Field Sampling Plan

Williamsburg Works
Former Manufactured Gas Plant Site

Brooklyn, New York
AOC Index No. A2-0552-0606
Site #: 224055

Submitted to:
National Grid USA
1 MetroTech Center
Brooklyn, NY 11201

Submitted by:
GEI Consultants, Inc.
455 Winding Brook Drive
Glastonbury, CT 06033

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08090*1002

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Abbreviations and Acronyms

ASTM	American Society for Testing and Materials
COC	Chain Of Custody
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
ELAP	Environmental Laboratory Approval Program
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FSP	Field Sampling Plan
GEI	GEI Consultants, Inc.
HASP	Health and Safety Plan
KeySpan	Keyspan Corporation
LEL	Lower Explosive Limit
LNAPL	Light Non-Aqueous Phase Liquid
MGP	Manufactured Gas Plant
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAPL	Non-Aqueous Phase Liquid
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PDA	Personal Data Assistant
PID	Photo Ionization Detector
PM	Project Manager
PPE	Personal Protection Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation
SOP	Standard Operating Procedures
SVOC	Semivolatile Organic Compound
USDOT	United States Department of Transportation
VOC	Volatile Organic Compound

1. Purpose

1.1 Introduction

GEI Consultants, Inc. (GEI) has prepared this Draft Field Sampling Plan (FSP) to address the Remedial Investigation (RI) of the Williamsburg Works (Williamsburg) Manufactured Gas Plant (MGP) site located on multiple parcels located along North 12th and North 11th Streets and Kent Avenue and the East River in the Williamsburg Neighborhood in Brooklyn, New York. The FSP is a companion document to the *Draft Williamsburg Works MGP Remedial Investigation Work Plan* dated April 2008 (Work Plan) that was prepared by KeySpan Corporation (KeySpan)) [now part of National Grid]. The project location is shown on Figure 1 of the Work Plan. Proposed sample locations are summarized on Figure 2 of the Work Plan. The FSP was prepared to provide the applicable procedures for collecting, transporting, and logging analytical samples during the Williamsburg Works MGP RI.

A Draft Quality Assurance Project Plan (QAPP) dated April 2008 has been prepared under a separate cover. The QAPP details the project data objectives and quality assurance/quality control (QA/QC) measures that will be implemented during the implementation of the Work Plan.

2. General Field Procedures

2.1 Utility Clearance Procedure

Underground utilities, including electric, telephone, cable television, sewers, water, natural gas, etc., will be identified by owners/operators prior to any intrusive activity. KeySpan will provide underground utility locations on KeySpan property, if necessary. The drilling contractor will place a call to the New York City/ Long Island One Call Center (1-800-272-4480) at least two, but not more than 10 days, prior to the commencement of work activities. The New York City and Long Island One Call Center is open 24 hours a day, 7 days a week. The drilling and excavation contractors will make note of ticket reference number and names of the utility operators that will be notified by the New York City and Long Island One Call Center. Public and privately owned utilities will be located by responsible agencies at least 48 hours prior to field activities. The contractor will check that each notified operator has either marked the work site or given an “all clear” prior to commencing work. Other potential on-site hazards such as sharp objects, known subsurface structures, overhead power lines, and building hazards will be identified during the site reconnaissance visit.

If intrusive activity occurs on private property, then a private mark out company will be contracted to identify any subsurface utilities or obstructions prior to sample collection. As a precaution, the first 5 feet or 1 foot below the nearest identified utility of the boring location will be cleared utilizing hand tools, vacuum excavation, or non-intrusive methods.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.
2. New York City One Call Center & Long Island internet web page online http://www.nycli1calldsi.com accessed on March 5, 2007.

2.2 Field Notebook Procedure

Objective

The field notebook is intended to serve as a record of significant field activities performed or observed during the project. The field notebook will serve as a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies.

Procedure

1. Use a separate all-weather bound notebook for each site/location/project number.
2. Write neatly using black or blue waterproof pen (or note if field conditions [i.e., cold or wet weather] require use of pencil).
3. Write the project name, project number, and book number (i.e., 1 of 3) on the front cover. On the inside cover, identify the project name, project number, and "Return Book To:" the office address of the Project Manager (PM).
4. Number all of the pages of the field book starting with the first entry.
5. Record activities as they occur.
6. Neatly cross out mistakes using a single line and initial them. Erasures are not permitted. If an error is made on an accountable document assigned to one individual, that individual will make all corrections. The person who made the entry will correct any subsequent error discovered on an accountable document. All subsequent corrections will be initialed and dated.
7. Sign or initial and date the bottom of every page with an entry. Cross out unused portions of a page.
8. Record the following information upon each arrival at the site:
    a. Date/time/weather/project number
    b. Consultant personnel
    c. Purpose of visit/daily objectives
9. Record conversations with: [Recommendation - If possible, record telephone numbers of individual contacts for the site in the field notebook.]
    a. Contractors
    b. Clients
    c. Visitors (include complete names, titles, and affiliations whenever possible).
    d. Consultant office staff
    e. Landowners (site or abutters)
    f. Note time of arrival and departure of individuals visiting the site.
10. Examples of the field information to be recorded include time of occurrences.
    a. General site work activities
    b. Subcontractor progress
    c. Type and quantity of monitoring well construction materials used
    d. Use of field data sheets or electronic logging equipment (i.e., boring logs, monitoring well sampling logs, etc.)
    e. Ambient air monitoring data
    f. Locations and descriptions of sampling points
    g. Sample media (soil, sediment, groundwater, etc.)
    h. Sample collection method
    i. Number and volume of sample(s) collected and sample bottle preservatives used

   j. Sample identification number (s) and date and time of sample collection
   k. Approximate volume of groundwater removed before sampling
   l. Field observations
   m. Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
   n. References for all maps and photographs of the sampling site(s)
   o. Information pertaining to sample documentation such as: bottle lot numbers/ dates and method of sample shipments/chain-of custody record numbers and overnight shipping air bill numbers.
   p. Surveying data (including sketches with north arrows)
   q. Changes in weather
   r. Rationale for critical field decisions
   s. Recommendations made to the client representative and PM.
11. Record the following information upon departure.
   a. Include a site sketch or representative site photograph of conditions at the end of the day, if required.
   b. Time
   c. Summarize work completed/work remaining
   d. Place a diagonal line though and sign portions of pages not used or skipped.

Precautions

- Only record facts.
- Do not fail to record an observation because it does not appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions.
- Do not use spiral notebooks because pages can be easily removed.

References

1. *ASFE Model Daily Field Report* (1991), ASFE, Inc.
2. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

2.3 Daily Activity Report Procedure

Objective

A daily activity report will be generated daily from the field database or field notebook to summarize the activities, observations, and decisions made during the day's fieldwork.

Procedure

At the completion of the day's fieldwork, all pertinent field observations will be recorded in the site database, computer electronic form or on a hard copy paper form. If the electronic database is used, the database will generate the daily activity report that includes all samples collected and submitted to the laboratory for analysis. A daily activity report form is located in Appendix A. This report must be completed at the end of the workday. The daily activity report will be forwarded to the PM and site manager once completed. Field reports will be maintained at the site electronically and/or in hard copy form.

Contents of the report should include, at a minimum, the following information:

1. Date, project name, project number/phase/task, and site location.
2. A record of person(s) present at the site during the workday.
3. A brief description of the daily activities performed (e.g., drilled five borings in the overburden).
4. A summary of any significant field observations to include:
    a. A summary of deviation(s) from the work plan or objectives.
    b. A summary of field decision(s) made, who made it/them, and the basis for such decision(s).
    c. Any recommendations that may result from field observations and any actions that resulted from those recommendations.
5. A summary of specific fieldwork completed (e.g. WWSB-01, drilled depth 20 feet).
6. A summary of samples submitted for laboratory analysis.

Precautions

- The daily activity report should be based solely upon factual information. Any speculation should be clearly noted in the report as such.
- The daily activity report should never be released to anyone other than the PM or client unless explicitly authorized by the PM or client.

2.4 Field Boring Data Logging

Objective

To prepare and record a succinct, accurate representation of subsurface conditions, drilling and soil sampling activities, monitoring well installation details, and borehole abandonment procedures. A completed boring log should contain sufficient information to facilitate the preparation of geologic cross sections, to identify possible contaminant sources or pathways observed, and to offer readers a thorough account of drilling and borehole abandonment procedures.

Procedures

1. All borings will be recorded in a field notebook and/or electronically on a personal data assistant (PDA) utilizing a soil logging program. Prior to beginning drilling activities, generic project header information, project staff, subcontractors, and anticipated geologic formations should be entered into the pLog™ database and downloaded to the PDA. If a field notebook is used, then logging will be completed in accordance with procedures described above in subsection 2.2.
2. Complete the log concurrently with drilling procedures (i.e., do not let the driller work faster than your ability to accurately represent the subsurface conditions).
3. If applicable, record the conventional geotechnical parameters during Standard Penetration Testing as per American Society for Testing and Materials (ASTM)-D1586, including blow counts of the hammer per 6-inch increment, total penetration of the split-spoon sampler, and length of the entire sample recovered. Record the weight of the hammer, size of the split-spoon sampler, and distance of the hammer fall.
4. Record the depth at which casing, augers, or drilling equipment are seated and the sizes of the equipment. Be certain to include sizes and seating depths of telescoped casing (if used).
5. Record the time at which each sample is retrieved from the borehole.
6. Record the results of any headspace tests performed on samples collected from discrete depths and also the type of field equipment used.
7. Provide soil descriptions in accordance with soil description procedures located below in Section 5.
8. Use the field book to record any relevant drilling observations that cannot be recorded on the PDA such as advance rate, water levels, drilling difficulties, changes in drilling method or equipment, amounts and types of any drilling fluids, running sands, and borehole stability.
9. Record the procedures and material used to abandon or seal each borehole upon completion.
10. At the completion of the day’s activities, download the PDA to the database and

generate, review, and edit (if necessary) the completed boring log. If a field notebook is used, make photocopies of the field notebook at the end of each day.

Precautions

- Electronic files should be backed up daily to prevent loss of data. A hardcopy of the boring logs for work performed each day should be generated as a backup. Hardcopy documents should be backed up also.
- Keep boring logs and rock core logs focused on actual observations. Record only factual information on the logs.

3. Surface Soil Sample Collection Procedure

The following surface soil sample collection procedure is applicable to the collection of representative surface soil. Alternative methods may be used at the field representative's discretion with the authorization of KeySpan and New York State Department of Environmental Conservation (NYSDEC).

Procedure

1. Surface soil samples will be collected at the locations indicated in the Site Work Plan. Sample management is detailed in the QAPP.

2. Samples will be collected using decontaminated stainless steel equipment.

3. If the selected sampling location is in a vegetated area, the vegetation will be removed over a one square foot area prior to sample collection. The sample will be collected from within the top two (2) inches of the exposed ground surface.

4. Samples will be collected by digging into the soil with a pre-cleaned stainless steel trowel.

5. All samples selected for laboratory analysis will be placed in the appropriate containers provided by the laboratory. Sample containers for volatile organic analysis will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel bowl with a decontaminated steel trowel or disposable scoop. This composite sample will be analyzed for all remaining parameters identified in the Site Work Plan.

6. All samples collected for analysis will be placed immediately into laboratory sample jars and properly stored in a cooler with ice to $4^{o}C$ before transport to the laboratory.

7. Duplicate samples will be collected at the frequency detailed in the QAPP by alternately filling two sets of sample containers. Composite samples may be required to obtain a sufficient soil volume.

8. Procedures for geologic logging, sample collection, and field classification are presented in Section 5. In addition, the surface soil sample will be described including:

    - Site;

- Location number;
- Interval sampled;
- Date;
- Initials of sampling personnel;
- Soil type;
- Color;
- Moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations (including organic vapor readings).

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

4. Subsurface Soil Sample Collection Procedure

The following subsurface soil sample collection procedure is applicable to the collection of representative subsurface soil using direct push Geoprobe® drilling methods. Conventional hollow-stem auger or resonant sonic drilling technologies may also be used if drilling conditions warrant. Alternative methods may be used at the field representative's discretion with the authorization of KeySpan and NYSDEC.

4.1 Sampling Methods

Location, equipment, and sampling situations will dictate the applicable method of sample collection for each boring location. Borings will generally be accomplished through the use of one of the following samplers or techniques:

- Geoprobe® Drilling Techniques
- Conventional Hollow-Stem Auger Drilling Methods
- Resonant Sonic Drilling Methods

These samplers and sampling techniques will result in the collection of representative samples.

4.2 Sample Interferences

Proper sampling procedures will be used to collect samples in accordance with the standard operating procedures (SOP) to prevent cross contamination and improper sample collection. Common causes of sample interferences are listed below to ensure that the samplers can avoid potential sample collection problems.

1. Cross Contamination: Eliminated or minimized through the use of dedicated or disposable sampling equipment where appropriate. Where the use of dedicated or disposable sampling equipment is not possible or practical, the equipment will be decontaminated in accordance with the SOP for Decontamination of Field Sampling Equipment is located in Section 11.

2. Improper Sample Collection: Typical improper sample collection techniques include:

    - Improper decontamination of sampling equipment
    - Use of sampling equipment or sample containers that are not compatible with the contaminants of concern or the laboratory analytical method.
    - Sample collection in an obviously disturbed or non-representative area.

4.3 Equipment/Apparatus

Equipment needed for collection of subsurface soil samples may include (depending on technique chosen):

- Geoprobe® Sampling Apparatus
- Rotary Hollow-Stem Auger Sampling Apparatus
- Rotosonic Sampling Apparatus
- Stainless Steel Sampling Tools
- Laboratory Provided Sample bottles
- Resealable plastic bags
- Ice
- Coolers, packing material
- Chain of Custody (COC) records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Digital Camera
- Field data sheets/Logbook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal protection equipment (PPE)

4.4 Subsurface Soil Sample Procedure

Subsurface sampling will be conducted in accordance with the following general procedures and specific guidance for the methods discussed below.

4.4.1 General Procedures

Prior to sampling, New York City and Long Island One Call will be contacted and an accurate utility mark out will be established as described in subsection 2.1. If drilling on private property, then a private mark out company may be contracted to identify any subsurface utilities or obstructions prior to sample collection.

At each location, plastic sheet, plywood sheet, or other suitable cover will be placed around the augers during conventional hollow stem auger drilling rig to contain soil cuttings.

Procedures for geologic logging, sample collection, and field classification are presented in Section 5.

If a boring exhibits the presence of non-aqueous phase liquid (NAPL), drilling will proceed until signs of the free and residual product are no longer visible in accordance with the work plan and the limitations of the drilling equipment. Any deep drilling through nearby impacted zones will ensure that there is no vertical communication caused by the drilling. Specifically, the upper impacted units may be cased and grouted into a lower, more confining unit, if encountered.

All the borings will be backfilled using a tremie pipe from the bottom to the top of the bore hole with cement/bentonite grout in accordance with NYSDEC guidelines for standard grout mixtures:

- One 94-pound bag Type I Portland cement
- 3.9 pounds powdered bentonite
- 7.8 gallons potable water

The boring will be grouted to the surface and allowed to cure overnight. If excessive settling is observed in the borehole due to seepage of the grout into the formation, then additional grout may be applied. The surface conditions including any asphalt/concrete surface will then be restored to its original condition.

Investigation derived wastes will be handled as specified in investigation-derived waste handling procedure located in Section 13.

4.4.2 Direct Push Geoprobe® Procedures

For direct push Geoprobe® methods, discrete soil samples will be collected from each boring using a 4-foot or 5-foot close piston Macro-Core® sampler configuration. Macro-Core® will be advanced to the beginning of the intended sample interval, the piston will be released, and the Marco-Cores® will be driven to the end the intended sample interval. This method will ensure that sampling of "slough" does not occur. The Macro-Core® will then be retrieved and the collected soil core will be extruded from the sampler along with the liner. After decontamination, the Macro-Core® sampler will be re-assembled using a new liner. The Macro-Core®, rods and other sample collection equipment will be decontaminated as indicated below in subsection 11.2.2.

4.4.3 Rotary Hollow Stem Auger Procedures

For rotary hollow-stem auger methods, split-spoon sampling will be conducted in accordance with ASTM Specification D-1586-84 for standard penetration test and split barrel sampling. Soil samples will be collected continuously through split-spoon sampling methods at the boring location. Split spoon samples will be collected ahead of the lead auger flight.

Upon collection of each split spoon sample, the lead auger will be advanced over the sampled interval prior to collection of the next split spoon sample. This method will ensure that "double-spooning" ahead of the augers does not occur. In addition, while the augers are being advanced a temporary auger plug will be placed at the bottom of the lead auger to minimize or eliminate the potential for formation materials to run up into the augers. The use of an auger plug will help assure that split spoon samples are representative of in-situ formation materials. Split-spoons will be decontaminated after each sample is collected as indicated below in subsection 11.2.2.

4.4.4 Rotosonic Procedures

For rotosonic methods, soil samples will be collected utilizing a stainless steel core barrel that is advanced utilizing resonant sonic energy. A larger diameter casing is then advanced over the core barrel. The core barrel is retrieved to the surface for sample extrusion. Core samples will be taken directly from the core barrel by extruding it into a plastic baggie-like sleeve, stainless steel tray, or retained in a clear plastic liner. The core barrel will be cleaned with tap water following each use. The field geologist will classify and sample the soil located within the liner. Upon completion, the excess soil will be placed into a 55-gallon drum for disposal and the inner liner properly disposed as indicated in Section 13. The core barrel will then be advanced within the isolation casing on the same borehole to collect the next soil core interval. The core barrel, casing, and other sample collection equipment will be decontaminated as indicated below in subsection 11.2.2.

References

1. New York State Department of Environmental Conservation, Division of Environmental Remediation, 2003. *Groundwater Monitoring Well Decommissioning Procedures*. NYSDEC, April, 2003.

2. ASTM, 1997. *D1586-84 (1992) Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.* ASTM, West Conshohocken, PA. 1997.

4.5 Shelby Tube Sampling

Shelby tube samples will be collected in accordance with the latest revision of ASTM D/587. When the desired sampling depth is reached, the hollow-stem auger or casing will be cleaned out using whatever method is preferred so as not to disturb the material to be sampled. The Shelby tube will be lowered to the bottom of the borehole, then advanced (pushed) via pressure without rotation by a continuous relatively rapid motion until 24 inches of penetration is achieved. At the discretion of the field geologist, a period of approximately 10 minutes, measured from the time of insertion, will be allowed to provide for sample adhesion to the tube walls. Prior to removal, the tube may be rotated two complete revolutions to shear the bottom of the sample from the native material.

Upon removal, the field geologist will log the tops and bottoms of the sample for soil classification. Samples recovered via Shelby tube will be preserved in conformance with the latest revision of ASTM D 4220. To preserve the natural moisture content of the samples, the tube ends will be sealed with a minimum of 0.50 inch of paraffin wax. Plastic slip caps will be applied at the ends of the sample tube, taped, then dipped and sealed in wax.

5. Soil/Sediment Description Procedure

The following soil description procedure is applicable for use in describing surface and subsurface soils. This procedure may be varied or changed as required, dependent upon site conditions and equipment limitations. Any deviation from this standard will be documented in the field sampling book and in the final report.

5.1 Description Method

All soils will be described using the Unified Soil Classification System/ASTM D2488. The use of one standard will allow continuity of sampling descriptions between sample locations and personnel.

5.2 Sample Interferences

Proper handling of cores while recording descriptions will be used to ensure that handling does not effect sample collection or cause cross contamination within the core sample.

Cross Contamination: Eliminated or minimized with dedicated or disposable sampling equipment where appropriate. Where the use of dedicated or disposable sampling equipment is not possible or practical, the equipment will be decontaminated in accordance with the procedure for the decontamination of field sampling equipment located below in Section 11.

5.3 Equipment/Apparatus

Equipment needed for description of soil samples may include:

- Stainless steel sampling tools
- Decontamination equipment/supplies
- Safety equipment
- Tape measure
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent marker
- PPE

5.4 Soil Sample Description Procedure

The sampling procedure is as follows:

All soils are to be logged using ASTM D2488 *Standard Practice for Description and Identification of Soils*. The description of each sample interval should be prepared as follows:

1. The specific intervals for description should be noted for each sample. The description should not necessarily be for the entire subsurface soil interval. Geologic horizons, small-scale units, or other changes in soil conditions within the subsurface soil sample should be identified and described separately.
2. Soil description should include particular notes if the field representative believes that there is a possibility the soil sample being described is not representative of the interval sampled.
3. The following data will be recorded on the sample collection method, if applicable:
    a. Method of collection, hollow stem auger, rotosonic, Geoprobe®, etc.
    b. Interval sampled vs. amount recovered.
    c. Blow counts, weight of hammer, and hammer free fall distance for split spoon samplers, if used.
4. For course grained soils with less than 50% fines:
    a. GROUP NAME (SYMBOL), Structure, % Gravel Sand and Fines in order of predominance, % Cobbles and/or boulders (by Volume), Maximum Particle Size, Other (moisture, depositional descriptions, representativeness), Color, Local or Geologic Name, environmental/geologic descriptions.
5. For fine grained soils with greater than or equal to 50% fines:
    a. GROUP NAME (SYMBOL), Structure, Plasticity, Plasticity characteristics (if performed), % Gravel Sand, and size ranges, Other (moisture, depositional descriptions, representative nature), Color, Local, or Geologic Name, Field Soil Strength measurements (if performed), environmental/geologic descriptions.
6. Specific descriptions of each of the above description categories are described in Appendix B or below.
7. Soil moisture will be described as Dry, Moist, or Wet.
8. Soil color will be described using the color chart in Appendix B. Colors may be combined: e.g., red-brown. Color terms should be used to describe the "natural color" of the sample as opposed to staining caused by contamination.
9. The representative nature of the sample interval should be noted if there is a possibility the soil sample being described is not representative of the interval sampled.

10. Visual evidence of contamination should be described in the sample log with the specific depths or depth intervals where the contamination was noted. Descriptions of visual, olfactory, and product observed should conform to the following standards.
    a. **Sheen** - iridescent petroleum-like sheen. Not to be used to describe a "bacterial sheen" which can be distinguished by its tendency to break up on the water surface at angles, whereas petroleum sheen will be continuous and will not break up. A field test for sheen is to put a soil sample in a jar of water and shake the sample (jar shake test), then observe the presence/absence of sheen on the surface of the water in the jar.
    b. **Stained** - used w/color (i.e., black or brown stained) to indicate that the soil matrix is stained a color other than the natural (non-impacted) color of the soil.
    c. **Coated** - soil grains are coated with tar/free product – there is not sufficient free-phase material present to saturate the pore spaces.
    d. **Blebs** - observed discrete sphericals of tar/free product - but for the most part the soil matrix was not visibly contaminated or saturated. Typically, this is residual product.
    e. **Saturated** - the entirety of the pore space for a sample is saturated with the tar/free product. Care should be taken to ensure that you are not observing water saturating the pore spaces if you use this term. Depending on viscosity, tar/free-phase saturated materials may freely drain from a soil sample.
    f. **Oil**. Used to characterize free and/or residual product that exhibits a distinct fuel oil or diesel fuel like odor; distinctly different from MGP-related odors/impacts.
    g. **Tar**. Used to describe free and/or residual product that exhibits a distinct "coal tar" type odor (e.g., naphthalene-like odor). Colors of product can be brown, black, reddish-brown, or gold.
    h. **Solid Tar**. Used to describe product that is solid or semi-solid phase. The magnitude of the observed solid tar should be described (e.g. discrete granules or a solid layer).
    i. **Purifier Material**. Purifier material is commonly brown/rust or blue/green wood chips or granular material. It is typically associated with a distinctive sulfur-like odor. Other colors may be present.
    j. **Olfactory Descriptors.** Use terms such as " tar-like odor" or "naphthalene-like odor" or "fuel oil-like odor" that provide a qualitative description (opinion) as to the possible source of the odor. Use modifiers such as strong, moderate, faint to indicate intensity of the observed odor.
    k. **Dense Non-Aqueous Phase Liquid (DNAPL)/Light Non-Aqueous Phase Liquid (LNAPL).** A jar shake test should be performed to identify and determine whether observed tar/free-phase product is either denser or lighter than water. In addition, MGP residues can include both light and dense

phases - this test can help determine if both light and dense phase materials are present at a particular location.

l. **Viscosity of Free-Phase Product –** If free-phase product/tar is present, a qualitative description of viscosity should be made. Descriptors such as:

Highly viscous (e.g. taffy-like)
Viscous (e.g. No. 6 fuel oil or bunker crude like)
Low viscosity (e.g. No. 2 fuel oil like)

11. A photo ionization detector or flame ionization detector (PID/FID) will be used to screen all soil samples at the core location at 6 to 12-inch intervals. This screening data may be used to aid in selection of specific analytical sampling intervals. In addition, the PID or FID will be used to screen samples using the jar headspace method described below in subsection 5.5. The maximum readings from the jar headspace screening will be recorded and included on the logs. PID or FID will be calibrated daily at a minimum.

5.5 Soil Screening Procedure

The objective of field screening of soils is to measure the relative concentrations of volatile organic compounds (VOCs) present in soil at the project site. This information can be used to: 1) segregate soil based upon the degree of impacts, 2) to identify samples for laboratory analysis of VOCs, and 3) as a qualitative method to evaluate the presence or absence of VOCs in soils. A PID or FID may be used.

Procedure

1. Prior to sampling event, the instrument must be calibrated to the appropriate standard and have the appropriate detector for the contaminants expected to be encountered at the site. The type of standard and detector to be used is indicated in the Draft QAPP.
2. Record background readings of atmospheric conditions in the work area while walking across the work area. The highest meter response should be recorded in the field notebook.
3. Fill a clean, glass jar approximately half way with soil. Use a clean stainless steel sampling implement. Quickly cover the top of the jar with a sheet of aluminum foil and affix the lid to the jar. Each jar should be labeled to indicate the sample location and depth from which the sample was collected.
4. Allow the soil to volatilize for at least 10 minutes. Shake vigorously at the beginning and at the end of the headspace development period. If ambient temperatures are below 50 °F, headspace development should occur, if possible, with a heated area.

5. After headspace development, gently remove the screw cap and expose the foil seal. Quickly puncture the foil seal with the instruments tip to approximately ½ of the headspace depth.
6. Following the probe insertion through the foil seal, record the highest meter response as the jar headspace concentration. Maximum response should occur within 3 to 5 seconds after probe insertion.

Precautions

- Follow safety procedures defined within the Williamsburg Works MGP Site Health and Safety Plan (HASP).
- The various instruments may work poorly in rain, high humidity, or in cold temperatures. In these instances, headspace readings will be completed in dry or warm areas.
- Care must be taken to prevent water or soil particulates from entering the tip of the instrument. If this occurs, the probe tip should be cleaned before further use.
- While establishing background conditions and performing jar headspace screening, care should be taken to avoid extraneous VOC sources such as vehicle emissions or other organic vapor sources.

5.6 Air Monitoring Procedure

Air monitoring will be conducted as specified in the Work Plan and the HASP dated April 2008 that is provided as part of the RI Work Plan. Air monitoring will be conducted utilizing a PID during all intrusive subsurface soil sampling activities. A multiple gas meter will be used to monitor will be used to monitor for total VOCs, hydrogen cyanide, hydrogen sulfide, lower explosive limit (LEL) and percent oxygen during intrusive subsurface soil sampling activities. During subsurface soil sampling, particulate monitoring will be conducted with a personal mini-ram digital particulate meter up wind and downwind of the work zone. All monitoring equipment will be calibrated at the beginning of the day and more frequently, if needed, with manufacturer specified calibration gas.

5.7 Quality Assurance/Quality Control

There are no specific QA activities that apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

5.8 Sample Labeling Procedure

All samples collected will be labeled in accordance with the table listed below.

PRIMARY SAMPLES TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES Surface Soil-ID (SAMPLE DEPTH-FEET) WW-SS-01 (0-0.2) Test Pit-ID (SAMPLE DEPTH-FEET) WW-TP-01 (5-6) Boring -ID (SAMPLE DEPTH-FEET) WW-SB-01 (10-15) **GROUNDWATER SAMPLES** Monitoring Well-ID WW-MW-01 **SOIL VAPOR SAMPLES** Soil Vapor-ID WW-SV-01	**FIELD BLANKS** SAMPLE-ID – [DATE] WW-SS-FB-033108 WW-SB-FB-033108 WW-MW-FB-033108 **MATRIX SPIKE/DUP** SAMPLE [ID] [DEPTH] [EITHER Matrix Spike (MS) OR Matrix Spike Duplicate (MSD)] WW-SS-01 (10-15) MS/MSD WW-SB-01 (10-15) MS/MSD WW-MW-01 (10-15) MS/MSD **TRIP BLANKS** SAMPLE- ID [DATE] WW-TB-063008 **BLIND DUPLICATES** SAMPLE -ID[XX][DATE] WW-SS-XX-063008 WW-SB-XX-063008 WW-MW-XX-063008

In addition to the information listed above, each sample will be labeled with the date and time the sample was collected, laboratory analysis requested, initials of the sampler(s), and the project number. Sample handling procedures are located in the QAPP.

References

1. ASTM *D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).* ASTM International, West Conshohocken, PA.

2. ASTM *D 2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).* ASTM International, West Conshohocken, PA.

6. Test Pit Excavation

The following test pit soil sample collection procedure is applicable to the collection of representative subsurface soil using a backhoe. Alternative methods may be used at the field representative's discretion with the authorization of KeySpan and NYSDEC.

6.1 Test Pit Specifications

Test Pits will be installed according to the following specifications:

1. When specified in the Site Work Plan, test pits will be excavated using a rubber-tired backhoe. In the event deep excavations are required, a track hoe will be utilized.
2. Locations of test pits will be finalized in the field, based on the location of potential source areas and existing underground utilities.
3. If the prospective test pit location is covered by asphalt or concrete, the area will be saw cut prior to excavation.
4. During excavation activities, personnel will stand upwind of the excavation area to the extent possible. Air monitoring will be conducted in accordance with the HASP.
5. Test pit materials will be visually described, as well as photographed for future reference.
6. Material removed from the test pit will be placed on polyethylene sheeting.
7. Should sampling of excavated material be performed, samples will be collected from the stockpiled material and/or the backhoe bucket.
8. Upon completion, the materials from the test pit will be placed back in the excavation in the reverse order in which it was excavated.
9. Visually clean soils, such as surface soils, will be segregated from soils that may be impacted. The visually clean soils will be used to cover the impacted soils/source materials when placed back in the excavation.
10. Test pits will be backfilled as soon as possible after completion. No test pit excavation will remain open overnight.
11. For gravel roadways and parking areas, the backfill will be tamped down in 18-inch lifts. A six (6) inch layer of clean run of crushed gravel will be tamped in-place as the final lift. For test pits located in asphalt-covered areas, the surface will be replaced with cold or hot asphalt mix, compacted by rolling, and trimmed flush with the adjoining surface. Test pits located in grassed areas will be reseeded.
12. Following restoration of the excavation, the test pit will be staked to facilitate subsequent location by surveying crews, if necessary.

13. If during test pit activities a pipe or other buried utility is encountered, excavation will cease, the orientation and dimensions will be recorded, the test pit backfilled and a new test pit attempted in the general vicinity of the initial location. If a pipe or underground utility is accidentally severed, the owner of the utility, then KeySpan, will immediately be notified. Liquid flows or electricity will be shut off immediately and appropriate repairs initiated as soon as possible. If a release of liquid occurs, the Consultant/Contractor PM will notify KeySpan who will then notify NYSDEC. Appropriate response actions will be implemented.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

7. Monitoring Well Installation and Development

Monitoring wells will be installed at the completion of the soil boring installation, all permanent wells will be developed prior to the collection of groundwater samples. The following procedures will be used to install and develop all permanent monitoring wells.

7.1 Monitoring Well Specifications

Monitoring wells installed in unconsolidated deposits that do not penetrate a presumed confining layer will be constructed according to the following specifications:

1. Install polyvinyl chloride (PVC) 1.5-inch or 2-inch diameter, threaded, flush-joint casing, 1.5-inch or 2-inch diameter inner diameter screens.
2. Wells will be screened in the unconsolidated deposits. Screens will be 10 feet in length, and slot openings will be 0.010 inch. Alternatives may be used at the discretion of the field geologist, based on site-specific geologic conditions.
3. If appropriate, a sump, at least 2 feet in length, may be attached to the bottom of the screen to collect DNAPLs.
4. Where appropriate, the annulus around the screens will be backfilled with clean silica sand (based on Site-specific geologic conditions and screen slot size) to a minimum height of 1 to 2 feet above the top of the screen.
5. Where appropriate a bentonite pellet seal or bentonite slurry will be placed above the sand pack. If a pellet seal is used, it will be allowed to hydrate for at least 30 minutes before placement of grout above the seal. Where possible, the bentonite pellet seal will be a minimum of 24-inches in depth, except in those instances where the top of the well screen is in close proximity to the ground surface. In these instances, the well will be completed in accordance with specifications provided by the field geologist who will incorporate an adequate surface seal into the well design.
6. The remainder of the annular space will be filled with a cement grout up to the ground surface. The grout will be pumped from the bottom up. The grout will be mixed in the following relative proportions: One 94-pound bag Type I Portland cement, 3.9 pounds powdered bentonite, and 7.8 gallons potable water. The grout will be allowed to set for a minimum of 48 hours before wells are developed.
7. The top of the casing will be finished using flush-mount casings with keyed-alike locks.
8. A concrete surface pad will be sloped to channel water away from the well casing.
9. A weep hole will be drilled at the base of the protective standpipe casing to allow any water between the inner and outer casing to drain.
10. The top of the PVC well casing will be marked and surveyed to 0.01 foot, and elevations will be determined relative to a fixed benchmark or datum. The

measuring point on all wells will be on the innermost PVC casing.

11. Characteristics of each newly installed well will be recorded in the field notebook. A monitoring well checklist is shown on Figure 1 and a generic overburden well monitoring diagram is shown on Figure 2 attached within Appendix C.

Monitoring wells that penetrate a confining layer will be installed via double/ isolation casing.

A typical double-cased monitoring well construction diagram for wells installed in unconsolidated soils that penetrate a presumed confining layer is located in Appendix C. The decision to install double-cased wells will be made on a boring-specific basis by the field geologist. Double-cased wells will be installed when the boring for the monitoring well penetrates a presumed confining layer. The confining layer shall be defined as a minimum five (5) foot thick, predominantly clay unit that has been shown to be laterally continuous across the Site. In the event the field geologist, KeySpan, and NYSDEC PMs decide a reasonable possibility exists for contamination to be deposited in deeper, clean zones during the drilling and installation of a monitoring well, the well will be double-cased. The purpose of the steel protective casing will be to minimize the possibility that residual contamination is deposited at the depth of the screened interval during the drilling process.

Monitoring wells that penetrate confining layers will be installed according to the following specifications:

- 6-inch inner diameter (ID) steel outer casings will be installed to a depth of at least 2 feet below the lower limit of observed or measured contamination and/or the confining layer. This casing will be grouted in place with cement or sealed by alternate methods approved by the NYSDEC to inhibit downward migration of contamination.
- The 6-inch casing will be installed through 6.25-inch ID hollow-stem augers. The augers will be filled with grout prior to their removal to ensure the integrity of the borehole and the grout seal. Then, the 6-inch casing will be installed into the grout and hydraulically pushed approximately 1-foot beyond the bottom of the boring. Potable water will be tremied to the bottom of the inside of the casing to dilute the grout, thereby allowing the grout to be more easily pumped out of the casing. The grout pumped out of the casing will be drummed and staged with other investigation-derived waste (IDW). Alternate isolation methods may be used as approved by the NYSDEC.
- The cement-bentonite grout remaining in the annulus between the casing and the formation will be allowed to set for at least 24 hours before drilling is continued. The drilling will then continue using a 4-inch diameter flush-joint spin casing or other

appropriately sized drill casing and potable water. All lubricant water will be containerized.

The well will be constructed of 2-inch diameter PVC or stainless steel riser pipe and screen, sand pack, bentonite seal, grout, and surface casing as specified for single cased monitoring wells and in accordance with NYSDEC requirements. The bentonite seal may consist of pellets or a mixture of bentonite slurry and sealed with grout. The grout will be mixed in the following relative proportions: One 94-pound bag Type I Portland cement, 3.9 pounds powdered bentonite, and 7.8 gallons potable water. The grout will be allowed to set for a minimum of 48 hours before wells are developed.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

7.2 Monitoring Well Development

After a minimum of 48 hours after completion of permanent monitoring wells, one or a combination of the following techniques will be used in the monitoring well development:

1. Surging;
2. Bailing;
3. Using a centrifugal pump and dedicated polyethylene tubing; and/or
4. Positive displacement pumps and dedicated polyethylene tubing.

Development water will initially be monitored for organic vapors with a PID. In addition, the development water will be observed for the presence of non-aqueous phase liquids NAPLs or sheens. The development water will be contained in a tank and/or 55-gallon steel drums on-site. The purge water will be disposed of in accordance with NYSDEC requirements. The wells will be developed until the water in the well is reasonably free of visible sediment (<50 nephelometric turbidity units (NTU) if possible). Well development will not exceed 10 well volumes. Following development, wells will be allowed to recover for at least two weeks before groundwater is purged and sampled. All monitoring well development will be overseen by a field representative and recorded in the field logbook.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

7.3 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing may be performed on selected monitoring wells as indicated in the Site Work Plan to obtain estimates of groundwater velocities and potential groundwater recovery rates for the aquifer. The objective of the hydrogeologic testing is to determine the hydraulic properties of the aquifer in the vicinity of the Site.

Slug tests may be conducted in selected monitoring wells utilizing the rising or falling head slug test technique. Rising head tests can be performed in unconfined and confined aquifers. Falling head tests should only be performed in confined aquifers. The slug tests will be performed by subjecting water-bearing units in the screened interval to a stress caused by the sudden displacement of the water level within the well. The rising head tests will be conducted as follows:

1. Slugs and other downhole equipment will be decontaminated before and after each test by methods described in Section 10.
2. Prior to conducting each slug test, the static water level in the well will be measured to the nearest 0.01 foot. Water levels will be measured during the test with an electronic water level indicator and with pressure transducers attached to a data logger, thereby providing water level measurements by two independent devices.
3. A weighted slug of known volume will be inserted gently into the well below the water table. The water level will be measured until the water level returns to static conditions.
4. The slug will be suddenly withdrawn from the well and the water level recovery will be monitored at appropriate intervals until recovery is complete and stabilized.
5. Wells that were bailed dry during development may not be able to provide meaningful data through slug tests. Tests will be terminated in wells that do not recover significantly (>80% of static level) within one hour. These wells will be bailed dry and their recovery measured with an electronic water level indicator.

The falling head tests will be conducted as follows:

1. Slugs and other downhole equipment will be decontaminated before and after each test by methods described in Section 10.
2. Prior to conducting each slug test, the static water level in the well will be measured to the nearest 0.01 foot. Water levels will be measured during the test with an electronic water level indicator and with pressure transducers attached to a data logger, thereby providing water level measurements by two independent devices.

3. A weighted slug of known volume will be quickly inserted into the well below the water table. The water level will be measured until the water level returns to static conditions.
4. The test will be terminated in wells that do not recover significantly (>80% of static level) within one hour.

The slug test data will be analyzed using either the Cooper, Bredehoeft, and Papadopulos (1967) type curve method or the Bouwer and Rice (1976, 1989) method. The Cooper et al. analysis assumes that the well penetrates a confined aquifer, and the Bouwer and Rice method applies where unconfined conditions are prevalent.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

8. Groundwater Sampling Procedure

The following is a step-by-step sampling procedure to be used to collect groundwater samples from the monitoring wells and temporary groundwater monitoring points. Well sampling procedures will be recorded in the field notebook. Sample management is detailed in the QAPP.

1. Groundwater samples will not be collected until at minimum, two weeks following well development of permanent wells.
2. Prior to sampling, a round of groundwater elevation measurements will be collected. The measurements will be made from the surveyed well elevation mark on the top of the inner PVC casing with a decontaminated electric water/product level probe. The measurements will be made in as short a time frame as practical to minimize temporal fluctuations in hydraulic conditions. The time, date, and measurement to nearest 0.01 foot will be recorded in the field logbook.
3. Place a plastic sheet on the ground to prevent contamination of the bailer rope and/or the tubing associated with the purging (pump) equipment.
4. Each monitoring well will be purged with a centrifugal, submersible, peristaltic, or whale pump and dedicated polyethylene tubing, or other methods at the discretion of the field geologist, and with the prior approval of KeySpan and NYSDEC.
5. Monitoring wells will be purged at a rate to minimize drawdown within the well to the extent practicable.
6. The water quality parameters of temperature, pH, conductivity, oxygen reduction potential, turbidity, and dissolved oxygen (DO) will be measured and recorded, at 3 to 5 minute intervals with a multi-parameter water quality probe. At least, 1 well volume of water will be removed prior to sampling. When the parameters stabilize over 3 consecutive readings, sampling may commence. Stability is achieved when pH is within 0.1 standard unit, temperature is within 0.5ºC, Eh is within 10% and specific conductivity is within 10% for three consecutive readings. Record results in the field logbook prior to sample collection.
7. Collect VOC samples with a dedicated polyethylene bailer lowered by a dedicated polypropylene rope or other methods as indicated. Other parameters may be collected with a submersible, or peristaltic pump using the low-flow sampling technique. The pump should be capable of throttling to a low flow rate suitable for sampling.
8. If the well goes dry before the required volumes are removed, the well may be sampled when it recovers sufficiently.

9. After all samples are collected, the water level in the monitoring well will be gauged and the locking cap will be re-installed.
10. Investigation derived water and PPE will be disposed of dedicated disposable sampling equipment in garbage bags or stored in temporary 5-gallon containers.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.
2. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples From Monitoring Wells,* published July 30, 1996 by the United States Environmental Protection Agency (EPA).

9. Soil Vapor and Indoor Air Sampling Procedure

9.1 Soil Vapor Sample Collection

This set of procedures outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

9.1.1 Soil Vapor Probe Installation

Permanent and temporary soil vapor probes will be installed using the procedure outlined below:

- Record weather information (temperature, barometric pressure, rainfall, wind speed, and wind direction). Record substantial changes to these conditions that may occur during the course of the probe installation. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Install soil vapor probes using a direct-push drill rig (e.g., GeoProbe® or similar) or manually using a slide hammer. Probes will consist of stainless-steel drive points with stainless steel screens attached to food-grade (inert) Teflon or polyethylene tubing through which the soil vapor sample will be drawn.
- Attach the drive points to a drive rod (stainless-steel tube) and drive the rod to the target depth, as define in the work plan.
- Withdraw the drive rods from the hole, leaving the drive point and tubing.
- Place filter pack material, such as glass beads or clean silica sand, in the annular space surrounding the tubing directly above the sample point to a height of approximately 1 to 2 feet. The depth of the filter pack material should always be adequate to prevent the bentonite slurry above from going over the drive point and sample inlet screen.
- Place bentonite slurry in the annulus above the filter pack material to provide a seal in the borehole. Ideally, place the bentonite annular seal at least 3 feet thick, although adjustments to this thickness may be required based on site-specific conditions. The entire borehole must be filled to the ground surface with either entirely bentonite or with natural fill between two bentonite seals (one above the filter pack material and one at the ground surface). Permanent installations must have a surface seal made of cement or cement/bentonite grout.
- For permanent installations, install flush-mounted protective covers to protect the probe and the tubing.
- Cut the end of the tubing to allow proper closure of the flush-mounted protective cover, but with a sufficient length of tubing exposed at the surface to facilitate connection of sampling equipment.

- Close or cap the sample tubing following installation and following collection of each sample.

9.1.2 Collection of Soil Vapor Samples

Collecting soil vapor samples will be accomplished by using the following procedure:

- Record weather information (i.e., temperature, barometric pressure, rainfall, wind speed, and wind direction) at the beginning of the sampling event. Also, record substantial changes to these conditions that may have occurred over the past 24 to 48 hours and that do occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles, etc.).
- Identify sampling locations on a plot plan that also identifies buildings, other landmarks, and potential sources of VOC contamination to both the surface and outdoor air. Record the depth of the probe screen below grade.
- If necessary, connect additional tubing to the tubing extending from the soil vapor probe to allow for connection to sample collection equipment.
- Calculate the volume of air in the probe, tubing (volume = $\pi r^2 h$), including any additional tubing added in the step above and the annular space between the probe and the native material if sand or glass beads were used.
- Connect a vacuum pump or gas-tight syringe (~60 cubic centimeters [cc]) to the sample tubing. At a flow rate of no more than 0.2 liter per minute (lpm), purge air from the tubing until one to three of the above-calculated air volumes are removed.
- During purging, evaluate the potential for ambient air to be introduced in the soil vapor sample through the annulus of the soil vapor probe or tubing connections using a tracer gas such as helium. The procedures for the tracer gas evaluation are described below. Note that the bentonite used in the probe installation should have sufficient time to seal before the samples are collected. The tracer gas evaluation will verify if the seal is sufficient.
- Use an evacuated Summa® passivated (or equivalent) stainless-steel canister to collect the soil vapor sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre-calibrated by the laboratory for the desired flow rate or duration of sample collection, as identified in the project-specific work plan. The sampling flow rate should always be less than 0.2 lpm. The canisters will be batch certified as clean by the laboratory.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by

the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Connect the tubing from the soil vapor probe to the flow controller.
- Completely open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).
- Provided that no additional sampling is expected to be conducted, either pull out (if practical) or abandon in place the sampling probe. When abandoning, cut the tubing back as far down as practical and cover to surface with native soil.

All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II SOP for the Validation of Organic Data modified to accommodate the USEPA Method TO-15.

9.1.3 Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample. A tracer gas evaluation should be conducted on all soil vapor probes. After the initial round of sampling and with the approval of the regulating agency, the use of tracer gas may be reduced to a minimum of 10 percent for permanent and semi-permanent probes if the initial round results showed installations with competent seals.

The following tracer gas evaluation procedure uses in-field tracer gas measurements and tracer gases (e.g., helium) that can be measured by portable detectors.

- Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. A tracer gas detector will be attached to the valve fitting at the bottom of the chamber to verify the presence of the tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >50%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior measuring the tracer gas concentration.
- Use the tracer gas detector to measure the tracer gas concentration in the pump exhaust.
- Record the tracer gas concentrations in the chamber and in the soil vapor sample. If the evaluation indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement of the sample collection. A nondetectable level of tracer gas is preferred; however, if the evaluation indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

9.2 Sub-Slab Soil Vapor Collection

This set of procedures outlines the general steps to collect sub-slab vapor samples. The Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

9.2.1 Sub-Slab Vapor Probe Installation

Temporary sampling probes will be installed using the following procedures:

- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles, etc.).
- If appropriate, record weather information (temperature, barometric pressure, rainfall, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may have occurred over the past 24 to 48 hours and that do occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Identify sampling location(s) on a floor plan that also identifies any slab breeches (e.g., utility penetrations, sumps, drains, and cracks) and locations of HVAC equipment.
- Insert a section of food-grade (inert) Teflon® or other appropriate tubing through a 3/8-inch (approx.) hole drilled through the slab. If necessary, advance the drill bit 2 to 3 inches into the sub-slab material to create an open cavity.
- Install the tubing inlet to the specified sampling depth below the slab, not to exceed 2 inches.
- Seal the annular space between the hole and tubing using 100% beeswax or another inert, non-shrinking sealing compound such as permagum.

9.2.2 Sub-Slab Vapor Sample Collection

Sub-slab vapor samples will be collected by following the steps outlined below.

- Purge the tubing using a vacuum pump or gas-tight syringe (~60 cc). Calculate the volume of air (volume = _$\pi r^2 h$) in the tubing and purge one to three tubing volumes prior to sample collection at a rate no greater than 0.2 liter per minute (lpm).
- Use an evacuated Summa® passivated (or equivalent) canister to collect the sub-slab vapor sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre-calibrated by the laboratory for the desired flow rate or duration of sample collection, as defined in the site-specific work plan. The sampling flow rate should always be less than 0.2 lpm. The canisters will be batch certified as clean by the laboratory.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab vapor sampling probe to the flow controller.

- Completely open the valve on the canister. Record the time that the valve is opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling, when practical (sometimes the canister will sample over a 24-hour period and routine monitoring is not practical).
- Complete the NYSDOH building survey and chemical survey form.
- Stop sample collection after the scheduled duration of sample collected, but when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).
- For temporary probes, remove the probe and seal the slab hole with cement. Repair flooring, if any.

All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II SOP for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

9.2.3 Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample. A tracer gas evaluation should be conducted on all soil vapor probes. After the initial round of sampling and with the approval of the regulating agency, the use of tracer gas may be reduced to a minimum of 10 percent for permanent and semi-permanent probes if the initial round results showed installations with competent seals.

The following tracer gas evaluation procedure uses in-field tracer gas measurements and tracer gases (e.g., helium) that can be measured by portable detectors.

- Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. A tracer gas detector will be attached to the valve fitting at the bottom of the chamber to verify the presence of the tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >50%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior measuring the tracer gas concentration.
- Use the tracer gas detector to measure the tracer gas concentration in the pump exhaust.
- Record the tracer gas concentrations in the chamber and in the soil vapor sample. If the evaluation indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement of the sample collection. A nondetectable level of tracer gas is preferred; however, if the evaluation indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

9.3 Indoor Air Sample Collection

This set of procedures outlines the general steps to collect indoor air samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sampling locations and other indoor air requirements (inventory, etc.).

Indoor air samples will be collected by following the steps outlined below:

- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles, etc.).
- Record weather information (temperature, barometric pressure, relative humidity, wind speed, and wind direction) and indoor temperature and humidity at the beginning of the sampling event. Record substantial changes to these conditions that may have occurred over the past 24 to 48 hours and that do occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Identify sampling location(s) on a floor plan that also identifies locations of HVAC equipment, chemical storage areas, garages, doorways, stairways, sumps, drains, utility perforations, north direction, and separate footing sections
- Use an evacuated Summa® passivated (or equivalent) stainless-steel canister to collect the outdoor air sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre-calibrated by the laboratory for the desired flow rate or duration of sample collection, as defined in the site-specific work plan. The sampling flow rate should always be less than 0.2 lpm. The canisters will be individually certified as clean by the laboratory.
- Place the canister at the sampling location. The sample should be collected from breathing height (e.g., 3 to 5 feet above ground). Either mount the canister on a stable platform or attach a length of inert tubing to the flow controller inlet and support it such that the sample inlet will be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.
- Completely open the valve on the vacuum pressure in the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling, when practical (sometimes the canister will sample over a 24-hour period and routine monitoring is not practical). During monitoring, note the vacuum pressure on the gauge.
- Complete the NYSDOH building survey and chemical survey form.
- Stop sample collection after the scheduled duration of sample collection, but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.

- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).

All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II SOP for the Validation of Organic Data modified to accommodate the USEPA Method TO-15.

9.4 Ambient Air Sample Collection

This set of procedures outlines the general steps to collect ambient air samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations and sampling duration.

The following procedures will be followed for the collection of ambient air samples:

- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles, etc.).
- Select a location upwind of the building or other area that is being evaluated. If possible, select a location upwind or near the HVAC air intake for the building being sampled.
- Record weather information (i.e., temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Use an evacuated Summa® passivated (or equivalent) stainless-steel canister to collect the ambient air sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre-calibrated by the laboratory for the desired flow rate or duration of sample collection, as defined in the site-specific work plan. The sampling flow rate should always be less than 0.2 lpm. The canisters will be individually certified as clean by the laboratory.

- Place the canister at the sampling location. If the sample should be collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet will be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.
- Completely open the valve on the vacuum pressure in the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Document on a field form an outdoor plot sketch that indicates the building being sampled, streets, sampling location, location of potential outdoor air sources, north direction and paved areas. Also record pertinent observations such as odors, readings from field instrumentation, and significant activities in the vicinity that result in air emissions.
- Monitor the vacuum pressure in the canister routinely during sampling, when practical (sometimes the canister will sample over a 24-hour period and routine monitoring is not practical). During monitoring, note the vacuum pressure on the gauge.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the chain-of-custody for the project file.

- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).

All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II SOP for the Validation of Organic Data modified to accommodate the USEPA Method TO-15.

References

1. *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York,* New York State Department of Health, October 2006.

2. *Draft Standard Operating Procedure for Soil Vapor Intrusion Evaluations at National Grid Sites in New York State,* National Grid, March 2008.

10. Sediment Sampling Procedure

The following standard sediment sampling procedure is applicable to the collection of representative sediment core samples from the East River. This procedure may be varied or changed as required, dependent upon site conditions and equipment limitations. Any deviation from this standard will be documented in the field notebook and in the final report.

10.1 Sampling Methods

Location, equipment, and sampling situations will dictate the applicable method of sample collection for each point. Sediment sampling will generally accomplished through the use of one of the following samplers or techniques:

- Ponar/Shipek Grab Sampler
- Vibracore Sampler
- Remote Sampler

These samplers and sampling techniques will likely result in the collection of representative sediment samples from the East River and Bushwick Inlet.

10.2 Sample Interferences

Proper sampling procedures will be used to collect samples in accordance with this SOP to prevent cross contamination and improper sample collection. Common causes of sample interferences are listed below to ensure that the samplers can avoid potential sample collection problems.

1. Cross Contamination: Eliminated or minimized through the use of dedicated or disposable sampling equipment where appropriate. Where the use of dedicated or disposable sampling equipment is not possible or practical, the equipment will be decontaminated in accordance with the SOP for Decontamination of Field Sampling Equipment located in Section 11.
2. Improper Sample Collection: Typical improper sample collection techniques include:
    - Improper decontamination of sampling equipment.
    - Use of sampling equipment or sample containers that are not compatible with the contaminants of concern or the laboratory analytical method.
    - Sample collection in an obviously disturbed or non-representative area.

10.3 Equipment/Apparatus

Equipment needed for collection of sediment samples may include (depending on technique chosen):

- Vibracore Sampling Rig
- Ponar/Shipek Sampler
- Stainless Steel Sampling Tools
- Laboratory Provided Sample bottles
- Resealable plastic bags
- Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal protection equipment (PPE)
- Global positioning system (GPS)

10.4 Pre-Sampling Procedures

10.4.1 Sample Location

A GPS navigation system will be used to identify and record sample location coordinates. The base station will be located on land based survey control point tied into the New York State Plane coordinate system. If required, the proposed locations may be adjusted based upon access and obstructions.

10.5 Sample Collection

10.5.1 Ponar/Shipek Sampler

Surficial sediment samples will be collected from the upper 6 inches (approximate) using a Ponar or Shipek type grab sampler. Both of these sampling devices have the advantages of being relatively easy to handle and operate, readily available, moderately priced, and versatile in terms of the range of substrate types they can effectively sample. In addition, both of these grab samplers provide sufficient sample volume (7.5 or 3 cubic liters, respectively) to allow sub sampling for multiple analytes.

Careful use of grab samplers is required to avoid problems such as loss of fine-grained surface sediments from the bow wave during descent, mixing of sediment layers upon impact, lack of sediment penetration, and loss of sediment from tilting or washout upon ascent

The sampling procedure is as follows:

1. Prior to sample collection, the grab sampler will be decontaminated.
2. When deploying the grab sampler, the speed of descent should be controlled, with no “free fall” allowed. In deep waters, use of a winching system is recommended to control both the rate of descent and ascent.
3. The sampler will be carefully lowered the last few feet to minimize dispersal of fine material due to a sampler-induced shock wave.
4. At the time of the sample collection, the sample location will be surveyed with GPS survey equipment.
5. After the sample is collected, the sampling device should be lifted slowly off the bottom, and raised to the surface at a slow and steady rate.
6. Sediments in direct contact with sides or teeth of the grab sampler will be excluded from samples to prevent potential contamination from the grab sampling device when possible.
7. Prior to sampling directly from the grab sampler, the overlying water will be removed by opening the jaws of the ponar slightly and allowing the water to drain. If the overlying water is turbid, then the suspended solids will be allowed to settle, if possible, prior to draining.
8. Where sampling directly from the sampler is not possible or feasible, the sampler will be slowly opened over a sample platform. The sampler will be placed such that the sample may be deposited with minimal disturbance.
9. Photograph the sample in color with a camera. Place a small label with sample field Identification (ID) number and approximate depth so that it appears in each frame.
10. Sediments will be described in accordance with the soil description procedure listed above in Section 5.
11. Place sediment samples into pre-cleaned laboratory provided jars for the appropriate analyses as determined in the work plan. Label each jar with the unique grab sample identification number and depth of the sample.
12. Place the sample containers into plastic sealable bags or bubble wrap and place them in an iced cooler until transfer shipment to the analytical laboratories. Add sample to the chain of custody form.

If the above sampling protocols are followed, it will minimize the effects of typical disadvantages to Ponar or Shipek samplers such as possible shock wave and loss of very fine grained surface deposits, potential for water column contamination, and nearby down current sediment re-deposition. The potential does exist for larger materials such as twigs and stones to prevent jaw closure that will result in collection of unacceptable sample. In areas with significant debris in sediment, collection of a representative sediment surface sample may not be possible due to method and equipment limitations.

10.5.2 Vibracore Sampler

A Vibracore Sampler will be used to collect samples at depth that maintain a representative vertical profile of the sediment stratigraphy. The corer is slowly lowered to the substrate and vibrated into the sediments. Vibrations from the core barrel do cause minimal realignment of sediment grains; however, compaction and strata-bending are nearly eliminated.

The sample collection procedure is as follows:

1. The core location will be located via GPS and recorded in boat's navigational software and/or project field book.
2. Measure the water depth using appropriate means, such as a sounding line, marked pole or fathometer.
3. Press and vibrate the core barrel into the sediment until it is inserted 20 feet, or until refusal occurs. Note insertion length in the field book.
4. Retrieve the core barrel containing the sample.
5. With the Lexan sleeve and the barrel held vertically in the boat, drill a hole in the Lexan tube just above the top of the sediment column to drain off water.
6. Cut off the Lexan tube just above the sediment surface and cap both ends.
7. Label the tube lengths with sample station ID codes using a permanent marker.
8. Section the core into five 48-inch sections, capping each end, and ensuring the upper ends are marked with the depth interval.
9. Stow the core sections upright on the boat in a vertical rack.
10. Transport core sections ashore and place in an enclosed vertical rack with ice for processing as soon as possible.

Once on shore, the cores will be transported to the Williamsburg MGP site for processing. Core samples for visual logging and analytical sampling shall be processed as follows:

1. Place core section on the core-processing table and secure with the cutting guides.
2. Using the metal guides, cut the Lexan core liner lengthwise using a router or other vibrating cutter tool with a guide such that the cutting bit penetrates the Lexan liner and does not cut significantly into the sediment core. Rotate the core 180 degrees and repeat the process. Disturbed sediment adjacent to the liner wall should not be

sampled, but it is important not to contaminate the undisturbed interior of the core with plastic chips or other debris from the cutting process.

3. Once the liner wall is cut through along opposite sides (top and bottom of the horizontal core), use a 6-foot length of stainless steel wire to separate the core into two half-cylinders. With the core secured on the core processing table, line the wire up along the top saw cut. Draw the wire evenly thought the core vertically until the core is separated.
4. If the core material cannot be separated using the wire, a thin rectangular stainless steel blade should be used to separate the core using a series of vertical cuts along the core's axis. Vertical cutting in discrete steps, rather than "dragging" the blade through the core, insures that the layered structure of the core is not obscured, and that contaminants are not spread across layers. Between each vertical cut, decontaminate the blade as described in Section 11.
5. Arrange the two half-cylinders of the core section side-by-side, with the cut surfaces facing up. Extend a tape measure along them, starting at the original top end of the core.
6. Photograph the core in color with a camera. Insure that the wet surface of the core does not reflect light directly into the camera lens. Photograph the core section in overlapping frames; place a small label with core field ID number so that it appears in each frame. Advance the tape measure appropriately for any additional sections of the same core.
7. Sediments will be described in accordance with the soil description procedure (Section 5).
8. Collect each analytical sample, as pre-determined in the work plan, from the undisturbed core interior with a clean, stainless steel spoon or spatula. Do not sample any obviously "non-sediment" objects in the core interval; bottle caps, broken glass, sticks, large rocks, etc.
9. Place sediment samples into pre-cleaned laboratory provided jars for the appropriate analyses as determined in the work plan. Label each jar with the unique core identification number and depth of the sample.
10. Place the samples containers into plastic sealable bags or bubble wrap and place them in an iced cooler until transfer shipment to the analytical laboratories.

10.5.3 Remote Sampler

A remote sampler will be used to collect surficial sediment samples at shallow depths where either ponar/Shipek or vibracore methods are inaccessible.

The sample collection procedure is as follows:

1. Prior to sample collection, the remote sampler will be thoroughly decontaminated.

2. The remote sampler may consist of a stainless steel or Teflon scoop attached to a telescoping pole or other similar device.
3. The remote sampler is extended to the location of the sediment sample targeted for collection.
4. Once a sufficient volume of material is collected in the scoop, then the sampler should be retrieved slowly to avoid the loss of extremely fine material as the sampler passes thru the water column.
5. The sample is then transferred directly to a pre-cleaned laboratory container.
6. This process may be repeated if additional sample volume is necessary.

10.6 Quality Assurance/Quality Control

QA/QC procedures that apply to the these activities include QA/QC laboratory samples including blind duplicate, MS/MSD samples, and field blank samples. QA/QC samples are detailed in the Draft Work Plan and Draft QAPP. Prior to collection of the QA/QC samples, equipment will decontaminated in accordance with procedures described in Section 11.

The following general QA procedures apply:

All data must be documented on field data sheets or within site field notebooks.
All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented as indicated in the Draft QAPP.

References

U.S. Environmental Protection Agency, Office of Water, Office of Science & Technology. 2001. *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual*. EPA-823B-01-002, October 2001

State of Ohio, Environmental Protection Agency, Division of Surface Water. 2001. *Sediment Sampling Guide and Methodologies, Second Edition*. November 2001

ASTM, 2003. *D4823-95 (2003) Standard Guide for Core Sampling Submerged, Unconsolidated Sediments.* ASTM International, West Conshohocken, PA. August 2003.

11. Equipment Decontamination Procedure

The following equipment decontamination procedure is applicable for use in decontaminating sampling tools used in collection of analytical samples from surface soils, subsurface soils, and groundwater. Equipment decontamination will prevent cross-contamination and maintain analytical sample integrity. This procedure may be varied or changed as required, dependent upon site conditions and equipment limitations. Any deviation from this standard should be documented in the field-sampling book and in the final report.

11.1 Equipment/Apparatus

Equipment needed for decontamination of sampling equipment may include:

- Alconox or non-phosphate soap
- Simple Green
- Methanol
- 10% Nitric acid solution
- De-ionized water
- Decontamination buckets
- Secondary containment vessels
- Plastic sheeting
- Scrub brushes
- PPE

11.2 Equipment Decontamination Procedure

Equipment will be decontaminated in accordance with procedures specified in the Work Plan as summarized below. Equipment decontamination procedures are also detailed within the Draft QAPP.

11.2.1 Sampling Equipment and Tools

Prior to sampling, all non-dedicated equipment (i.e., bowls, spoons, bailers, and soil sampling apparatus (i.e. Macro-Core Shoe and split spoon equipment) will be decontaminated as follows.

- Decontamination of sampling equipment and hand tools may take place at the sampling location as long as all liquids are contained in pails, buckets, etc.
- All sampling equipment will be washed with water and a non-phosphate detergent (Alconox, Simple Green, etc.) to remove gross contamination.

- All sampling equipment will then be rinsed with de-ionized water.
- All equipment used to collect samples for VOC and semivolatile organic compounds (SVOC) analysis will then receive a methanol rinse followed by a de-ionized water rinse.
- All equipment used to collect samples for metals analysis will then receive a 10% nitric acid solution rinse followed by a de-ionized water rinse.
- At no time will decontaminated equipment be placed directly on the ground.
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

11.2.2 Drill Rig and Backhoe Decontamination

A decontamination pad will be constructed of High Density Polyethylene (HDPE) sheeting on a prepared surface sloped to a sump. If possible, the decontamination pad will be constructed onsite, even if work is to be performed offsite. If contaminated soils are encountered offsite, the need for a temporary off-site decontamination pad will need to be evaluated.

The size of the pad shall be sufficient to drive the drill rig on without tearing the sides or bottom of the plastic sheet. Sides of the pad will be bermed so that all decontamination water is contained. Upon completion of all field activities, the decontamination pad will be properly decommissioned. To accomplish decommissioning, all free liquids will be removed from the surface of the HDPE sheeting, including the sump area, and allowed to air dry. The HDPE sheeting will then be cut to manageable size, folded or rolled, and placed in the waste container (roll-off container or 55-gallon drum). The wood timbers used to construct the containment berm will be inspected to ascertain if the material has come in contact with decontamination liquids during use. If they have, the materials will be steam cleaned or disposed in the waste container for subsequent disposal at an appropriate facility. If the materials have not been in contact with decontamination liquids, they may be reused.

Geoprobe® rig drilling implements will be decontaminated with water and a non-phosphate detergent and water rinse. Decontamination will be completed in close proximity to the proposed borings and will be completed over a temporary decontamination pad or plastic containers because of site constraints. The macro-core sampling shoe will be decontaminated in accordance with subsection 11.2.1.

All equipment used in intrusive work including backhoe, drilling rig, augers, bits, tools, split-spoon samplers, and tremie pipe will be cleaned with a high-pressure hot water or steam cleaning unit. The equipment will be broom-cleaned with a wire brush to remove dirt, grease, and oil before beginning fieldwork and before leaving the project Site upon completion of the last sampling activity. Tools, drill rods, and augers will be placed on sawhorses or polyethylene plastic sheets following steam cleaning. Direct contact with the ground should be minimized. The augers, rods, and tools will be decontaminated between each drilling location according to the above procedures. The backhoe bucket, arm, and any other part of the equipment, which may have contacted excavated soil, will be decontaminated between each test pit location. Decontamination water will be containerized on-site prior to disposal.

Unless sealed in manufacturers packaging, monitoring well casing and screens will be steam cleaned immediately before installation. The screen and casing shall then be wrapped in polyethylene plastic and transported from the designated decontamination area to the well location.

11.3 Quality Assurance/Quality Control

There are no specific QA activities that apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on field data sheets or within site field notebooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.
2. U.S. Environmental Protection Agency, 1993. U.S. EPA Contract Laboratory Program – Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration. Document ILMO1.0-ILO-1.9, 1993. U.S. Environmental Protection Agency, Washington, DC.

12. Analytical Sample Handling and Transport

Subsurface soils collected will be handled and submitted for laboratory analysis according to the following procedure. The QAPP provides a detail description of sample handling and transport.

1. Samples will be transferred from the sample equipment into suitable, labeled sample containers specific for the laboratory analyses to be performed. Use laboratory-provided, pre-preserved sample bottles for specific analyses. Do not overfill bottles if they are pre-preserved.
2. Secure the sample container with the appropriate cap, place the sample container in a resealable plastic bag or bubble wrap, and place it inside of a sample cooler provided by the laboratory. Use ice to cool the sample cooler to 4 degrees Celsius.
3. Record all pertinent sample identification data in the site database and/or field notebook.
4. Print the completed COC record from the database, sign, and photocopy. If necessary, a hard copy COC may be used in the place of the electronic database. A COC is attached in Appendix D. Place the original COC in a resealable plastic bag and affix it to the inside of the top of the cooler/or will transmitted to the laboratory courier upon a sample pick-up.
5. Attach a custody seal to the outside of the cooler prior to shipment/pickup.

13. Investigation-Derived Waste Handling Procedure

13.1 General Waste Handling Procedures

The following procedure provides guidelines for the management of investigation derived wastes. Wastes anticipated to be generated as part of the Williamsburg Works MGP RI include the following materials: subsurface soils, groundwater, decontamination fluids, PPE, and miscellaneous investigation-derived field supplies. All wastes will be segregated into sediment and subsurface soil, fluids and PPE/miscellaneous investigation-derived materials. Investigation derived wastes will be placed in a United States Department of Transportation (USDOT)-approved 55-gallon drum, roll-off or tank. Each waste vessel will labeled with a "Non-Hazardous Waste Label" designated with "Pending Characterization."

Information on the label should include:

Generator: KeySpan Corporation
Address: 1 MetroTech Center, Brooklyn, NY 11201

At the end of each day, each waste container should be secured and placed onto the drum containment pad. Each container should be covered and sealed at the end of waste handling activities. The field representative will document the number and type of investigation derived wastes. Investigation -derived wastes will be documented on the waste tracking sheet and provided to the KeySpan PM. A waste tracking sheet is attached in Appendix E.

13.2 Investigation Derived Waste Sample Collection Procedure

If required, the field representative will obtain a waste profile sample of soil and fluid investigation derived wastes. A sample will be collected from each of the investigation-derived wastes that require analysis for disposal. Soil wastes will be collected by using shovels, hand auger or other equipment, composited and then placed into laboratory provided sample jars. The waste profile parameters will be provided to the field representative prior to collection of the waste profile sample. Samples will be collected into laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under COC as described in above Section 12.

References

1. Field Sampling Plan For Site Investigations At Manufactured Gas Plants, KeySpan Corporation, March 2004.

Appendix A

Daily Activity Report (electronic only)

DAILY ACTIVITY REPORT

DATE:		**Consultant Personnel:**	
PROJECT:		**KeySpan Personnel:**	
PROJECT NO.:		**Other Personnel:**	
SITE LOCATION:		**NYSDEC Personnel:**	
		Site Visitors:	

Description of Activities and Summary of Significant Field Observations (Indicate Times as Appropriate)

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Drilling Summary

Completed Boring ID	Completed Well ID	Total Depth of Soil Sampling	Well Screen Bottom Depth	Well Screen Top Depth	Isolation Casing Depths	Other

Summary of Soil Samples Submitted for Laboratory Analyses

Soil Sample ID	Boring ID	Depth Interval	Time Collected	Analyses Requested	Duplicate Sample ID	MS/MSD (yes/no)

Summary of Groundwater Samples Submitted for Laboratory Analyses

Groundwater Sample ID	Well ID	Time Collected	Analyses Requested	Sample Tube Intake Depth	Purge/Sample Flow Rate	Duplicate Sample ID

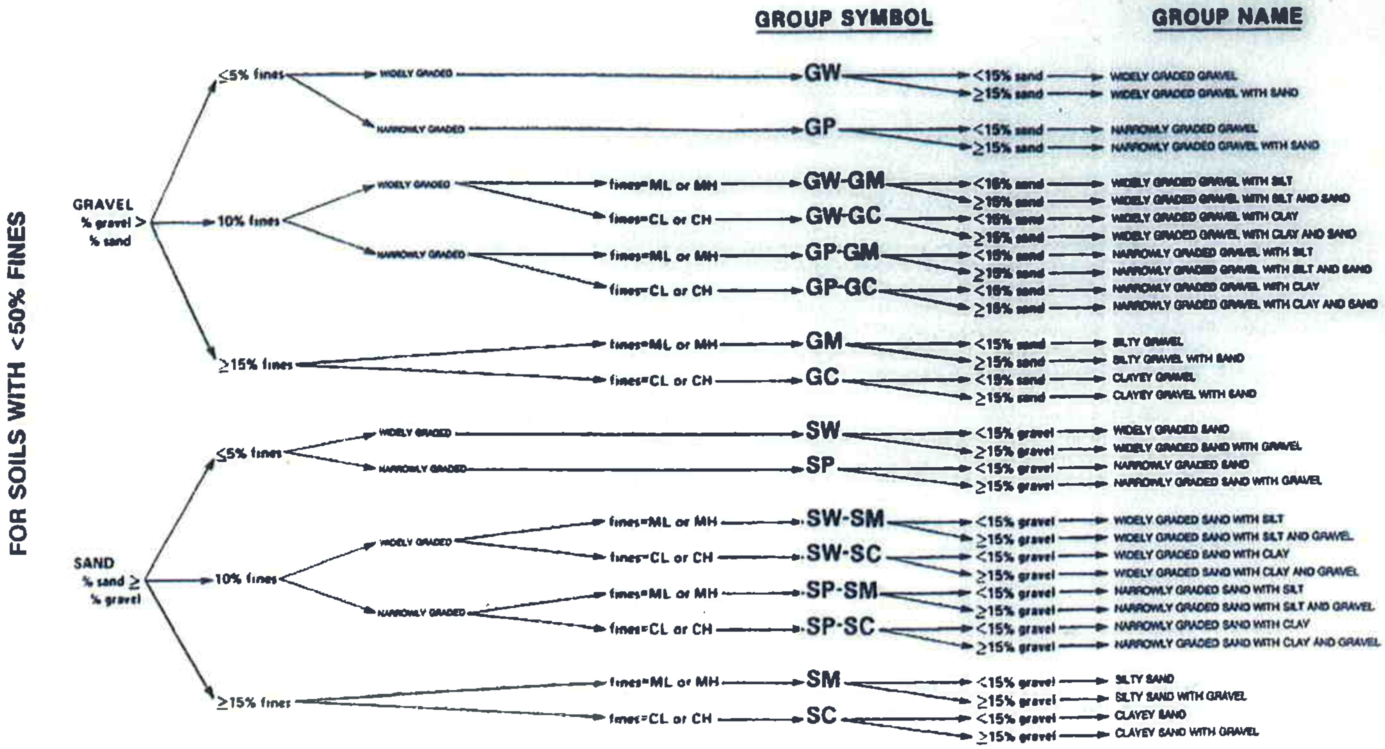
Appendix B

Visual-Manual Description Standards (electronic only)

GEI Consultants

COARSE GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

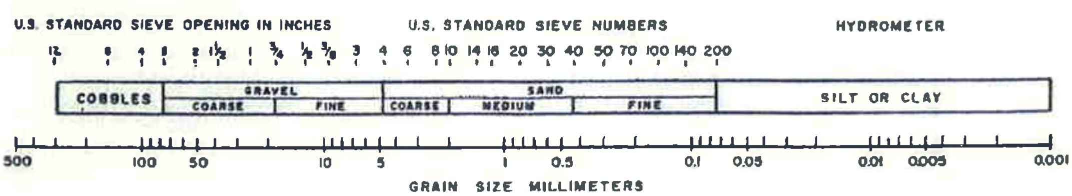


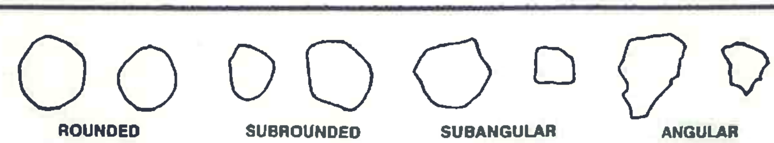
SOIL DESCRIPTION FORMAT

1. GROUP NAME and SYMBOL
2. Structure: stratified, laminated (layers <6 mm thick), lensed, homogeneous
3. Percent gravel, sand, fines (by dry weight), in order of predominance:
   - gravel - fine, coarse, and angularity
   - sand - fine, medium, coarse, and angularity
   - fines - plasticity characteristics
4. Percent cobbles and/or boulders (by volume)
5. Maximum particle size
6. Other - if appropriate - odor, roots, cementation, reaction with HCl, particle shape, moisture condition
7. Color
8. Local or geologic name

EXAMPLES

1. NARROWLY GRADED SAND (SP); mostly fine sand; <5% fines; brown.
2. SILTY SAND WITH GRAVEL (SM); ~60% fine to coarse, subangular sand; ~20% silty fines with low plasticity; ~20% fine, subangular gravel, max. size 10 mm; sample contained ~5% (by volume) subrounded cobbles to 200 mm; gray, Basal Glacial Till.
3. CLAYEY SAND (SC) and WIDELY GRADED SAND (SW); stratified layers ranging from ~6 to 20 mm thick; SC layers consist of fine sand with low plasticity clayey fines ranging from ~20 to 40%; SW layers consist of fine to coarse subrounded sand with <5% fines; SC layers are olive-gray, SW layers are brown; Hydraulic Fill.

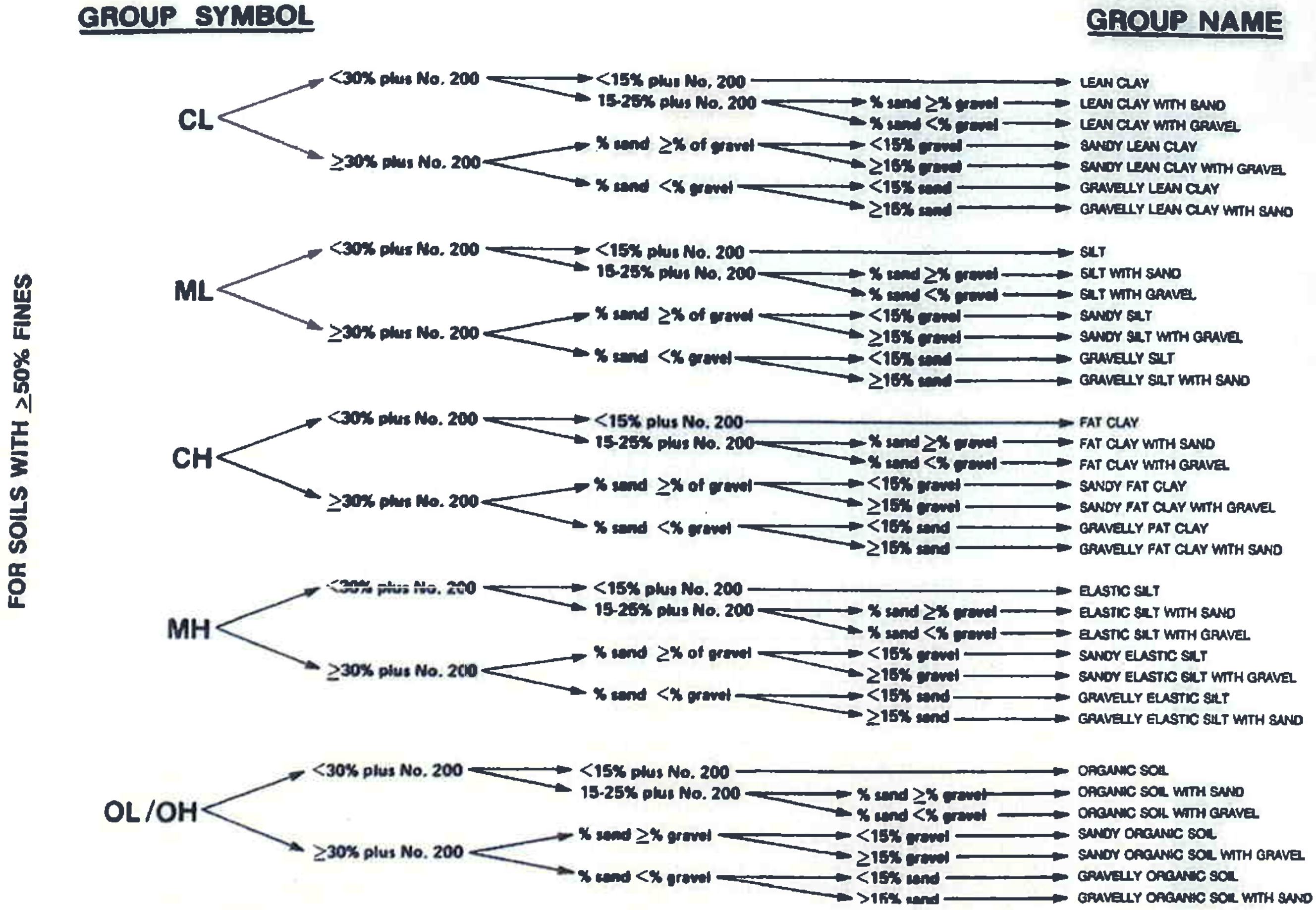




FINE GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

GEI Consultants



SOIL DESCRIPTION FORMAT

1. GROUP NAME and SYMBOL
2. Structure; stratified, laminated, fissured, slickensided, blocky, lensed, homogeneous
3. Plasticity
4. Plasticity characteristics (if performed) - dilatancy, dry strength, toughness at PL
5. Percent gravel, sand; size ranges
6. Other - if appropriate - odor, roots, cementation, reaction with HCl, particle shape, moisture condition
7. Color
8. Local or geologic name
9. Field soil strength measurements:
   Q_p = unconfined compressive strength from pocket penetrometer
   S_v = undrained shear strength from torvane

EXAMPLES

1. LEAN CLAY (CL); homogeneous, medium plasticity, occasional small shell fragments, gray, Boston Blue Clay.
2. SANDY SILT (ML); hetergeneous till structure, nonplastic, ~30% fine to coarse, subangular sand; ~10% angular to subangular fine gravel, max. size 88 mm; brown, Glacial Till.
3. ELASTIC SILT WITH GRAVEL (MH); homogeneous, medium plasticity, medium dry strength, no dilantancy, low toughness; ~20% fine gravel, max. size 10 mm; brown, Q_p = 0.70, 0.75 tsf; S_v = 0.35, 0.40, tsf

TABLE 12 Identification of Inorganic Fine-Grained Soils from Manual Tests

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

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A ⅛-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

TABLE 9 Criteria for Describing Dilatancy

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

TABLE 8 Criteria for Describing Dry Strength

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

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

Appendix C

Monitoring Well Information (electronic only)

Figure 1

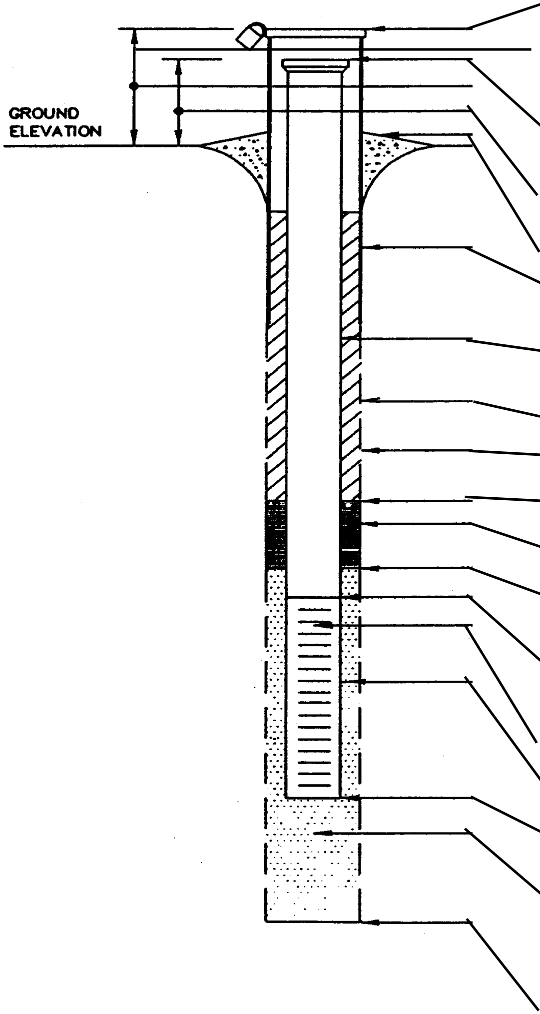
WELL INSTALLATION CHECKLIST

Project Name		Drilling Co.		Boring No.	
Project Number		Drillers		Date Started	
Project Location				Date Completed	
Site Location		Inspector			

Final depth of boring and bore hole diameter	
Depth bottom of sand pack and sand used (e.g. Morie #0)	
Type of casing (e.g. 2-in SCH 40 PVC)	
Depth bottom of screen and screen type (e.g. 10-slot)	
Depth top of screen	
Depth top of sand pack	
Depth top of seal and type of seal (e.g. cement/bentonite grout)	
Type of surface seal	
Well completion (e.g. stickup or flush mount)	

Figure 2
Overburden Monitoring Well Construction Diagram

Project		Driller	
Project No.		Drilling Method	
Date		Development Method	
Elevation		Boring No.	
Field Geologist		Well No.	

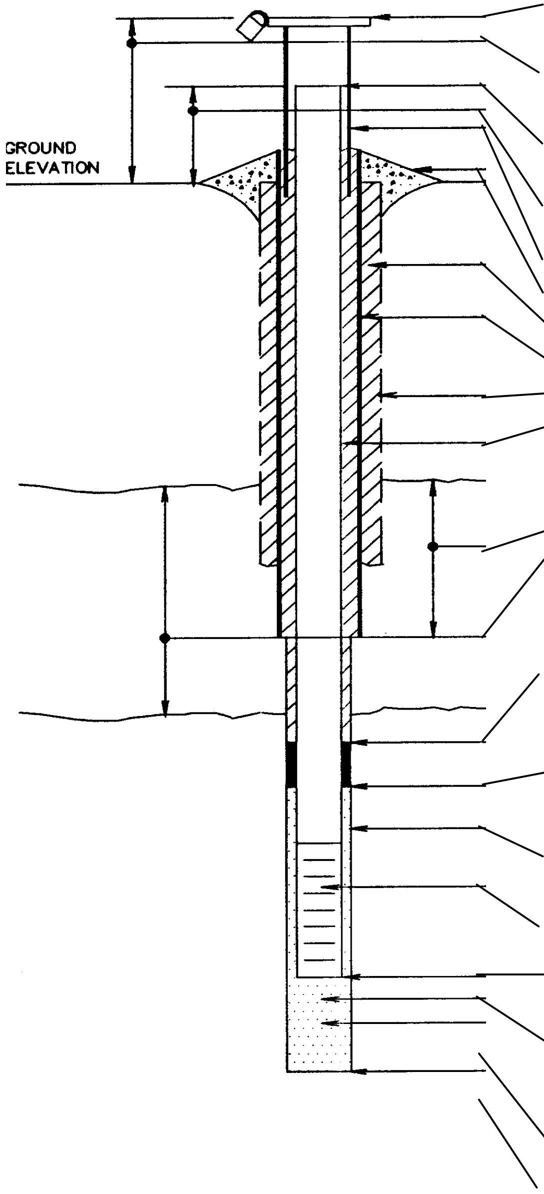


Elevation of Top of Surface Casing	
Stick Up Casing Above Ground Surface	
Elevation of Top of Riser Pipe	
Riser Pipe Above Ground Surface	
Type of Surface Seal	
Surface Casing I.D.	
Type of Surface Casing	
Riser Pipe I.D.	
Type of Riser Pipe	
Borehole Diameter	
Type of Backfill	
Elevation/Depth Top of Seal	
Type of Seal	
Elevation/Depth Top of Sand Pack	
Elevation/Depth Top of Screen	
Type of Screen	
Slot Size and Length	
Type of Sand Pack	
Elevation/Depth Bottom of Screen	
Elevation/Depth Bottom of Sand Pack	
Type of Backfill Below Monitoring Well	
Elevation/Depth of Hole	

NOT TO SCALE

Figure 3
Double Cased Monitoring Well Construction Diagram

Project		Driller	
Project No.		Drilling Method	
Date		Development Method	
Elevation		Boring No.	
Field Geologist		Well No.	



Elevation of Top of Surface Casing	
Stick Up Casing Above Ground Surface	
Elevation of Top of Riser Pipe	
Riser Pipe Above Ground Surface	
Surface Casing I.D.	
Type of Surface Seal	
Type of Surface Casing	
Upper Aquifer Casing I.D.	
Borehole Diameter/Depth	
Riser Pipe I.D.	
Type of Riser Pipe	
Type of Backfill	
Depth Casing is Set In	
Confining Layer	
Approximate Thickness Confining Layer	
Elevation/Depth Top of Seal	
Type of Seal	
Elevation/Depth Top of Sand Pack	
Type of Sand Pack	
Borehole Diameter/Depth	
Type of Screen	
Slot Size and Length	
Elevation/Depth Bottom of Screen	
Elevation/Depth Bottom of Sand Pack	
Type of Backfill Below Monitoring Well	
Elevation/Depth of Hole	

NOT TO SCALE

Groundwater Sample Log Sheet

Client: __KeySpan____________________________ Well Identification: _______________
Project Number: ______________________________________ Date: _______________
Site Name / Location: ____________________________ _______________ Depth to Water (ftbtoc): _______________
Weather: ____
Well PID (ppm): _________________

Purging Information

Time	pH	Specific Cond. (mS/m)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Salinity	ORP (Eh) (mV)	Rate (lpm)	Comments (color, odor, etc.)
3@3-5 m.	+/- 0.1	3%	10%	10%	3%		+/- 10 mV		

Approximate Purge Volume: _____________________

Sampling Information

Personnel: ________________________________

Analysis	Number	Size	Type	Preserv.	Sample Collection Sample Name: Time:

Notes:

Appendix D

Chain-of-Custody (electronic only)

Chain of Custody Record

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

SEVERN TRENT **STL**
Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client	Project Manager	Date	Chain of Custody Number 00732
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page ____ of ____
City / State / Zip Code	Site Contact / Lab Contact	Analysis (Attach list if more space is needed)	
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.	Matrix / Containers & Preservatives		

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH		Analysis												Special Instructions/ Conditions of Receipt

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other______

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Appendix E

Waste Tracking Form (electronic only)

Monthly Tracking Inventory of Former MGP Site Investigation Derived Waste:

Site Name	Address	Project Start Date(dd/mm/yy)	Project Completion Date(dd/mm/yy)	Profile samples collected(Y/N)	Description of Waste On-site			
					55-gal. Drums	Roll-Offs	Frac Tank	Miscellaneous