2	5 days (unpreserved) 12 days (preserved)
Semivolatile Organics	(2) 1-liter containers (glass)	Cool 4ºC	5 days extraction; 40 days analysis
Cyanide	(1) 500-ml container (plastic)	Cool 4ºC NaOH to pH >12	12 days
Soil Samples			
Volatile Organics	(1) 4-oz container (glass)	Cool 4ºC	12 days
Semivolatile Organics	(1) 4-oz container (glass)	Cool 4ºC	5 days extraction; 40 days analysis
Cyanide	(1) 4-oz container (glass)	Cool 4ºC	12 days

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

Table B-4. Data Validation Checklist - Laboratory Analytical Data, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

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

Table B-5. Electronic Data Deliverable (EDD) Format, Site Characterization, Dunkirk Former MGP Site, Dunkirk, 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, WATER, etc.
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 as 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.

ARCADIS

Appendix D

DNAPL Contingency Plan

Imagine the result

National Fuel Gas Distribution Corporation

Appendix D
DNAPL Contingency Plan

Dunkirk Former Manufactured Gas Plant Site

(Site No. 9-07-035)

Dunkirk, New York

August 2009

I. Scope and Application

This document has been prepared to guide drilling activities at sites where there is a reasonable expectation that dense, non-aqueous phase liquid (DNAPL) may be present, and provide procedures to be implemented in the event that DNAPL is encountered during subsurface investigations. These procedures are proposed to limit the potential of remobilizing DNAPL, if any, in response to drilling and sampling activities. In addition, the procedures are designed to optimize the recovery of encountered DNAPL (if any) in a safe and efficient manner. This DNAPL Contingency Plan was developed based on a similar document prepared by DNAPL expert Bernard H. Kueper, Ph.D., P.Eng., of Queens University, for an EPA Region 1 Superfund Site (Kueper, May 1995).

Downward DNAPL mobilization from overburden into the bedrock may occur in response to drilling activities (short-circuiting along drill stem and/or completed well screen) and groundwater extraction (creation of downward hydraulic gradient in excess of previously measured downward gradients). This DNAPL Contingency Plan addresses drilling-related issues.

II. Personnel Qualifications

DNAPL contingency field activities will be performed by persons who have been trained in proper drilling and well installation procedures under the guidance of an experienced field geologist, engineer, or technician.

III. Equipment List

The following materials will be available during soil boring and monitoring well installation activities, as required:

- Work Plan, Field Sampling Plan (FSP), and site Health and Safety Plan (HASP)
- personal protective equipment (PPE), as required by the HASP
- equipment specified under drilling and well installation SOPs
- hydrophobic dye (Oil Red O or Sudan IV), pertinent at chlorinated solvent sites

- disposable polyethylene pans for performing soil-water pan tests
- clean, empty jars for performing soil-water shake tests

IV. Cautions

The presence or absence of DNAPL at a site can have significant implications in terms of site management, health and safety, and the feasibility of potential remedial alternatives. Therefore, field personnel must be attentive to the potential for DNAPL, recognize when DNAPL is encountered during drilling, and accurately document field observations indicating the presence of DNAPL and interpreted DNAPL depth. In addition, opportunities to characterize DNAPL, when present, may be rare. When practicable, DNAPL samples should be collected and analyzed for physical and chemical characteristics.

V. Health and Safety Considerations

Field activities associated with this DNAPL Contingency Plan will be performed in accordance with the site HASP, a copy of which will be present on site during such activities.

VI. Procedure

DNAPL Screening During Overburden Drilling

To screen for the potential presence of DNAPL in soil, drilling procedures must allow for high-quality porous media samples to be taken. Split-spoon samples or direct-push samplers should be taken continuously in 2-foot intervals ahead of the auger or drill casing. Upon opening each split-spoon sampler or direct-push plastic liner sleeve, the soil will immediately be screened for the presence of organic vapors using a portable photoionization detector (PID) or organic vapor analyzer (OVA). During screening, the soil will be split open using a clean spatula or knife and the PID or OVA probe will be placed in the opening and covered with a gloved hand. Such readings will be obtained along the entire length of the sample.

If the PID or OVA examination reveals the presence of organic vapors above 100 parts per million (ppm), the sample will undergo further detailed evaluation for visible non-aqueous phase liquid (NAPL). The assessment for NAPL will include a combination of the following tests/observations:

- Evaluation for Visible NAPL Sheen or Free-Phase NAPL in Soil Sampler – The NAPL sheen will be a colorful iridescent appearance on the soil sample. NAPL may also appear as droplets or continuous accumulations of liquid with a color typically ranging from yellow to brown to black, depending on the type of NAPL. Creosote DNAPL (associated with wood-treating sites) and coal-tar DNAPL (associated with manufactured gas plant [MGP] sites) are typically black and have a characteristic, pungent odor. Pure chlorinated solvents may be colorless in the absence of hydrophobic dye. Solvents mixed with oils may appear brown.

- Soil-Water Pan Test – A portion of the selected soil interval with the highest PID or OVA reading > 100 ppm will be placed in a disposable polyethylene dish along with a small volume of potable or distilled water. The dish will be gently tilted back and forth to mix the soil and water, and the surface of the water will be viewed in natural light to observe the development of a sheen, if any. A small quantity of Oil Red O or Sudan IV hydrophobic dye powder will be added and the soil and dye will be manually mixed for approximately 30 to 60 seconds and smeared in the dish to create a paste-like consistency using a new nitrile glove-covered hand. A positive test result will be indicated by a sheen on the surface of the water and/or a bright red color imparted to the soil following mixing with dye.

- Soil-Water Shake Test – A small quantity of soil (up to 15 cc) will be placed in a clear, colorless, 40-mL vial containing an equal volume of potable or distilled water. After the soil settles into the water, the surface of the water will be evaluated for a visible sheen. The jar will be closed and gently shaken for approximately 10 to 20 seconds. Again, the surface of the water will be evaluated for a visible sheen or a temporary layer of foam. A small quantity (approximately 0.5 to 1 cc) of Oil Red O or Sudan IV powder will be placed in the jar. The sheen layer will be evaluated for a reaction to the dye (change to bright red color). The jar will be closed and gently shaken for approximately 10 to 20 seconds. The contents in the closed jar will be examined for visible bright red dyed liquid inside the jar. A positive test result will be indicated by the presence of a visible sheen and foam on the surface of water, a reaction between the dye and the sheen layer upon first addition of the dye powder, a bright red coating the inside of the vial (particularly above the water line), or red-dyed droplets within the soil.

- Estimation of Relative Degree of NAPL Saturation – When NAPL is interpreted as present in a particular portion of soil, the field geologist will attempt to estimate the relative degree of NAPL saturation in the soil. Specifically, based on the apparent, visible continuity of NAPL within the soil, an interpretation will be made as to whether the observed NAPL is pooled (continuous section of soil across entire diameter of soil sample in which the pore spaces are filled with a mixture of

NAPL and water) or residual (isolated droplets or blebs of NAPL, surrounded by pore spaces containing only water).

If NAPL is obviously present upon opening the soil sampler or evaluating the soil sample within the split-spoon sampler or direct-push liner sleeve, it is not necessary to perform a soil-water pan test or soil-water shake test. In addition, it is not necessary to perform both a soil-water pan test and a soil-water shake test. Either test method is acceptable. The pan test may be preferred in some circumstances because the presence of a sheen may be easier to see on a wider surface.

The results of each test or observation will be recorded in the field notebook.

DNAPL Screening During Bedrock Drilling

To screen for the potential presence of DNAPL in bedrock, drilling fluids, rock cuttings, and/or core samples are monitored for the presence of sheens. During drilling using rotary methods (coring or roller bit drilling with water or drilling mud), the return fluid will be screened with a PID or OVA and evaluated continuously for the presence of a sheen in the recirculation tub. Where core samples are obtained, they will be carefully evaluated for the presence of a sheen on fracture surfaces. During drilling using air-rotary methods, rock cuttings will be continuously screened using a PID or OVA and evaluated for the presence of a sheen. During drilling with rotary methods, the positive head level at the borehole will reduce the potential for DNAPL short-circuiting via the borehole.

If a sheen is observed with any of these methods, drilling will be temporarily discontinued and an evaluation will be undertaken to determine whether pooled DNAPL is present. The drill stem will be retracted to a few feet above the apparent depth where the sheen was first encountered. Groundwater will be extracted from the borehole to produce a drawdown of 5 to 10 feet below the approximate static, non-pumping water level for a period of 20 minutes to test for the presence of pooled, mobilizable DNAPL in the fractures surrounding the open borehole. The bottom of the borehole will then be evaluated for the presence of DNAPL using an interface probe or bottom-loading bailer. If no DNAPL is observed, the interpretation will be made that the sheen was not produced by pooled DNAPL. In this case, if drilling by the rotary method, the recirculation water will be replaced by clean water and drilling will continue. Replacing the recirculation water reduces the potential for cross-contamination and facilitates observation of a newly created sheen, if any, at a deeper interval. Accumulation of DNAPL in the bottom of the borehole, however, indicates that the boring has encountered pooled DNAPL. If DNAPL has accumulated, it will be removed using a bottom-loading bailer or pump.

Data Collection Below Zone Containing Pooled DNAPL

If pooled DNAPL is encountered in a borehole and deeper drilling is required to collect data below a zone containing pooled DNAPL, one of the following actions will be taken.

1. Adjustment of Drilling Location **-** The boring where pooled DNAPL was encountered will be abandoned by tremie grouting using neat cement grout and a replacement boring will be re-attempted at a nearby location.

2. DNAPL Sump Installation - A DNAPL collection well will be installed with a blank sump properly grouted in place below the screen and the boring will be re-attempted at a nearby location. In this case, after removing the DNAPL in the borehole, the boring may be advanced an additional 2 to 3 feet to accommodate a blank sump below the interval with apparent pooled DNAPL.

3. Casing Off DNAPL Layers - If pooled DNAPL is found to be present throughout an area where deeper drilling is essential, a permanent, grouted casing should be installed. The bottom of the pooled DNAPL likely coincides with the top of a relatively fine-grained, low permeability, stratum (capillary barrier). Permanent casing will be installed to the bottom of the borehole and grouted in place using the displacement method prior to advancing the borehole any further. In this case, after removing any DNAPL that may have accumulated in the borehole, the boring may be advanced a few feet into the top of the underlying confining layer or up to 5 feet in bedrock prior to grouting the casing to assist in isolating the zone containing apparently pooled DNAPL. When the casing is grouted in place and the grout has set, the drilling recirculation water will be replaced with clean water to prevent cross-contamination and facilitate observation of a newly created sheen (if any) at a deeper interval, and drilling will continue.

DNAPL Monitoring

New wells installed in borings where DNAPL was encountered during drilling will be monitored for DNAPL accumulation in the DNAPL sump using an oil-water interface probe or bottom-loading bailer within approximately one day following initial installation. If DNAPL is encountered, a bottom-loading bailer or pump will be used to remove the DNAPL, the final DNAPL thickness will be recorded, and the DNAPL thickness will be reassessed after another day of accumulation (if any). This process will be repeated until DNAPL no longer accumulates overnight, at which point the accumulation monitoring and removal period will extend to one-week intervals. If no DNAPL accumulation is observed over a period of one week, further DNAPL monitoring may be continued with a longer period between monitoring events.

Any DNAPL recovered during drilling and monitoring activities should be analyzed for chemical composition, DNAPL-water interfacial tension, density, and viscosity. The physical tests should be performed at the approximate groundwater temperature at the site where the DNAPL sample was obtained, typically between 10ºC and 20ºC. These parameters will allow for correlation of groundwater chemistry with suspected DNAPL locations and will allow an estimate to be made of the volume and potential mobility of DNAPL, if any, in the formation.

VII. Waste Management

DNAPL removed from wells will be temporarily stored on-site in metal drums for subsequent appropriate off-site disposal. The locations and volumes of recovered DNAPL will be noted.

VIII. Data Recording and Management

Any occurrence of DNAPL encountered during subsurface investigations will be documented in an appropriate field notebook in terms of the drilling location (boring or well identification), depth below surface, type of geologic material DNAPL was observed within, field screening and testing results, and apparent degree of DNAPL saturation (pooled or residual). DNAPL locations and depths will be recorded on subsurface log forms, as appropriate.

IX. Quality Assurance

DNAPL can be mobilized downward as a result of drilling operations. It is very difficult to drill through DNAPL without bringing about vertical DNAPL mobilization. This opinion is stated by USEPA (1992): “In DNAPL zones, drilling should generally be minimized and should be suspended when a potential trapping layer is first encountered. Drilling through DNAPL zones into deeper stratigraphic units should be avoided.” The DNAPL screening procedure outlined in this plan should, therefore, be implemented while drilling at all locations and depths within overburden or bedrock where potential DNAPL presence is suspected. If data collection is required below a zone containing DNAPL, the interval containing DNAPL will be cased off prior to drilling deeper.

X. References

Kueper, B.H., May 11, 1995. DNAPL Contingency Plan. [Prepared at the request of *de maximis, inc*.].

United States Environmental Protection Agency (USEPA), 1992. Memorandum from D. Clay: Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities – Update. OSWER Directive No. 9283.1-06.