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Work Plan
for
Geoprobe and Indoor Air Assessment
EMR Circuits
Hauppauge, Suffolk County, New York
Site Number 1-52-105
Contract Work Authorization Number: D006132-1

Prepared for
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Table of Contents

Figures

List of Appendices

1.0 Introduction

Shaw Environmental and Infrastructure Engineering of New York, P.C. (Shaw) is pleased to provide this Work Plan for the collection of groundwater, soil vapor, sub-slab vapor and indoor air samples at EMR Circuits, Inc. (Site Number 1-52-105) located at 85-99 Marcus Boulevard, Hauppauge, Suffolk County, New York (**Figure 1**). The proposed scope of work discussed herein has been developed in accordance with Work Authorization (WA) D006132-1 provided to Shaw on January 13, 2009.

1.1 Facility Description and Location

Operational/Disposal History

The site is a former circuit board manufacturing facility that was operational between 1981 and 1984. From February, 1981 to 1983 the owner of EMR Circuits illegally discharged spent hazardous wastes into a floor drain which connected to two underground leaching pools located in the parking lot on the north side of the building according to information provided to Shaw by the New York State Department of Environmental Conservation (NYSDEC). The discharge was first noticed by the Suffolk County Department of Health Services (SCDHS) when they received complaints and investigated site operations, at which time they identified liquids bubbling up through the cement driveway. Even after entering into a consent order with SCDHS and agreeing to cease all discharges, EMR Circuits reportedly continued to discharge hazardous wastes into the leaching pools until late 1983.

Remedial History

On November 11, 1983 the known leaching pool was emptied and cleaned. An additional leaching pool was located during this site work. This second leaching pool was emptied and cleaned on January 25, 1984. Both pools were backfilled with clean sand and gravel and the floor drain within the building was sealed with cement. The leaching pools extended approximately 10 feet below ground surface (ft bgs) and 20 ft bgs, respectively.

In March, 1985 the SCDHS collected two groundwater samples at depths of 115 feet and 130 feet below ground surface (bgs) at or near the site. The VOC constituent 1,1,1-trichloroethane (TCA) was detected in the sample collected at 115 feet bgs at a concentration of 390 micrograms per liter (ug/l); 1,1,1-TCA was not detected in the sample collected at 130 feet bgs.

A Phase II site investigation was conducted by the Responsible Party. The results of this investigation were submitted to NYSDEC in January, 1992. Soil samples collected as part of this investigation did not indicate the presence of volatile organic compounds or metals above contract reporting detection limits. The Responsible Party conducted additonal groundwater sampling activities in June, 1992 that demonstrated that the site did not contribute to groundwater contamination in this area and remediation completed in 1984 was adequate to remediate this site. The site was subsequently delisted in March, 1993.

The NYSDEC and New York State Department of Health (NYSDOH) have requested that the potential for vapor phase impacts be evaluated at this facility. The proposed scope of work to complete that activity is detailed in the remaining sections of this work plan.

The generalized scope of work was detailed in the January 13, 2009 Work Authorization (WA) issued to Shaw. Supporting documents referenced in this work plan include Shaw's Field Activities Plan (FAP), Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP), all of which were submitted to the NYSDEC in December, 2008. A copy of the FAP has been included as **Appendix A**.

2.0 Scope of Work

The scope of work is to advance six direct push borings to assess soil, groundwater and soil vapor conditions at the site. Four of the six borings will be advanced to approximately 8 feet below ground surface and completed as temporary soil vapor points to facilitate the collection of soil vapor samples; four soil samples will also be collected from the borings for analysis. One boring, adjacent to the historic release, will be advanced to approximately 60 feet below ground surface and completed as a temporary soil vapor point. The final boring will be advanced to approximately 105 feet below the ground surface and completed as a temporary well to collect a "grab" groundwater sample and/or utilized to collect a hydro-punch sample as directed by the NYSDEC.

In addition to the sampling mentioned above the potential for soil vapor impacts within the former EMR Circuits building or adjacent structures will be determined**.** Specifically, two sub slab soil vapor samples, one indoor air sample and one ambient outdoor air sample will be collected as part of this evaluation. Additional vapor phase sampling may be directed or requested by the NYSDEC as outlined in **Section 3.0**.

2.1 Soil Sampling

Continuous soil cores will be collected to classify the geology of the site at five of the six proposed sampling locations. Four borings will be advanced to 8 feet bgs and one will be advanced to 60 feet bgs. Dual tube samplers with sample liners (sleeves) will be used to expedite the process. The soil borings will be logged and field screened using a photoionization detector (PID) with an 11.7 eV lamp. Depth discrete soil samples will be collected from within each boring at locations exhibiting the highest PID readings or where visual impact is observed as detailed in Shaw's December, 2008 FAP (**Appendix A**). Two samples from within the 60 foot boring will be sent for laboratory analysis. The two samples that exhibit the highest PID reading collected from the eight foot borings will be secured for laboratory analysis. Samples will be labeled, handled, and packaged following the procedures described in the approved QAPP and analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol.

The two samples collected from the 60-foot soil vapor point, a duplicate and matrix spike/matrix spike duplicate (MS/MSD) sample will be sent to an approved laboratory for analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs) and metals by EPA methods 8021B (or 8260), 8270C, 8081A, 8082 and 6010/7000, respectively under proper chain of custody. The two soil samples collected from the 8 foot borings will be sent to an approved laboratory for analysis of VOCs by EPA method 8021B or 8260.

2.2 Soil Vapor Points

Stainless steel screen attached to a dedicated section of laboratory or food grade Teflon tubing will be placed in the borehole once the desired depth below ground surface is reached. The borehole will be backfilled with glass beads to a minimum of six inches above the screened interval and a bentonite slurry will be placed above the glass beads to the ground surface. The bentonite will cure 24 hours prior to sampling.

A tracer gas test will be completed prior to collecting soil vapor samples in accordance with the NYSDOH Guidance for Evaluation of Soil Vapor Intrusion in New York State document. Upon completion of the tracer gas test, the tubing will be purged of approximately two to three probe volumes at a flow rate of less than 0.2 liters per minute. PID readings will be collected and recorded during the purging process. An individually certified summa canister with a two hour regulator will be connected to the sample tubing when a sufficient volume is removed. Sampling will continue until there is approximately 5 inches of mercury (in. Hg) remaining in the canister.

A total of 6 soil vapor (5 locations plus a duplicate sample) and an ambient air sample will be collected. Samples will be shipped under proper chain of custody to an approved laboratory for analysis of VOCs by EPA method TO-15 to an accuracy of 1 $\mu g/m^3$. Additional details regarding the proposed sampling methods are included in Shaw's FAP.

The borehole will be backfilled and grouted to the surface once sampling is completed. All boreholes will be abandoned using a cement-bentonite grout mixture in compliance with applicable New York State laws and regulations. The location will be marked with a stake or flag for surveying.

2.3 Temporary Well

Once the desired depth is reached (approximately 105-feet below ground surface) using the methods specified above in **Section 2.1**, a one-inch diameter PVC temporary well will be installed or a hydro-punch will be utilized to collect a grab groundwater sample. The actual installation and completion methodology will be dictated determined in consultation with the NYSDEC project manager.

2.4 Groundwater Sampling

Groundwater samples will be collected from the four existing monitoring wells (MW-1D, MW-1 through MW-3, **Figure 1**) and the temporary well that will be installed as part of this investigation. Prior to sample collection depth to water will be measured, recorded and used to construct a groundwater contour map for the site. The four existing monitoring wells will be purged in accordance with EPA Region II (**Appendix B**) and Shaw's FAP "low flow" sampling methods and achieve a turbidity under 50 NTU's (unless the well is purged dry). A "grab" groundwater sample will be collected from the temporary well location.

A field blank, duplicate and matrix spike/matrix spike duplicate (MS/MSD) sample will also be collected. All groundwater samples will be labeled, handled, and packaged following the procedures described in the approved QAPP and analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol. Samples will be sent under proper chain of custody for analysis of VOCs by 8260. Samples from monitoring well MW-1 will also be analyzed for SVOCs, pesticides, PCBs and metals by EPA methods 8270C, 8081A, 8082 and 6010/7000, respectively. The grab ground water sample will be field filtered if they have a turbidity greater than 50 NTU's and submitted for analysis of total and dissolved metals by EPA method 6010/7000.

2.5 Structure Sub-Slab Soil Vapor and Indoor Air Sampling

Two sub slab soil vapor, one indoor air sample and one ambient outdoor air sample will be collected from the building located immediately south of the former leaching pools. One of the sub slab vapor points will be collected from directly south of the former leaching pools, on the north side of the building while the other sub slab vapor point will be collected from the south wall of the building (**Figure 1**). The indoor air sample collection point will be biased toward any cracks observed during the building inventory process. These samples will be collected concurrently with the soil vapor samples discussed in **Section 2.2**. The content, materials in storage and general building conditions will be surveyed, photographed (noting any stained or stressed areas) and documented in accordance with the questionnaire in the NYSDOH Guidance for Evaluation Soil Vapor Intrusion document (**Appendix C**) prior to the collection of the samples as well as weather conditions, temperature, and pertinent PID readings.

The two sub-slab soil vapor samples will be collected near the location of the former leaching pools using the following procedures:

- Visually assess the floor condition, line of traffic and select sample locations that are in close proximity to major cracks and other floor penetrations (sumps, pipes, floor drains, etc.). Confirm sampling location with NYSDEC/NYSDOH personnel.
- Drill a hole through the concrete floor slab at the selected location using an electric hammer drill.
- Sweep concrete dust away from the drill hole and wipe the floor with a dampened towel
- Insert the Teflon tubing into the hole, extending no further than 2 inches below the bottom of the floor slab.
- Place non-toxic modeling clay around the tubing at the floor penetration, packing it in tightly around the tubing.
- Conduct helium leak detection test to insure that seal is "tight".
- Purge approximately one to three probe volumes at a flow rate of less than 0.2 liters per minute using a low-flow Gilian™ air pump. When a sufficient volume is removed, connect the individually certified summa canister with a twenty-four hour regulator to the sample tubing.
- Record the serial number of the canister and associated regulator on the chain-of-custody (COC) form and field notebook/sample form.
- Assign sample identification on the canister identification tag and record this on COC and field notebook/sample form.
- Record the gauge pressure; the vacuum gauge pressure must read -28 +/-2 in Hg or the canister cannot be used and should be replaced.
- Record the sample start time on the air sampling form (**Appendix C**) and take a digital photograph of canister setup and surrounding area.
- Sampling will continue until there is approximately 5 +/-1 in. Hg remaining in the canister.

- Install the plug on the canister inlet fitting and place the sample container in the original box.
- Complete the sample collection log with the appropriate information, and log each sample on the COC form.
- Ship samples under proper chain of custody to an approved laboratory for analysis of VOCs by EPA method TO-15 to an accuracy of 1 $\mu g/m^3$, except for TCE, Carbon Tetrachloride, and Vinyl Chloride which require a method detection limit (MDL) of 0.25 $\mu g/m^3$. (**Appendix D** – Laboratory MDLs)
- Remove the temporary subsurface probe and properly seal the hole with hydraulic cement or similar material. Photograph the repair and retain in project file.

Individually certified summa canisters with a twenty-four hour flow regulator will be utilized for the subslab vapor, indoor air sampling and ambient outdoor air samples. The ambient samples will be collected at a height within the breathing zone at pre-selected locations. No duplicate samples will be collected with the subslab vapor, indoor air or ambient air samples.

2.6 Investigation Derived Waste Management

Shaw is responsible for the proper storage, handling, and disposal of investigative-derived waste including personal protective equipment (PPE) and solids and liquids generated during the well drilling, well development and sampling activities. All drummed materials will be clearly labeled as to their contents and origin. All investigative derived waste will be managed in accordance with NYSDEC-DER Technical and Administrative Guidance Memorandum 4032 and the FAP. Accordingly, handling management and disposal will be as follows:

- Liquids generated from contaminated equipment decontamination that exhibit visual staining, sheen, or discernable odors will be collected in drums or other containers at the point of generation. They will be stored in a designated staging area as directed by the NYSDEC. A waste subcontractor will then remove the drums and dispose of them at an off-site location.
- Liquids generated during well purging or a decontamination activity that does not exhibit visible staining, sheen, or discernable odors will be discharged to an unpaved area on the site where it can percolate into the ground as approved by the NYSDEC.
- Soil cuttings produced during site investigative activities will be placed within the borehole or dispersed to the ground unless visible contamination or elevated PID readings are observed. Soil and rock cuttings from drilling operations that exhibit visible staining, sheen or discernable odors will be staged onsite until an appropriate treatment/disposal procedure has been approved by the NYSDEC.

- Used protective clothing and equipment that is suspected to be contaminated with hazardous waste will be placed in plastic bags, packed in 55-gal ring-top drums and transported to the drum staging area for proper disposal.
- Non-contaminated trash and debris and protective equipment will be placed in a trash dumpster and disposed of by a local garbage hauler as appropriate or warranted at each site. Alternative disposal arrangements will be discussed with the NYSDEC.

2.7 Utilities

Shaw will contact the local "one call" agency to schedule the utility mark-outs no later than ten days prior to the start of work. On-site utility mark-out will be coordinated with the site owner, visual observations or similar utility maps as provided by the tax assessor.

Shaw field personnel and their drilling subcontractor will be prepared to hand clear all on-site locations in accordance to Shaw SOP-HS-308 (HASP). Prior to any sub-surface penetration Shaw will review the utility mark out provided by the "one-call" agency and visually inspect to help determine what utilities may be within the sample collection areas. Minor field adjustments of proposed sample locations may be required (in consultation with the NYSDEC) once the mark out is completed.

2.8 Surveying

An updated site plan will be developed using recent aerial photography of the site. General site features including buildings, roadways, utility poles and fences will be included on the site plan. The locations of all borings and monitoring wells will be surveyed using a portable Trimble GPS unit and tied into the North American Datum 1983 and UTM Zone 18 coordinate system with an accuracy of +/- three feet.

Top-of-casing elevations of existing monitoring wells will be checked by Shaw field personnel for accuracy of +/- 0.01 ft by using a transit level and survey equipment. These elevations will be used to develop an updated groundwater contour map for the site which will be included within the site summary report.

2.9 Decontamination

All equipment that may come in contact with the sample, interior of a borehole, or other equipment that has entered the borehole (including such items as the drill rods, bits, miscellaneous sampling equipment, and tools) will be thoroughly cleaned using an alconox rinsed and potable water rinse prior to reuse as detailed in the FAP. Additional cleaning of the equipment may be necessary under some circumstances. Decontamination fluids will be discharged to the ground surface unless a visible sheen is noted or an odor is detected, at which time the decontamination water will be containerized and staged for proper disposal as outlined in the FAP.

3.0 Additional Investigation – If Directed

Additional sub slab soil vapor and indoor air samples may be required within the surrounding buildings. If directed, air samples will be collected from beneath and within the five structures located adjacent to and immediately down-gradient of the site to determine the pathway of the soil vapor.

3.1 Sub Slab Soil Vapor and Indoor Air Sampling

If directed, one sub slab soil vapor and one indoor air sample will be collected from each of the five buildings located adjacent to the site. Prior to the collection of the samples the buildings will be surveyed in accordance with the NYSDOH Guidance for Evaluation Soil Vapor Intrusion document. The NYSDOH Indoor Air Quality Questionnaire and Building Inventory checklist (**Appendix B**) will be completed and weather conditions, temperature, and PID readings will be recorded.

The sub-slab soil vapor samples will be collected from permanent sub-slab vapor points constructed with a stainless steel sample port with an allen nut plug that is completed flush with the floor using the procedures outlined in **Section 2.5**.

One indoor air sample will be collected at each of the 5 buildings using individually certified summa canisters fitted with a twenty-four hour flow regulator. In addition, one duplicate subslab vapor and indoor air sample will be collected from a pre-determined location. The samples will be collected at a height within the breathing zone at pre-selected locations. Sampling will continue until there is approximately 5 +/-1 in. Hg remaining in the canister.

One ambient outdoor air sample will be collected at a pre-determined location. The sample will be collected using an individually certified summa canister equipped with a twenty-four hour regulator. The sample will be collected at a height within the breathing zone. Sampling will continue until there is approximately 5 +/- 1 in. Hg remaining in the canister. All samples will be shipped under proper chain of custody to an approved ELAP-certified laboratory for analysis of VOCs by EPA method TO-15 to an accuracy of 1 $\mu g/m^3$.

4.0 Schedule

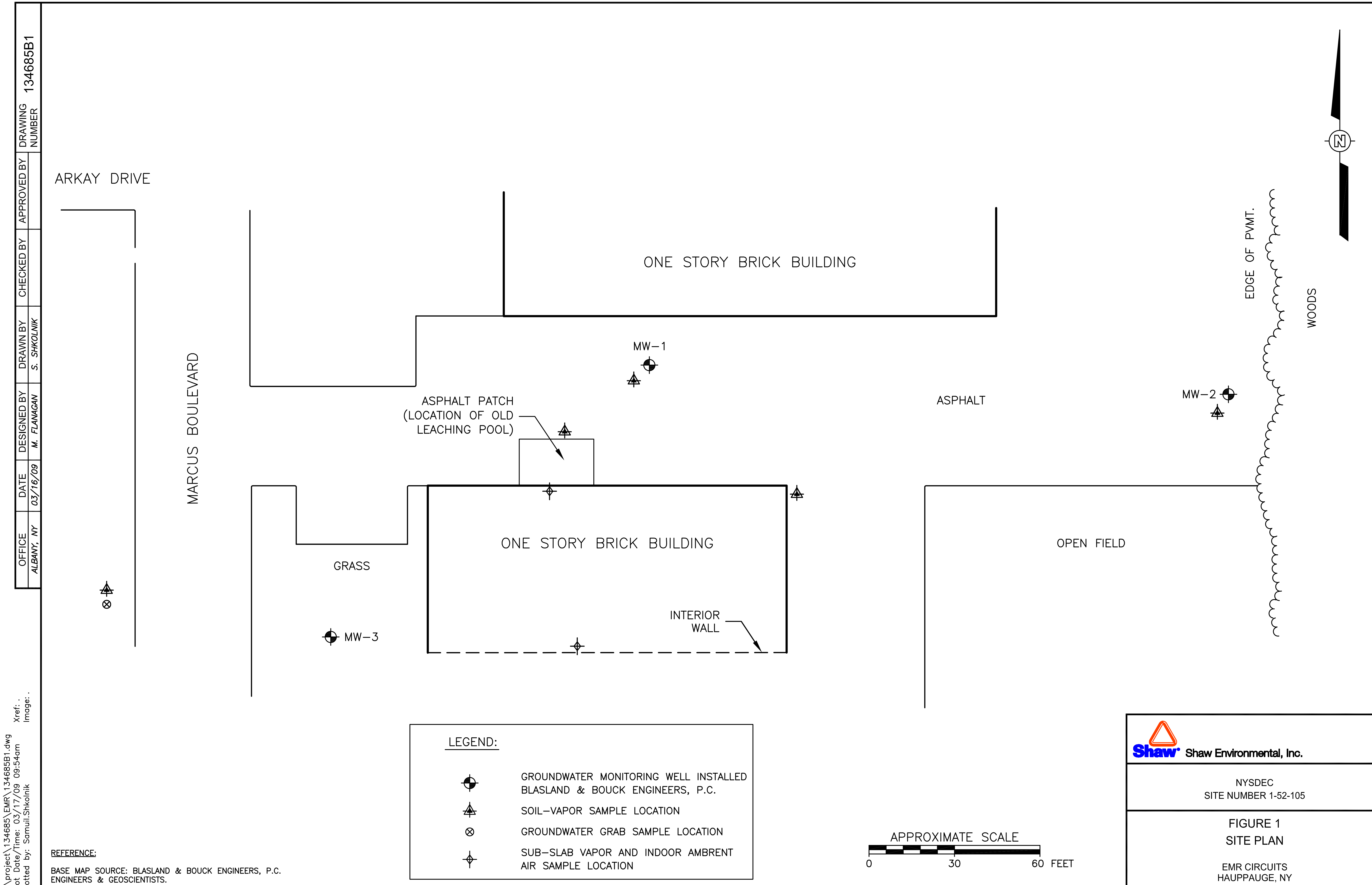
4.1 Schedule

Field work will commence within 90 days of submission of the Draft Work Plan to the NYSDEC. Upon approval of the work plan by the NYSDEC, Shaw will schedule the field work with the approved direct push subcontractor and coordinate activities with the NYSDEC project manager. The following schedule is proposed:

- Shaw will work with the direct push subcontractor to coordinate the contractor's schedule to minimize the impact to site operations and expedite the sampling effort. It is anticipated that the actual field sampling effort (task 3) can be completed in five (5) 10-hour days. The work start time will be determined by the Shaw site supervisor and may vary depending upon weather, site conditions and the NYSDEC schedule.
- Analytical results will be received from the ELAP-approved laboratory in a Category B deliverable format within 28 days of sample receipt. Preliminary laboratory results will be provided to the NYSDEC (via email) within 14 days of sample receipt.
- The supplemental building assessment will be conducted within 30 days after review of the initial soil vapor evaluation results, if directed by the NYSDEC.
- All samples collected during the site investigation will be submitted to an approved third party validator. The validator will provide a data validation/usability report within 30 days of receipt of analytical results.
- The results of these investigative activities will be included in a draft summary letter format report discussing all analytical data and field investigative activities. The report will include tabulated data, figures, boring logs and site map developed using an existing base map and the GPS coordinates collected during the site investigation. Three copies of the draft report will be submitted to the NYSDEC and NYSDOH for review and comment within 90 days after completion of field work.
- Shaw will revise the draft letter according to the comments provided by the NYSDEC and NYSDOH. The final report will be submitted in both hard copy and electronic format. In addition an electronic data deliverable (EDD) will be submitted along with the report for use by the NYSDEC. The report and EDD will be provided to the NYSDEC and NYSDOH within 30 days after receipt of comments.

A site-specific project schedule with dates and milestones will be provided to the NYSDEC upon approval and confirmation of site activities.

FIGURES


ARKAY DRIVE
MARCUS BOULEVARD
ONE STORY BRICK BUILDING
MW–1
ASPHALT PATCH (LOCATION OF OLD LEACHING POOL)
ASPHALT
MW–2
EDGE OF PVMT.
WOODS
ONE STORY BRICK BUILDING
GRASS
OPEN FIELD
INTERIOR WALL
MW–3
N
LEGEND:
GROUNDWATER MONITORING WELL INSTALLED BLASLAND & BOUCK ENGINEERS, P.C.
SOIL–VAPOR SAMPLE LOCATION
GROUNDWATER GRAB SAMPLE LOCATION
SUB–SLAB VAPOR AND INDOOR AMBRENT AIR SAMPLE LOCATION
APPROXIMATE SCALE
0
30
60 FEET
REFERENCE:
BASE MAP SOURCE: BLASLAND & BOUCK ENGINEERS, P.C. ENGINEERS & GEOSCIENTISTS.
Shaw Shaw Environmental, Inc.
NYSDEC
SITE NUMBER 1-52-105
FIGURE 1
SITE PLAN
EMR CIRCUITS
HAUPPAUGE, NY
OFFICE ALBANY, NY
DATE 03/16/09
DESIGNED BY M. FLANAGAN
DRAWN BY S. SHKOLNIK
CHECKED BY
APPROVED BY
DRAWING NUMBER 134685B1
Xref: .
Image: .
L:\project\134685\EMR\134685B1.dwg
Plot Date/Time: 03/17/09 09:54am
Plotted by: Samuil.Shkolnik

APPENDIX A

SHAW ENVIRONMENTAL AND INFRASTRUCTURE ENGINEERING OF NEW YORK, P.C.

FIELD ACTIVITES PLAN

Shaw Environmental & Infrastructure Engineering of New York, P.C.

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FIELD ACTIVITIES PLAN
Contract Number D006132

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December 2008

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Table of Contents

List of Appendicies

1.0 Introduction

Shaw Environmental and Infrastructure of New York, P.C. (Shaw) has prepared this Field Activities Plan (FAP) to outline the typical field activities that Shaw personnel may be asked to complete as part of work assignments issued by the New York State Department of Environmental Conservation (NYSDEC) under Superfund Standby Contract No. D006132.

The elements of this FAP have been prepared in accordance with the most recent and applicable guidelines and requirements of the NYSDEC and the New York State Department of Health (NYSDOH) and Shaw Standard Operating Procedures (SOP). We understand that site specific work plans will be developed for each Work Assignment as directed by the NYSDEC project manager. Every effort will me made to rely upon the work elements discussed herein to expedite the approval process and minimize costs to the Department.

2.0 Anticipated Field Activities

The primary field work assignments anticipated to be completed under this term contract include the assessment and evaluation of soil, groundwater and air quality conditions to evaluate the potential impact to human health and the environment and determine whether remedial activities are required at each site. Shaw anticipates that the following field tasks will be completed during site investigative phases of this contract. The work elements have been taken from the final contract and example work plans provided by the NYSDEC.

2.1 Direct-Push Soil Borings

Direct-push borings are used to continuously collect subsurface soil samples from each soil boring. These boring are commonly used to classify shallow overburden soils, collect soil samples, quickly and cost effectively delineate potential impacts and facilitate the installation of temporary monitoring wells, piezometers and/or soil vapor points.

A clean sampling probe is driven into the ground using vibratory techniques. Subsurface soils are continuously extracted, screened, and classified to identify soil types, assess potential impacts (both visually and through the use of field instruments) and collect representative soil samples from selected depth intervals. The selection of subsurface soils for laboratory analysis will be made in consultation with a NYSDEC project manager and or clearly determined in site specific work plans.

Typically, samples are secured for laboratory analysis based upon the following parameters:

1. Intervals that exhibit visual signs of contamination;
2. Soil intervals that exhibit the highest response on the field screening device;
3. The interval above the water table interface (assuming none of the above conditions trigger the need for sample collection);
4. A combination of all of the above as directed by the NYSDEC project or field manager.

All soil borings will be classified and logged according to the Unified Soil Classification System. Information including the field description of soil quality conditions, classification, sampling interval, PID reading, and other field observations will be recorded on a soil boring log form or field notebook. An example of the typical soil boring log is provided in **Appendix A**.

Soil samples secured for laboratory analysis will be sent to an approved NYSDOH Laboratories Approval Program (ELAP)-certified laboratory for analytical analysis using the U.S. Environmental Protection Agency (USEPA) methods specified by the approved work assignment. Samples will be managed in accordance with Section 2.0 of Shaw's Quality Assurance Project Plan (QAPP).

Soils extracted during the advancement of the direct push bit will be used to back fill the boring (assuming temporary monitoring points are not completed or the point is required to remain open for additional sampling exercises). Soils exhibiting "gross contamination" (i.e. staining, separate-phase product, visual, olfactory, evidence of impact or high PID screening) will not be placed back into the boring, but will be managed in accordance with the Waste Storage practices proposed in **Section 2.12** of this document, after consultation with and approvals by the NYSDEC project manager. Bentonite pellets may be used to backfill the boring if the extracted soils are not acceptable.

2.2 Monitoring Well Installation and Construction

Monitoring wells will be installed and constructed to define geologic and hydrogeologic characteristics of a project site. The ultimate goal in the installation of these wells is to accurately characterize groundwater quality conditions, delineate any contaminant plume(s) that may exist at the site and determine the potential for offsite migration of any groundwater contaminants. Monitoring wells will be installed at locations determined in consultation with the NYSDEC project manager. These locations will be based upon experience, anticipated regional or site specific groundwater conditions, existing information gathered during previous site investigative activities, knowledge of the existing contaminate distribution or impacts, historical data and other information provided by the NYSDEC.

2.2.1 Types of Monitoring Wells

Permanent or temporary monitoring wells will be installed depending upon site-specific conditions and the request of the NYSDEC project manager. Permanent wells would be proposed at locations requiring long term monitoring; temporary wells would be installed at locations requiring cursory or short term monitoring. Completed well depth will be dependent upon groundwater monitoring objectives, anticipated site specific conditions, contaminant behavior and site geology.

All monitoring wells will be designated as “MW-#”. Shallow, intermediate, or deep depth wells will be identified with an “S”, “I”, or “D” that is immediately preceded by the well number (e.g., “MW-#I”).

Shallow monitoring wells will be installed to assess the uppermost water bearing zone and or “perched aquifers” that are of concern to the NYSDEC. Intermediate and deep monitoring wells will be installed in consultation with the NYSDEC; these wells will typically be used to evaluate vertical hydraulic gradient and contaminant distribution within complex geologic formations or to assess regional water bearing zones of particular concern or interest. The monitoring wells will be installed by a licensed and qualified well drilling contractor and supervised and documented by a field geologist according to the procedures described in Sections 2.2.2 and 2.2.3.

2.2.2 Temporary Monitoring Well Construction

Temporary monitoring wells will be installed using direct-push techniques to the appropriate depth, assuming that the site conditions are amenable to direct-push methodology. The applicability of this technique to site conditions will be discussed with the NYSDEC project manager prior to implementation.

The temporary wells will be completed using 1-inch diameter Schedule 40 PVC 0.010-slot screen and an appropriate length of Schedule 40 PVC riser to the ground surface. The slot screen size may be changed based upon site specific geologic conditions. The screened interval will be installed at depths to capture groundwater from the predetermined zone. The riser will extend above ground surface unless directed otherwise by the project manager. The annular space will be backfilled with sand to approximately 2 feet above the screen interval and a bentonite seal will be placed from the top of the sand to the ground surface to complete the temporary monitoring well. No casing or similar steel protective device will be installed around the temporary points unless directed by the NYSDEC Project Manager.

When it has been determined that it is necessary to “close” a temporary monitoring well, the PVC casing will be removed from the ground and the boring may be backfilled with drill cuttings or bentonite and marked with a stake/flag or similar device as directed by the NYSDEC. The location will be labeled and identified on the site map so that it can be located at a later date. Borings installed in paved or concrete areas will be backfilled and refinished at the ground surface with concrete or asphalt cold patch.

2.3 Permanent Monitoring Well Construction

Permanent monitoring wells will likely be installed in two types of materials: overburden or bedrock. The following sections detail the installation procedures for each type of monitoring well.

2.3.1 Overburden Wells

Overburden monitoring wells will typically be installed using hollow-stem augering techniques. A 4-1/4 inch (ID) hollow-stem auger will typically be employed to install 2-inch diameter wells while a 6-1/4 inch (ID) hollow-stem auger will be used to install 4-inch diameter wells. Split spoon samplers will be used to secure samples for classification and laboratory analysis at intervals determined by field screening or other means. Boreholes will typically extend at least 5 feet into the groundwater table or to a depth directed by the NYSDEC. Monitoring wells will be constructed with a ten foot section of proper slot sized well screen (as determined by site conditions) and the appropriate length of schedule 40 PVC flush-joint casing to ground surface. Alternative well materials (i.e. stainless steel or similar) may be employed as directed by the NYSDEC. The annular space between the boring wall and the PVC riser will be backfilled with appropriate size Morie Sand or equivalent. The sandpack will be extended at least 2 feet above the screened interval and at least two feet of bentonite chips will be placed above the sandpack and hydrated. The remaining annular space will be backfilled with drill cuttings and/or a cement/bentonite grout mixture as directed by the NYSDEC project manager.

Monitoring wells will be completed at the ground surface (as flushmounts) or will extend approximately 3 feet above the ground surface. If the wells are extended above ground surface a steel protective casing (and possibly bollards) will be used to adequately protect the well depending upon well location and/or direction from the NYSDEC representative. Each well will have a cap and a locking cover. A concrete pad will be installed around each well casing and a weep hole will be drilled in the protective casing to allow any water between the inner and outer casing to drain.

Alternative drilling methods will be discussed and addressed, as needed, in site specific work plans.

2.3.2 Bedrock Monitoring Wells

Bedrock monitoring wells will be installed using a combination of hollow-stem augering and rock coring/air rotary drilling. Borings will be advanced through the overburden material using 6-1/4 inch inside diameter (I.D.) hollow-stem augers or similar equipment dictated by site conditions. Split spoon samplers will be used to collect soil samples from the overburden material if warranted.

Once bedrock is encountered, a 6- inch “rock socket” will be installed into the competent rock, assuming that rock cores are not to be collected. If rock cores are to be collected, the bedrock will be NX or HQ cored to a site-specific depth below ground surface.

Monitoring wells will be constructed with at least a ten foot section of appropriate slot size well screen and schedule 40 PVC flush-joint casing to ground surface. The length and slot size of the well screen will be determined by site specific geologic conditions and the zones from which samples will be taken.

The annular space between the boring wall and the PVC riser pipe will be backfilled with the appropriately sized Morie Sand or similar materials to at least 2 feet above the top of the screened interval. A two foot layer of bentonite chips will be placed on top of the sandpack and hydrated. The remaining annular space will be backfilled with a cement/bentonite grout mixture and/or drill cuttings to the ground surface.

Monitoring wells will be completed at the ground surface (as flushmounts) or will extend approximately 3 feet above the ground surface. If the wells are extended above ground surface a steel protective casing and possibly bollards will be used to adequately protect the well depending upon well location and/or direction from the NYSDEC representative. Each well will have a cap and a locking cover. A concrete pad will be installed around each well casing and a weep hole will be drilled in the protective casing to allow any water between the inner and outer casing to drain.

2.4 Monitoring Well Development

All monitoring wells will be developed by the drilling subcontractor and/or Shaw personnel. The wells will be developed to remove any drilling fluids or sediment that may have entered the well during installation and to "settle" the filter pack. For best results, monitoring wells should be developed no sooner than 48-hours following installation, assuming that schedule and budget allows.

Monitoring wells will be developed using surging and/or pumping techniques. Well development will be considered complete when either 10 well volumes have been removed, the well has been purged "dry", or field readings of temperature, conductivity, and pH have stabilized and a turbidity of less than 50 nephelometric turbidity units (NTU) has been achieved (whichever comes first). Development water will be discharged to the ground surface, away from the well, or containerized if separate-phase product, odor or similar field issues are encountered. If the development water is containerized, it will be handled and disposed off in accordance with **Section 2.12**.

The wells will be allowed to stabilize for at least 2 weeks after development prior to collecting samples for analysis as dictated by groundwater recharge, project schedule or NYSDEC requests.

2.5 Groundwater Monitoring and Sampling

2.5.1 Groundwater Monitoring and Sampling Procedures

Prior to sampling, groundwater monitoring wells will be purged unless insufficient well volume exists or directed otherwise by the NYSDEC project manager. The wells will be purged as discussed in **Section 2.5.3**.

Field sampling procedures will include the collection of water level measurements, purging of static water within the wells, collection of field groundwater chemistry measurements, and sample collection at each monitoring well location. A copy of the field purging and sampling log form used to record well volumes, field water quality measurements, and sampling flow rates is included in **Appendix A**.

Water levels will be measured in all site monitoring wells prior to purging or sampling. All water level measurements will be collected using an oil/water interface probe to allow for the measurement of product thickness (if any) in the groundwater monitoring wells. This information will eventually be used to prepare a groundwater contour map and evaluate groundwater flow patterns at the site.

Groundwater samples will be analyzed by USEPA methods in accordance with the NYSDEC Analytical Services Protocol (ASP) during sampling events. Samples will be handled, managed and labeled as detailed in Shaw's December, 2008 Quality Assurance/Quality Control Plan for this contract.

2.5.2 Groundwater Sampling-Temporary Monitoring Wells

Temporary monitoring wells may or may not be purged prior to sampling as directed by the NYSDEC. If the wells will be purged, the purging will be completed in accordance with **Section 2.5.3** below. Groundwater samples will be collected from temporary monitoring wells using a disposable bailer or a peristaltic pump with clean, dedicated polyethylene tubing. The groundwater sample will be collected using the procedures outlined **Section 2.5.3.3.**

2.5.3 Groundwater Purging and Sampling – Permanent Monitoring Wells

2.5.3.1 Field Analytical, Purging and Sampling Equipment

Field equipment that will typically be used at the site will include submersible pumps, peristaltic pumps, and /or disposable polyethylene bailers; electronic oil/water interface probe (IP) with an accuracy of +/-0.01 feet, and a multiparameter water quality meter (which includes probes for measurement of pH, turbidity, dissolved oxygen, temperature, and conductivity). Additionally, a PID instrument (mini RAE or similar) will be used to measure the potential for VOC's within the well head as required by the site-specific Health and Safety Plan (HASP). Each piece of equipment will be checked and calibrated as outlined in the QAPP. Prior to each use, field analytical equipment probe(s) will be decontaminated.

2.5.3.2 Purging and Sampling Procedures

Groundwater samples will be collected from each well a minimum of 2 weeks following monitoring well installation and development. The following procedures will be used for monitoring well groundwater sampling:

- Wear appropriate personal protective equipment as specified in the site-specific Health and Safety Plan (HASP) and the HASP Addendum.
- Unlock and remove the well cap.
- Obtain PID readings at the well head and record them in the field logbook.
- Measure the static water level in the well with an IP. The IP must be washed with Alconox detergent and water, then triple rinsed with deionized water between individual wells to prevent cross-examination.
- Calculate the volume of water in the well using the measurements shown on field visit forms (**Appendix A**). Well volume must be documented on the same forms.
- Place polyethylene sheeting near the well casing (but out of walk ways to avoid slip, trip and fall hazards) to prevent contact of sampling equipment with the ground in the event sampling equipment is dropped.
- Purge the well using one of the methods described below. Purged water must be managed separately from decontamination fluids unless otherwise directed by the NYSDEC.
  - Purge 3-5 well volumes with a dedicated, disposable polyethylene bailer.
  - Purge 3-5 well volumes with a centrifugal or a submersible pump using new dedicated polyethylene tubing in each well.
  - Use "low-flow" purging techniques to minimize purge water volume. Remove sufficient well volume such that field parameters stabilize as detailed below.
- Allow field parameters (i.e. pH, dissolved oxygen, specific conductivity, and temperature) to stabilize before collecting groundwater samples. Purging will be considered "complete" if the following conditions are met:
  - Consecutive pH readings are ±0.2 pH units of each other
  - Consecutive water temperatures are ±0.5°C of each other
  - Consecutive measured specific conductance is ±10 percent of each other.

If the well goes "dry" before the required volumes are removed, the well may be sampled when it recovers 80% of the initial static volume.

If these parameters are not met after purging a volume equal to 3-5 times standing water volume in the well, the NYSDEC and Shaw Project Manager will be contacted to determine the appropriate action(s).

- Obtain sample from well with a bailer suspended on new, clean nylon twine or using low flow sampling techniques using care to not agitate the sample. Dedicated bailers or polyethylene tubing must be used in each well.
- Collect VOC sample first followed by semi-volatile organic sample. Carefully pour directly into the appropriate sample bottles. Sample bottles must be obtained from the laboratory.
- Place analytical samples in cooler and chill to at least 4°C. Samples must be shipped or delivered to the analytical laboratories within 24 hours of collection.
- Decontaminate any sample pumps between each well following the procedure in Section 2.9; the polyethylene tubing and twine must be properly discarded.
- Re-lock well cap.
- Complete field logbook, sample sheet, custody seals, and pertinent chain-of-custody forms.

Groundwater samples will be placed in appropriate sample containers, sealed, and submitted to the laboratory for analysis. The samples will be labeled, handled, and packaged following the procedures described in the approved Quality Assurance Project Plan (QAPP). Quality assurance/quality control samples will be collected at the frequency detailed in the site-specific QAPP and workplans. Groundwater samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol.

Purge water will be discharged to the ground surface away from the well unless otherwise directed by the NYSDEC. If non-aqueous phase liquid or an odor is observed, or if directed by NYSDEC, the purge water must be containerized, handled, and disposed of as detailed in **Section 2.12**.

2.6 Groundwater Sampling Using Low Flow Sampling Technique

Low flow purging/sampling is a method of collecting groundwater samples from a monitoring well that does not require the removal of large volumes of water and therefore does not overly agitate the water column and suspended solids or potentially volatize VOCs present in the water during evacuation. This method removes water directly from the monitoring well's screen interval without disturbing any stagnant water above the screen by pumping the groundwater at a low enough flow rate to maintain minimal drawdown of the water column. Typically flow rates for this method range from 0.1 liters/minute (L/min) to 0.5 L/min depending on site hydrogeologic conditions.

2.6.1 Low Flow Purging/Sampling Equipment

Monitoring wells will be purged and sampled using the following equipment:

- A peristaltic pump with dedicated polyethylene tubing for each individual monitoring well;
- Electronic oil/water interface probe with an accuracy of +/-0.01 ft;
- PID instrument (MiniRAE or similar) to monitor vapor concentrations within the well prior to and during purging and sampling as required by the site-specific Health and Safety Plan (HASP);
- A graduated cylinder (unit of measure = Liters) or similar measuring device;
- A multi-parameter meter to measure pH, turbidity, dissolved oxygen, temperature, and conductivity of the purged groundwater; and
- Associated field forms (**Appendix A**).

Field equipment to be used at the site will be checked and calibrated as outlined in the QAPP prior to each use. In addition all down-hole, non-dedicated sampling equipment will be decontaminated using an Alconox/deionized rinse between each monitoring well location.

2.6.2 Low Flow Purging Procedures

Groundwater samples will be collected from each well a minimum of 2 weeks following monitoring well installation and development. The following procedures will be used for low-flow monitoring well groundwater purging:

- Wear appropriate personal protective equipment as specified in the site-specific Health and Safety Plan (HASP) and the HASP Addendum issued for each work assignment.
- Unlock and remove the well cap.
- Obtain PID readings at the well head and record them in the field logbook or field sampling form.
- Measure both the static water level and the total well depth in the monitoring well with an IP and record them in the field logbook or field form. The IP must be washed with Alconox detergent and water and rinsed with deionized water between individual wells to prevent cross-examination.
- Place polyethylene sheeting near the well casing (but out of walk ways to avoid slip, trip and fall hazards) to prevent contamination of sampling equipment in the event sampling equipment is dropped.

- Slowly lower the dedicated polyethlylene tubing down the monitoring well into the screen interval.
- Connect the tubing to the peristaltic pump and begin to purge the well using the lowest flow rate/frequency on the pump control. Adjust the flow rate to ensure a rate of between 0.1 to 0.5 L/min. Purge water must be managed separately from decontamination fluids unless otherwise directed by the NYSDEC.
- Direct the purge water thru the multi-parameter meter and allow field parameters (i.e. pH, dissolved oxygen, specific conductivity, and temperature) to stabilize before collecting groundwater samples. Purging will be considered "complete" if the following conditions are met:

  - Consecutive pH readings are ±0.2 pH units of each other
  - Consecutive water temperatures are ±0.5°C of each other
  - Consecutive measured specific conductance is ±10 percent of each other.

If the well goes dry before the required purge volumes are removed, the well may be sampled when it recovers 80% of its initial static volume.

If these parameters are not met the NYSDEC and Shaw Project Manager will be contacted to determine the appropriate action(s).

Purge water will be discharged to the ground surface away from the well unless otherwise directed by the NYSDEC. If non-aqueous phase liquid or an odor is observed, or if directed by NYSDEC, the purge water must be containerized, handled, and disposed of as detailed in **Section 2.12**.

2.6.3 Low Flow Sampling Procedures

Once the groundwater parameters have stabilized (or the well goes "dry" and recovers 80% of its initial static volume) the following procedures should be completed for sample collection:

- Retrieve the sample bottles required for sample analysis.
- Don a pair of clean nitrile gloves.
- Remove the pump effluent tubing from the multi-parameter meter and prepare for sample collection.

- Collect VOC sample first followed by semi-volatile organic sample. Carefully pour directly into the appropriate sample bottles. Sample bottles must be obtained from the laboratory.
- Place analytical samples in cooler and chill to at least 4°C. Samples must be shipped or delivered to the analytical laboratories within 24 hours of collection.
- Any sample pumps must be decontaminated between each well following the procedure in Section 2.9; the polyethylene tubing and twine must be properly discarded.
- Re-lock well cap.
- Complete field logbook, sample sheet, custody seals, and pertinent chain-of-custody forms.

Groundwater samples will be placed in appropriate sample containers, sealed, and submitted to the laboratory for analysis. The samples will be labeled, handled, and packaged following the procedures described in the approved Quality Assurance Project Plan (QAPP). Quality assurance/quality control samples will be collected at the frequency detailed in the site-specific QAPP and workplans. Groundwater samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol.

2.7 Exploratory Test Pits

Test pits will be excavated at locations outlined in the Work Plan. Test pits will allow for visual characterization of site conditions and collection of soil “grab” samples. These locations will be determined based upon site conditions and historic site usage. At no time will Shaw or NYSDEC personnel enter any test pit unless all requirements of the HASP have been followed and it has been determined that this activity is necessary.

Excavated soil will remain on site, placed on plastic sheeting (as appropriate) and utilized to backfill the test pits. Soils must be stored at appropriate distances from the excavation to maintain compliance with slope stability and HASP.

Prior to soil sampling, head space readings will be collected on each sample using a PID and soil placed in a sample jar or zip lock bag. These head space results will be used to preliminarily characterize soil impacts to determine if laboratory analyses of the soils are warranted. All samples collected from each test pit will be forwarded to an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol. All samples will be labeled, handled, and packaged following the procedures described in the QAPP. Quality assurance/quality control samples will be collected at the frequency detailed in the Generic QAPP and the site-specific project Work Plan.

After the soils in each test pit have been characterized and sampled, the test pit will be backfilled with the excavated soils. Test pits will be backfilled in lifts and compacted with the bucket of the excavator/backhoe.

2.8 Surface Water Sampling

Following identification and photographing of the surface water sampling locations, field personnel will collect the sample using a sample container, clean dipper, beaker, or pond sampler. The number of samples to be collected will be specified in the work plan.

The approximate location of the sample will be photographed, as appropriate, and noted in the field logbook. Field measurement of pH, dissolved oxygen, temperature, and specific conductivity will be obtained and recorded in the field logbook as requested by the NYSDEC. The field sampling crew will record visual observations (sample color, any unusual characteristics [odor, staining, etc.]) in the field notebook and/or the field sampling form. All equipment used in sample collection will be decontaminated between locations to prevent cross-contamination.

Surface water samples will be placed in appropriate containers, sealed, and submitted to an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol.

The samples will be labeled, handled, and packaged following the procedures described in the QAPP. Quality assurance/quality control samples will be collected at the frequency detailed in the QAPP and/or the site-specific project Work Plan.

2.9 Sediment Sampling

Proposed sampling locations will be photographed, noted on a site map and flagged to facilitate their location at a later date.

Surficial (0-6 in.) sediment samples will be collected using a clean, stainless steel coring device, a stainless steel hand auger, or a stainless steel scoop as appropriate for the sediment conditions. Dedicated sampling equipment will be used (when possible) to prevent cross-contamination and to minimize decontamination requirements.

Samples will be placed into a clean stainless steel bowl or directly into the sampling jar as directed by the NYSDEC.

The sampler will examine the sediment samples and record visual observations (sample color, texture, any unusual characteristics [odor, staining, etc.]) in the field notebook and on the field record of sediment sampling. The sampling tools and field instruments will be decontaminated between locations to prevent cross-contamination.

Sediment samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol. All samples collected will be labeled, handled, and packaged following the procedures described in the QAPP. Quality assurance/quality control samples will be collected at the frequency detailed in the QAPP and the site-specific project Work Plan.

2.10 Soil Vapor Point Installation and Sampling

Soil vapor points may be required to assess soil vapor impacts with the vadose zone. This sampling will be completed pursuant to the October 2006 *NYSDOH Guidance Document for Evaluating Soil Vapor Intrusion in the State of New York.*

2.10.1 Soil Vapor Point Installation

All soil vapor points will be flagged and labeled with the relevant sample location identification. Each pin flag will include sample identification information that can be used by NYSDEC staff during a subsequent site survey. Sample locations will be photographed and marked on a site map.

Soil vapor points will be installed using a direct-push device to install stainless steel drive points to a specified depth. Once the sampling depth is reached, the drive point rods will be retracted, leaving the drive point at the base of the interval. The 6-inch stainless steel sampling screen will be fitted with a dedicated section of 0.25-inch diameter Teflon or Teflon-lined tubing (laboratory or food grade) to collect the soil vapor samples.

The borehole will then be backfilled with sand/glass beads to a minimum of 6 inch above the screened interval. Granular bentonite pellets will be placed from approximately 6 inches above the screened interval to the ground surface hydrating concurrently with placement. Sufficient time (at least 24 hours) will then be provided to allow the bentonite to “cure”. Soil cuttings will be used to backfill the points unless a visible sheen or odor is evident, in which case the cuttings will be drummed and disposed of in accordance with **Section 2.16**.

2.10.2 Soil Vapor Point Sampling

Soil vapor samples will be collected as detailed below:

- Samples will not be collected until at least 24 hours after the temporary soil vapor points have been installed; 2-3 implant volumes (i.e., the volume of the sample probe and tube) will be purged prior to collecting the samples to ensure that representative samples are collected.
- Flow rates for both purging and sample collection will not exceed 0.2 liters per minute.
- Samples will be collected using conventional sampling methods and appropriate containers (ie., low flow rate; Summa® canisters, which are certified clean by the laboratory, using an appropriate USEPA Method). The sample duration for these samples will be specified by the work plan and could range up to 24 hours.
- A tracer gas (e.g., helium, butane, or sulfur hexafluoride) will be used at each location before collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring). Once verified, continued use of the tracer gas may be reconsidered.

The following issues (that may influence interpretation of the results) will be noted to document site conditions during sampling:

- Sample location including the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor ambient air sample locations (if applicable), and compass orientation (north).
- Weather conditions (e.g., precipitation, outdoor temperature, barometric pressure, wind speed, and direction) for the past 24-48 hours.

- Any pertinent observations such as odors and readings from field instrumentation.

The field sampling team will maintain a sample log sheet (Appendix A) summarizing the following:

- Sample identification
- Date and time of sample collection
- Sampling depth
- Identity of samplers
- Sampling methods and devices
- Purge volumes
- Volume of soil vapor extracted
- Canister and associated regulator identification
- Helium leak test results
- Vacuum before and after samples collected
- Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone
- Chain-of-custody protocols and records used to track samples.

After the sample collection period, the Summa® Canisters will be sent for laboratory analysis by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol. A minimum reporting limit of 1 microgram per cubic meter (µg/m) will be achieved for all analytes unless otherwise directed by the NYSDEC or NYSDOH.

Upon completion of the sampling, the sample tubing will be removed and the temporary soil vapor point location will be backfilled with soil cuttings and /or bentonite and marked with a stake/flag that will be labeled with the proper sample identification and illustrated on the site map such that it can be located by the site surveyor. Borings installed in paved or concrete areas will be backfilled and finished at the ground surface with concrete or cold patch.

2.11 Indoor Air Monitoring

Indoor air sampling programs will be completed in accordance with the NYSDOH Indoor Air Sampling and Guidance document. The protocol for any indoor air monitoring program will follow *NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York,* October 2006.

Indoor air sampling and analysis will be performed at locations identified by the NYSDEC and NYSDOH. Notices to participate in the indoor air monitoring program and scheduling of appointments will be completed by and be the responsibility of the NYSDEC and NYSDOH. The NYSDEC Project Manager will provide Shaw with a copy of the correspondence and indoor air sampling schedule.

2.11.1 Indoor Air Sample Collection

An inspection of general site conditions will be performed at each property location as part of the air sampling. The inspection will include the following activities:

- Completion of the NYSDOH Indoor Air Quality Questionnaire and Building Inventory included in Indoor Air Sampling and Analysis Guidance. A sample of the questionnaire will be provided in the site-specific Work Plan and is include in **Appendix A**.
- Documentation of exterior weather conditions and inside temperature.
- Ambient air (indoor and outdoor) screening using field equipment (i.e., parts per billion photoionization detector or similar).
- Selection of air sampling locations in consultation with NYSDEC and NYSDOH personnel.

Air samples will be collected from three locations per structure including the first floor, basement and the sub-slab environment. A section of Teflon or Teflon-lined tubing that is identified as laboratory or food grade will be extended from the Summa® canister to collect the ambient air sample from the breathing zone at approximately 3 to 5 feet above ground surface. Laboratory certified Summa® canisters, regulated for a 24-hour sample collection, will be used to evaluate the indoor air and sub-slab soil vapor conditions unless otherwise directed by the NYSDEC/NYSDOH.

2.11.1.1 Sub-Slab Sample Procedures

The following procedures will be used for all sub-slab sampling:

- Visually assess the condition of the floor. Select an area for sampling that is out of the line of traffic and away from major cracks and other floor penetrations (sumps, pipes, floor drains, etc.) and confirm sampling location with NYSDEC/NYSDOH personnel.
- Drill a hole through the concrete floor slab at the selected location using an electric hammer drill.
- Sweep concrete dust away from the drill hole and wipe the floor with a dampened towel.
- Insert the Teflon-lined polyethylene tubing into the hole drilled in the floor, extending no further than 2 inch below the bottom of the floor slab.
- Pour melted beeswax and/or non-toxic modeling clay around the tubing at the floor penetration, packing it in tightly around the tubing.
- Conduct helium leak detection test to insure that seal is "tight"
- Place a 6-L Summa® canister (provided by an independent laboratory) with a vacuum gauge and flow controller on the floor adjacent to the sample tube. The canister must be "certified clean" in accordance with USEPA Method TO-15 and under a vacuum pressure of no more than -30 in. of mercury in Hg. Flow controllers must be set for a 24-hour collection period unless requested otherwise.
- Record the serial number of the canister and associated regulator on the chain-of-custody (COC) form and field notebook/sample form. Assign sample identification on the canister identification tag and record this on COC and field notebook/sample form. For the property owner's privacy, do not use a sample identifier containing the name of the property owner or the address of the property.
- Record the gauge pressure; the vacuum gauge pressure must read -25 in Hg or less, or the canister cannot be used.
- Record the sample start time on the air sampling form (**Appendix A**) and take a digital photograph of canister setup and surrounding area.

2.11.1.2 Termination of Sample Collection

The following procedures will be used for terminating sample collection:

- Close the canister valve; record the stop time on the sample form.
- Record the final gauge pressure and disconnect the sample tubing and the pressure gauge/flow controller from the canister, if applicable.
- Install the plug on the canister inlet fitting and place the sample container in the original box.
- Complete the sample collection log with the appropriate information, and log each sample on the COC form.

- Remove the temporary subsurface probe and properly seal the hole in the slab with hydraulic cement or similar material. Photograph the repair if possible and retain in project file.

Field quality control samples will include duplicates and trip blanks. Field duplicates will be collected at the rate of 1 duplicate per 20 original samples (20 percent). Field duplicates will be collected by installing an in-line "tee," which will split the flow to 2 canisters set up adjacent to each other and each collecting vapors at identical flow rates. One trip blank will be analyzed and shipped to the laboratory with the final set of sample canisters.

2.11.2 Outdoor Air Sample Collection

Outdoor ambient air samples will be collected in addition to the indoor air samples. Ambient air samples will be collected during the same 24-hour period as the indoor air samples; these samples will presume to be representative of outdoor air conditions for the entire sampling area. The ambient air samples will be collected in a laboratory certified Summa® canister, regulated for a 24-hour sample collection or a duration specified by the NYSDEC/NYSDOH. A section of Teflon or Teflon-lined tubing (laboratory or food grade) will be extended from the Summa® canister to the breathing zone at approximately 3 to 5 feet above ground surface. The influent rate of the outdoor air sample must be less than 0.2 L per minute. Outdoor ambient air samples will be collected at a minimum of one (1) per day during the indoor air monitoring program or as directed by the NYSDEC project manager.

2.11.3 Laboratory Analysis of Air Samples

Air samples will be analyzed by an ELAP-certified laboratory. Detection limits for the analyzed compound list will be defined by the NYSDEC and NYSDOH prior to sample submittal and outlined in the site-specific work plan. For specific parameters identified by NYSDOH, where the selected parameters may have a higher detection limit (e.g., acetone), the higher detection limits will be designated by NYSDOH.

2.12 Storage and Disposal of Waste

Shaw is responsible for the proper storage, handling, and disposal of investigative-derived waste including personal protective equipment (PPE) and solids and liquids generated during the well drilling, well development and sampling activities. All drummed materials will be clearly labeled as to their contents and origin. All investigative derived waste will be managed in accordance with NYSDEC-DER Technical and Administrative Guidance Memorandum 4032.

Accordingly, handling and disposal will be as follows:

- Liquids generated from contaminated equipment decontamination that exhibit visual staining, sheen, or discernable odors will be collected in drums or other containers at the point of generation. They will be stored in a designated staging area as directed by the NYSDEC. A waste subcontractor will then remove the drums and dispose at an offsite location.
- Liquids generated during well purging or a decontamination activity that does not exhibit visible staining, sheen, or discernable odors will be discharged to an unpaved area on the site where it can percolate into the ground as approved by the NYSDEC.
- Concrete dust will be collected in shop vacuums and disposed of as non-regulated solid waste, unless photoionization detector readings or visual indications of contamination are noted during field operations.
- Soil and rock cuttings from drilling operations that do not exhibit visible staining, sheen, or discernable odors will be disposed of onsite or used to backfill temporary borings, wells or test pits.
- Soil and rock cuttings from drilling operations that exhibit visible staining, sheen or discernable odors will be staged onsite until an appropriate treatment/disposal procedure has been approved by the NYSDEC.
- Excavated soils from test pits will be used to backfill the excavation.
- Used protective clothing and equipment that is suspected to be contaminated with hazardous waste will be placed in plastic bags, packed in 55-gal ring-top drums and transported to the drum staging area for proper disposal.
- Non-contaminated trash and debris and protective equipment will be placed in a trash dumpster and disposed of by a local garbage hauler as appropriate or warranted at each site. Alternative disposal arrangements will be discussed with the NYSDEC.

2.13 Site Survey and Base Map Preparation

A detailed topographic base map of the site and immediate vicinity will be developed by a New York State licensed surveyor. All relevant features of the site and adjacent areas will be plotted. A site survey will incorporate all soil boring locations, monitoring well locations, test pit locations, soil vapor point locations, and surface water/sediment sampling locations, performing a topographic survey, and preparation of a site map (typically based upon a previous base map or site control markers).

The site map will also include site-specific features associated with the assessment activities and potential areas of concern to the NYSDEC. Contours will be plotted at 1-ft intervals. The elevations of all monitoring well casings will be established to within +/-0.01 ft based on the National Geodetic Vertical Datum.

The site tax map number will also be identified. The tax maps will be reviewed and the property lines of the parcels will be plotted on the base map.

2.14 References

Shaw, December, 2008. “Quality Assurance Project Plan for Work Assignments”. Prepared by Shaw for the NYSDEC.

New York State Department of Health *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*. New York State Department of Health, Division of Environmental Health Assessment, Center for Environmental Health. October, 2006.

Appendix A

Field Forms

Drilling Log

Monitoring Well **MW -**

Project *Site Name* Owner *NYSDEC*

Location *City, New York* Proj. No. *Shaw Project ID*

Surface Elev. *NA* Total Hole Depth *24.0 ft.* North ____ East ____

Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter ____

Screen: Dia *NA* Length *NA* Type/Size *NA*

Casing: Dia *NA* Length *NA* Type *NA*

Fill Material ____ Rig/Core ____

Drill Co. ____ Method ____

Driller ____ Log By ____ Date ____ Permit # *NA*

Checked By ____ License No. ____

COMMENTS

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0						
2						
4						
6						
8						
10						
12						
14						
16						
18						
20						
22						
24						

Shaw® Shaw Environmental, Inc.

Project Name:			
Date:			
Sampler(s):			

Sample Location Information:

Sample ID:		Address/Location:	
PID Meter Used:	He Detector Used:	Weather Conditions:	
	Soil Gas	**Ambient Air**	**Comments**
SUMMA CANISTER RECORD			
Canister Serial Number:			
Flow Controller Number:			
Start Date / Time:			
Stop Date / Time:			
Duplicate Sample ID:			
Sample ID Category:			
Sample Depth:			
Approximate GW Depth:			
Air Temperature:			
Direction/Distance from any Structure:			
Distance to Roadway:			
Any noticeable odor?			
PID Reading (ppb):			
He Detector Reading (ppm):			
Consituents Sampled:			
Container Description:			

Checked Seals:	☐ Yes	☐ No		
Tracer Gas Test:	☐ Successful	☐ Unsuccessful		
Sample:	☐ Duplicate	☐ Matrix Spike Duplicate	☐ Matrix Spike	☐ Analysis
Photo Taken:	☐ Yes	☐ No		

Shaw Environmental, Inc.
Monitoring Well Development Field Data Sheet

Project Name: Project Number:

Water Level Data

Date: ____________ Start Time: ___________ **Well ID:** ___________

Initial Total Casing Length__________________________ (feet)

Depth to Water (from top of casing)_________________ (feet)

a) Height of Water Column_________________________ (feet)

*Volume Factors:
2-inch well = 0.163 gal/ft
4-inch well = 0.653 gal/ft
6-inch well = 1.468 gal/ft

Well Volume ([a] x volume factor *) = ______ (feet) x ______ gallons/foot = _______ gallons

Development Data

Date: ____________ Time:______________ (start) ____________ (finish)

Method: ____
(Waterra, bailer, submersible pump, etc.)

Time							
Specific Conductivity							
pH							
Turbidity							
Temperature							
ORP							
DO							

Time							
Specific Conductivity							
pH							
Turbidity							
Temperature							
ORP							
DO							

Time							
Specific Conductivity							
pH							
Turbidity							
Temperature							
ORP							
DO							

Did well dry out? (If yes, how many times) Actual Volume Removed________ (gallons)

Personnel:____

COMMENTS:

Shaw Environmental, Inc.
Groundwater Sample Event Field Data Sheet

Project Name: Project Number:

Water Level Data

Date: ____________ Start Time: ___________ **Well ID:** ___________

Initial Total Casing Length________________________ (feet)

Depth to Water (from top of casing)________________ (feet)

a) Height of Water Column______________________ (feet)

*Volume Factors:
1-inch well = 0.041 gal/ft
1.5-inch well = 0.092 gal/ft
2-inch well = 0.163 gal/ft
3-inch well = 0.367 gal/ft
4-inch well = 0.653 gal/ft
6-inch well = 1.468 gal/ft

Well Volume ([a] x volume factor *) = ______ (feet) x ______ gallons/foot = _______ gallons

Purge Data

Date: ____________ Time:______________ (start) ____________ (finish)

Method:
(Waterra, bailer, submersible pump, etc.)

Purge Volume (if applicable): ____

Time							
Volume							
Specific Conductivity							
pH							
Turbidity							
Temperature							
ORP							
DO							

Did well dry out? (If yes, how many times) Actual Volume Removed________ (gallons)

Sampling Data

Sample Date: __________ Sample Time: __________
Appearance (visual) ____________________ Color __________ Odor __________
Sampling Method:

Constituents Sampled	Container Discription	Perservative

Personnel:
COMMENTS:

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name ______________________ Date/Time Prepared __________

Preparer's Affiliation ______________________ Phone No.__________

Purpose of Investigation______________________________________

1. OCCUPANT:

Interviewed: Y / N

Last Name: ________________ First Name: ________________

Address: ______________________________________

County: __________

Home Phone: ____________ Office Phone: ____________

Number of Occupants/persons at this location _____ Age of Occupants __________

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: ________________First Name: ________________

Address: ______________________________________

County: __________

Home Phone: ____________ Office Phone: ____________

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: __________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ___________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? ______

Other characteristics:

Number of floors______ Building age______

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

____

____

____

Airflow near source

____

____

____

Outdoor air infiltration

____

____

____

Infiltration into air ducts

____

____

____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________
c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor:	uncovered	covered	covered with ____________	
e. Concrete floor:	unsealed	sealed	sealed with ____________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with ____________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

____

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other ________

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: ____________________

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other________
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	______________________
1st Floor	______________________
2nd Floor	______________________
3rd Floor	______________________
4th Floor	______________________

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA Please specify__________

d. Has the building ever had a fire? Y / N When?__________

e. Is a kerosene or unvented gas space heater present? Y / N Where?__________

f. Is there a workshop or hobby/craft area? Y / N Where & Type? __________

g. Is there smoking in the building? Y / N How frequently? __________

h. Have cleaning products been used recently? Y / N When & Type? __________

i. Have cosmetic products been used recently? Y / N When & Type? __________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? ______

k. Is there new carpet, drapes or other textiles? Y / N Where & When? ______

l. Have air fresheners been used recently? Y / N When & Type? ______

m. Is there a kitchen exhaust fan? Y / N If yes, where vented? ______

n. Is there a bathroom exhaust fan? Y / N If yes, where vented? ______

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type? ______

Are there odors in the building? Y / N
If yes, please describe: ______

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ______

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: ______
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply: Public Water Drilled Well Driven Well Dug Well Other: ______

Sewage Disposal: Public Sewer Septic Tank Leach Field Dry Well Other: ______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: ______

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: ______________________________

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO)**, **Used (U)**, or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Shaw® Shaw Environmental, Inc.			Project Name:		
			Date:		
			Sampler(s):		
Sample Location Information:					
Sample ID:			Address/Location:		
PID Meter Used:		He Detector Used:	Weather Conditions:		
	Indoor Air		**Substructure**	**Ambient Air**	**Comments**
	Basement Ambient	First Floor Ambient	**Soil Vapor**		
SUMMA CANISTER RECORD					
Canister Serial Number:					
Flow Controller Number:					
Start Date / Time:					
Stop Date / Time:					
Start Pressure (inches Hg):					
Stop Pressure (inches Hg):					
Duplicate Sample ID:					
Sample Height/Depth:					
Room:			NA	NA	
Approximate GW Depth:	NA	NA		NA	
Air Temperature:					
Direction/Distance from any Structure:					
Distance to Roadway:	NA	NA	NA		
Any noticeable odor?					
PID Reading (ppb):					
He Detector Result:	NA	NA		NA	
Consituents Sampled:	TO - 15	TO - 15	TO - 15	TO - 15	
Container Description:	6 Liter Summa	6 Liter Summa	6 Liter Summa	6 Liter Summa	
Checked Seals:		☐ Yes	☐ No		
Tracer Gas Test:		☐ Successful	☐ Unsuccessful		
Photo Taken:					

APPENDIX B

US EPA REGION 2
GROUNDWATER SAMPLING PROCEDURE
LOW STRESS (LOW FLOW) PURGING AND SAMPLING

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of three options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

- Well construction data, location map, field data from last sampling event.

- Polyethylene sheeting.

- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

- Interface probe or equivalent device for determining the presence or absence of NAPL.

- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

- Decontamination supplies (see Section VII, below).

- Logbook (see Section VIII, below).

- Sample bottles.

- Sample preservation supplies (as required by the analytical methods).

- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

<u>Pre-Sampling Activities</u>

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water

level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

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

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5

minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

U.S. EPA Region II, 1989, CERCLA Quality Assurance Manual.

APPENDIX C

NYSDOH AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name ______________________ Date/Time Prepared __________

Preparer's Affiliation ______________________ Phone No.__________

Purpose of Investigation______________________________________

1. OCCUPANT:

Interviewed: Y / N

Last Name: ________________ First Name: ________________

Address: ______________________________________

County: __________

Home Phone: ____________ Office Phone: ____________

Number of Occupants/persons at this location _____ Age of Occupants ____________

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: ________________First Name: ________________

Address: ______________________________________

County: __________

Home Phone: ____________ Office Phone: ____________

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: __________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ___________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? ______

Other characteristics:

Number of floors______ Building age______

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

____

____

____

Airflow near source

____

____

____

Outdoor air infiltration

____

____

____

Infiltration into air ducts

____

____

____

5. **BASEMENT AND CONSTRUCTION CHARACTERISTICS** (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________
c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor:	uncovered	covered	covered with ____________	
e. Concrete floor:	unsealed	sealed	sealed with ____________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with ____________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

____

6. **HEATING, VENTING and AIR CONDITIONING** (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other ________

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: ____________________

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other________
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

<u>Level</u>	<u>General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)</u>
Basement	________________________
1st Floor	________________________
2nd Floor	________________________
3rd Floor	________________________
4th Floor	________________________

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA Please specify__________

d. Has the building ever had a fire? Y / N When?__________

e. Is a kerosene or unvented gas space heater present? Y / N Where?__________

f. Is there a workshop or hobby/craft area? Y / N Where & Type?__________

g. Is there smoking in the building? Y / N How frequently?__________

h. Have cleaning products been used recently? Y / N When & Type?__________

i. Have cosmetic products been used recently? Y / N When & Type?__________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? ____________

k. Is there new carpet, drapes or other textiles? Y / N Where & When? ____________

l. Have air fresheners been used recently? Y / N When & Type? ____________

m. Is there a kitchen exhaust fan? Y / N If yes, where vented? ____________

n. Is there a bathroom exhaust fan? Y / N If yes, where vented? ____________

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type? ____________

Are there odors in the building? Y / N
If yes, please describe: ____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: ____________
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _______
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: ____________________________

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: ______________________________

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

APPENDIX D

LABORATORY METHOD DETECTION LIMITS

Analytical Method Information

TO-15 in Air (EPA TO-15)

Preservation: Store at STP

Container: Summa canister **Amount Required:** **Hold Time:** 28 days

Analyte	MDL	MRL ppbv	MRL ug/m3	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Propene	0.302	0.500	0.86	30			70 - 130	30
Dichlorodifluoromethane (Freon12)	0.108	0.500	2.47	30			70 - 130	30
Chloromethane	0.124	0.500	1.03	30			70 - 130	30
1,2-Dichlorotetrafluoroethane (Freon 114)	0.0977	0.500	3.49	30			70 - 130	30
Vinyl chloride	0.138	0.500	1.28	30			70 - 130	30
1,3-Butadiene	0.186	0.500	1.10	30			70 - 130	30
Bromomethane	0.149	0.500	1.94	30			70 - 130	30
Chloroethane	0.158	0.500	1.32	30			70 - 130	30
Acetone	0.222	0.500	1.19	30			70 - 130	30
Trichlorofluoromethane (Freon 11)	0.197	0.500	2.81	30			70 - 130	30
Ethanol	0.176	0.500	0.94	30			55.1 - 230	30
1,1-Dichloroethene	0.124	0.500	1.98	30			70 - 130	30
Methylene chloride	0.110	0.500	1.74	30			70 - 130	30
1,1,2-Trichlorotrifluoroethane (Freon 113)	0.174	0.500	3.83	30			70 - 130	30
Carbon disulfide	0.0972	0.500	1.56	30			70 - 130	30
trans-1,2-Dichloroethene	0.0699	0.500	1.98	30			70 - 130	30
1,1-Dichloroethane	0.166	0.500	2.02	30			70 - 130	30
Methyl tert-butyl ether	0.108	0.500	1.80	30			70 - 130	30
Isopropyl alcohol	0.0923	0.500	1.23	30			70 - 130	30
2-Butanone (MEK)	0.105	0.500	1.47	30			70 - 130	30
cis-1,2-Dichloroethene	0.121	0.500	1.98	30			70 - 130	30
Hexane	0.0923	0.500	1.76	30			70 - 130	30
Ethyl acetate	0.154	0.500	1.80	30			70 - 130	30
Chloroform	0.221	0.500	2.43	30			70 - 130	30
Tetrahydrofuran	0.192	0.500	1.47	30			70 - 130	30
1,2-Dichloroethane	0.249	0.500	2.02	30			70 - 130	30
1,1,1-Trichloroethane	0.130	0.500	2.73	30			70 - 130	30
Benzene	0.124	0.500	1.60	30			70 - 130	30
Carbon tetrachloride	0.221	0.500	3.15	30			70 - 130	30
Cyclohexane	0.113	0.500	1.72	30			70 - 130	30
1,2-Dichloropropane	0.143	0.500	2.31	30			70 - 130	30
Bromodichloromethane	0.190	0.500	3.35	30			70 - 130	30
Trichloroethene	0.153	0.500	2.69	30			70 - 130	30
n-Heptane	0.111	0.500	2.05	30			70 - 130	30
4-Methyl-2-pentanone (MIBK)	0.339	0.500	2.05	30			70 - 130	30
cis-1,3-Dichloropropene	0.134	0.500	2.27	30			70 - 130	30
trans-1,3-Dichloropropene	0.116	0.500	2.27	30			70 - 130	30
1,1,2-Trichloroethane	0.160	0.500	2.73	30			70 - 130	30
Toluene	0.122	0.500	1.88	30			70 - 130	30
2-Hexanone (MBK)	0.289	0.500	2.05	30			70 - 130	30
Dibromochloromethane	0.142	0.500	4.26	30			70 - 130	30
1,2-Dibromoethane (EDB)	0.168	0.500	3.84	30			70 - 130	30
Tetrachloroethene	0.143	0.500	3.39	30			70 - 130	30
Chlorobenzene	0.149	0.500	2.30	30			70 - 130	30
Ethylbenzene	0.141	0.500	2.17	30			70 - 130	30
m,p-Xylene	0.246	1.00	4.34	30			70 - 130	30

Analytical Method Information

Analyte	MDL	MRL ppbv	MRL ug/m3	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Bromoform	0.190	0.500	5.17	30			70 - 130	30
Styrene	0.159	0.500	2.13	30			70 - 130	30
o-Xylene	0.116	0.500	2.17	30			70 - 130	30
1,1,2,2-Tetrachloroethane	0.253	0.500	3.43	30			70 - 130	30
1,3,5-Trimethylbenzene	0.176	0.500	2.46	30			70 - 130	30
4-Ethyltoluene	0.117	0.500	2.46	30			70 - 130	30
1,2,4-Trimethylbenzene	0.144	0.500	2.46	30			70 - 130	30
1,3-Dichlorobenzene	0.150	0.500	3.01	30			70 - 130	30
Benzyl chloride	0.174	0.500	2.58	30			70 - 130	30
1,4-Dichlorobenzene	0.143	0.500	3.01	30			70 - 130	30
1,2-Dichlorobenzene	0.132	0.500	3.01	30			70 - 130	30
1,2,4-Trichlorobenzene	0.223	0.500	3.71	30			70 - 130	30
Hexachlorobutadiene	0.411	0.500	5.33	30			70 - 130	30
Bromochloromethane								
1,4-Difluorobenzene								
Chlorobenzene-d5								
surr: 4-Bromofluorobenzene								