

Cook, Joshua P (DEC)

From: Locke, Anne <anne.locke@bms.com>
Sent: Monday, October 19, 2020 1:29 PM
To: Cook, Joshua P (DEC); Bogardus, Sara (HEALTH)
Cc: Garcia, Tara; Pufko, William; Marks, Davanna; McCune, William; Cornell, David
Subject: C734138 - Notice of upcoming activity - B55 Area PDI

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Josh and Sara,

Weather-permitting, Arcadis will perform the GPR survey of the former Building 55 area the week of November 2, 2020 and initiate drilling the week of November 9, 2020. All work will be in accordance with the department-approved Building 55 Area Pre-Design Investigation Work Plan (dated July 16, 2020) with modifications requested in the department response letter dated September 10, 2020.

Please advise if you have questions.

Anne Locke

Associate Manager, Environmental Protection | GPS
Syracuse Site

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Bristol-Myers Squibb Company

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 **Bristol Myers Squibb**



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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Region 7
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www.dec.ny.gov

September 10, 2020

Michael Furlong
General Manager, Syracuse
Bristol-Myers Squibb Company
PO Box 4755
Syracuse, NY 13221

Re: Bristol-Myers Squibb Restoration Area, Site ID No. C734138
Village of East Syracuse, Town of DeWitt, Onondaga County
Building 55 Area Pre-Design Investigation Work Plan

Dear Mr. Furlong:

The New York State Department of Environmental Conservation (Department) has reviewed the revised Building 55 Area Pre-Design Investigation Work Plan (work plan) dated July 16, 2020 for the interim remedial measure (IRM) planned for the Building 55 Area at the Bristol-Myers Squibb Restoration Area (site), which was prepared by Arcadis of New York, Inc. (Arcadis) on behalf of the Bristol-Myers Squibb Company (BMS). With the following two modifications, the work plan is approved.

1. Equipment blank (EB) samples must be collected for aldehyde analysis at the rate of one EB for every 20 normal samples. While aldehydes were detected in only one EB sample, that was the only EB collected for aldehyde analysis to-date.
2. The samples collected from just above the till layer must be collected from the borings with the greatest indications of impacts in the interval just above the till. If no impacts are identified based on field screening just above the till in any of the borings, then at least one of the locations must be selected from the boring with the greatest signs of impact in any interval of the soil column which indicate impacts other than petroleum may be present (e.g., purple staining, etc.).

Given that this action is for a planned IRM, the Department will accept horizontal delineation to a reading of 250 parts per million on a photoionization detector (PID); however, that should not imply that the Department feels that will provide adequate delineation to determine the extent of the area that requires remediation. Ultimately, if the IRM is not successful in adequately remediating the area, then additional remedial activities would be required; as part of an expanded IRM, or an additional IRM, or as part of the site's overall remedy.



Department of
Environmental
Conservation

Approval of the work plan does not imply that the Department feels this technology is the most appropriate remedial technology for this area. As noted by the Department in previous letters, there are contaminants of concern present in this area besides petroleum-related contaminants, which the proposed remedial technology may not address. If the IRM is not successful in adequately remediating all contaminants of concern for the targeted area, then additional remedial activities would be required; either as an additional IRM or as part of the site's overall remedy.

BMS must respond in writing within 15 days as to whether the modifications will be accepted. If accepted, BMS's acceptance letter and this letter must be attached to the front of all copies of the work plan. Please send the approved work plan, along with the modification letters, to the document repository and instruct the repository to replace any drafts of the work plan with the approved plan.

BMS must obtain and comply with any necessary State, local or federal permits.

The Department requires notification at least seven days in advance of field work.

If you have any questions, please do not hesitate to contact me at 315-426-7411 or joshua.cook@dec.ny.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read 'J. Cook', is positioned above the printed name.

Joshua P. Cook, P.E.
Professional Engineer 1

ec: Harry Warner (NYSDEC)
Joshua Cook (NYSDEC)
Scarlett McLaughlin (NYSDOH)
Sara Bogardus (NYSDOH)
Michael Furlong (BMS)
William Pufko (BMS)
Richard Mator (BMS)
Davanna Marks (BMS)
Anne Locke (BMS)
Cullen Flanders (Arcadis)
William McCune (Arcadis)

Mr. Joshua Cook, P.E.
Professional Engineer 1
New York State Department of Environmental Conservation
Region 7
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Syracuse, NY 13204

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Wexford
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Subject:
Building 55 Area Pre-Design Investigation Work Plan
Bristol-Myers Squibb Restoration Area
Site ID No. C734138 Village of East Syracuse,
Town of DeWitt, Onondaga County

ENVIRONMENT

Date:
July 16, 2020

Dear Mr. Cook:

Contact:
Cullen Flanders

On behalf of Bristol-Myers Squibb Company (BMS), Arcadis of New York, Inc. (Arcadis) is providing the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health with responses to the comments provided in the NYSDEC's June 15, 2020 letter regarding the Building 55 Area Pre-Design Investigation (PDI) Work Plan for the referenced site.

Phone:
724 934 9512

Email:
cullen.flanders@arcadis.com

The purpose of the PDI Work Plan is to collect additional data to facilitate the design of the Thermal In Situ Sustainable Remedial System (TISR) proposed for use in the Building 55 area. In accordance with Section 5.2(b)2.iii of DER-10, the PDI Work Plan provides the rationale for proposed sampling which will enable Arcadis to design the TISR to address hydrocarbon constituents released from a former fuel oil underground storage tank (UST). The remedial objective for the TISR is to reduce fuel-oil related hydrocarbon concentrations associated with the former UST such that natural attenuation processes can be relied upon to address dissolved hydrocarbons at concentrations above the applicable groundwater standards.

Our ref:
30049894

TISR systems have been successfully operated at 16 sites in North America, Brazil, and Europe to address hydrocarbon releases. One of these 16 systems was installed in New York at the Fort Drum US Army Base located north of Watertown. TISR has been successfully used at Fort Drum since 2017. The system at Fort Drum is being used to enhance the natural attenuation of several former hydrocarbon spills that consist of a hydrocarbon mixture of gasoline, diesel, kerosene, and heating oil. Based on my experience designing and operating TISR, the proposed PDI was developed to collect additional data to allow TISR to be designed to achieve the remedial objectives in an efficient and cost-effective manner.

The fuel oil was released to the environment through leaks in the UST and likely migrated within the subsurface through a permeable zone observed at depths ranging from approximately 8 to 14 feet below grade. This permeable zone is constrained above and below by silts and clays. The fuel oil is expected to migrate through the more permeable zone. Therefore, the PDI was developed to focus data collection on assessing the extent of fuel-oil related hydrocarbon impacts within the more permeable zone.

Following the guidance in DER-10 Section 3.5.1(d) and Appendix 2A, a field geologist will use a photoionization detector (PID) and visual observations to evaluate the hydrocarbon impacted area. The PDI will start near locations of known historical impacts and will work out radially from those locations. Based on field measurements and observations, borings will be advanced until the area is delineated horizontally to the north, east, south, and west of the former UST location. Horizontal delineation will be defined by field measurement of PID readings of less than 250 parts per million by volume (ppmv) and vertically the borings will be advanced until the till is encountered.

We have incorporated the remaining NYSDEC comments into a revised PDI Work Plan. Responses to NYSDEC technical comments are attached. The Revised PDI Work Plan will be bound separately.

If you have any questions regarding this PDI Work Plan Letter Response or require additional information, please do not hesitate to contact Anne Locke (anne.locke@bms.com) at (315) 432-2660.

Sincerely,

Arcadis U.S., Inc.



Cullen Flanders, P.E.
Vice President

Copies:

Reginald Parker (NYSDEC)
Harry Warner (NYSDEC)
Sara Bogardus (NYSDOH)
Scarlett McLaughlin (NYSDOH)
William McCune (Arcadis)
Robert Tyson (Bond)
Michael E. Furlong (BMS)
Richard Mator (BMS)
William Pufko (BMS)
Davanna Marks (BMS)
Anne Locke (BMS)
File

Attachments:

- 1 NYSDEC Comments and Arcadis Responses
- 2 Revised Building 55 Area Pre-Design Investigation Work Plan (bound separately)

ATTACHMENT 1

NYSDEC Comments and Arcadis Responses



NYSDEC COMMENTS AND ARCADIS RESPONSES

1. **The work plan must be certified by a qualified environmental professional or a professional engineer as set forth in section 1.5 of the Department's guidance document DER-10: Technical Guidance for Site Investigation and Remediation dated May 2010, as updated by its Errata Sheet.**

Response:

Arcadis concurs with the comment. The revised work plan has been certified by a professional engineer in accordance with DER-10 requirements and is included as Attachment 2.

2. **Attach the previously approved Field Sampling and Analysis Plan (FSAP), Quality Assurance Project Plan (QAPP), and Community Air Monitoring Plan (CAMP). Include any proposed deviations in the text of the work plan.**

Response:

Arcadis concurs with the comment. The previously approved FSAP, CAMP, and QAPP have been attached to the revised PDI Work Plan as Appendices A, B, and C, respectively. The FSAP and QAPP were subsequently modified by an addendum incorporated as Appendix C of the Groundwater Pre-Design Investigation and Supplemental Sampling Work Plan which was approved by NYSDEC on September 18, 2018. A copy of the Addendum is also included in Appendices A and C.

3. **Given past detections of aldehydes in blank samples, additional blanks must be collected for analysis of aldehydes. It is recommended an equipment blank be collected for each day of groundwater sampling. If necessary, depending on sampling methods, multiple equipment blanks should be collected each day. BMS should evaluate whether a trip blank should be analyzed for aldehydes. BMS and Arcadis should discuss with the laboratory and equipment supplier's potential sources of aldehydes and, if possible, eliminate that source prior to sampling (e.g., by using different equipment/tubing, etc.).**

Response:

Arcadis does not concur with the comment. While formaldehyde had previously been detected at a concentration of 33 micrograms per liter in a single equipment blank sample (EB 101118) collected in connection with the Groundwater Pre-Design Investigation implemented in 2018, this does not warrant modifying the blank sampling program as required by the approved QAPP. As the QAPP requires trip blanks be analyzed for volatile organics, it would also seem unwarranted to include analysis for aldehydes in the trip blanks. We have also reviewed the field and laboratory equipment to be used to mitigate potential sources of aldehydes.

4. In order to evaluate if the proposed PDI sampling plan is sufficient in delineating the area to be targeted by the IRM, please provide a summary of previous sampling including: pertinent field results, sampling intervals, analytes, detections, and any potential source areas or areas of concern.

Response:

Arcadis concurs with the comment. A summary of previous fuel oil related hydrocarbon sampling results and data that were used to support the development of the PDI has been added to Section 1, Paragraph 5.

5. It is not clear how the limits of the area to be treated will be determined. It is not clearly defined in either the PDI work plan or the Building 55 Area Interim Remedial Measures Work Plan, dated June 2020, which was prepared by Arcadis on behalf of BMS (IRM Work Plan). The PDI work plan states the primary intent of the PDI is to delineate the extent of subsurface impacts. The IRM Work Plan states two of its objectives are to address soil impacts that could result in impacts to groundwater and to restore the groundwater aquifer to pre-release conditions, to the extent practicable. Therefore, the goal of the PDI should be to delineate where soil impacts exceed the soil cleanup objectives (SCOs) for the protection of groundwater and where groundwater impacts exceed groundwater quality at the upgradient side of the Building 55 Area (i.e., to determine the impacts to groundwater attributable to the Building 55 Area).

Response:

Site characterization and delineation activities were completed during the Remedial Investigation (RI) phase. The NYSDEC approved the RI on November 26, 2019. The goal of the PDI is to collect additional data to support the design of the proposed Thermal In Situ Sustainable Remediation System (TISR). The goal of the TISR is to reduce fuel oil related hydrocarbon concentrations associated with the former UST such that natural attenuation processes can be relied upon to address residual contaminants above the NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1, Ambient Water Quality Standards and Guidance Values.

Considering the suspected environmental releases happened over 30 years ago, fuel oil related hydrocarbons concentrations detected in the groundwater are expected to reflect the fuel oil related hydrocarbons constituents present in soils at concentrations that could leach from the soil to the groundwater. The PDI proposes to use photoionization (PID) readings, grab groundwater samples, and select soil samples to identify locations that require remediation. The proposed soil samples are being collected to calibrate the soil and groundwater concentrations with respect to the PID readings. This calibrated data will allow future wellhead PID readings to be used to assess the performance of the TISR with respect to the relative hydrocarbon concentrations and allow the proper TISR optimization activities to be completed. When the remedial activities are completed, a work plan will be submitted to the NYSDEC to collect appropriate samples to assess compliance with the SCO.

6. In order to ensure adequate vertical delineation of contamination, at a minimum, five of the borings must be installed at least to the top of the till layer. Those borings must include the four corners of the boring grid and the fifth should be the boring with the greatest indications of impacts by contaminants other than petroleum (e.g., purple staining, elevated pH in groundwater, solvent odors, etc.). It is strongly recommended all borings be extended to the top of the till since it is a minor increase in scope and will result in much greater confidence in the data obtained (not to mention it will not be known which boring has the greatest impacts until all borings are complete).

Response:

The PDI Work Plan has been revised to state that all borings will be advanced to the top of the till. In addition, each boring will be completed until the impacted area has been delineated horizontal, which delineation is defined as PID readings less than 250 ppmv.

7. In order to provide adequate vertical delineation, in addition to the sampling that would be conducted per the FSAP and work plan, sampling must be conducted from intervals other than the most heavily impacted intervals in order to determine the full vertical extent of the area requiring treatment. If the PDI includes sampling of only the most heavily impacted zone, it will only result in verifying that the grossly contaminated zone requires treatment, and perhaps determine the horizontal extent of the treatment zone, but it will not provide information as to how thick the treatment zone should be.

Response:

The PDI is revised to collect 12 soil samples. Four samples will be used to support the horizontal extent of the fuel oil related hydrocarbons. Two borings will have 2 samples collected from each boring to access the vertical extent of the fuel oil related hydrocarbons. These 2 samples within the boring will be collected from the location of greatest indication of impacts and just above the till. The other 4 samples locations will be selected based on field observations.

8. In order to provide better vertical delineation of contamination, in addition to the sampling planned, soil samples must be collected for laboratory analysis from at least two boring locations from the interval just above the top of the till. The samples must be collected from the borings with the greatest indications of impacts in the interval just above the till. If no impacts are identified based on field screening just above the till in any of the borings, then at least one of the locations must be selected from the boring with the greatest signs of impact in any interval of the soil column which indicate impacts other than petroleum may be present (e.g., purple staining, etc.).

Response:

Refer to response 7 above concerning the vertical delineation of the fuel oil related hydrocarbons.

- 9. Based on the remedial investigation results at B55-3 and the anticipated system layout included in Figure 4 of the Building 55 Area Interim Remedial Measures Work Plan (IRM Work Plan), at least one more boring location must be added north of the PDI boring closest to B55-3. Based on the remedial investigation results at B55-2, an additional line of borings is needed east of the easternmost planned locations.**

Response:

The PDI Work Plan has been revised to make it clear that field investigations will continue vertically until the till is encountered and horizontally until borings do not detect PID readings above 250 ppmv.

- 10. If additional borings are necessary, borings must be advanced until the area to be addressed by the IRM is adequately delineated, even if that requires more than 15 additional borings.**

Response:

Refer to Response 6.

- 11. Include a statement in the work plan clarifying which SCOs will be used as a comparison. Again, since a goal of the IRM is to address groundwater contamination, the protection of groundwater SCOs are applicable.**

Response:

The PDI Work Plan has been revised to clarify that the applicable SCO (Unrestricted Use, Restricted Use – Commercial, and Restricted Use – Protection of Groundwater) will be used as a comparison, but note that the PDI is being completed to collect data to support the TISR design and not to evaluate compliance to the SCO.

- 12. The area to be treated must be based on the results of the PDI, along with prior investigation results. In order to document how the PDI results were used to determine the area to be treated, documentation of the PDI activities must be submitted along with the final design of the remedial system, which will be submitted along with a revised IRM Work Plan. The Department will provide a response to the draft IRM Work Plan separately. Documentation of the PDI activities must include field logs, laboratory data reports, data validation reports, tabulated data, figures showing actual surveyed boring locations, community air monitoring data, and documentation of proper disposal of investigation-derived waste.**

Response:

The PDI Work Plan was revised to include the prior fuel oil related hydrocarbons investigation data that was used to support the development of the PDI. Refer to Section 1, Paragraph 5, for those details.

The IRM Work Plan will be revised/updated per the results of the PDI. The IRM Work Plan will include field logs, laboratory data reports, data validation reports, tabulated data, figures showing actual surveyed boring locations, community air monitoring data, and documentation of the proper disposal of investigation-derived waste.

ATTACHMENT 2

Revised Building 55 Area Pre-Design Investigation Work Plan



Bristol-Myers Squibb Company

BUILDING 55 AREA PRE-DESIGN INVESTIGATION WORK PLAN

Site #C734138

BMS Syracuse North Campus Restoration Area
East Syracuse, New York

July 16, 2020



**Cullen
Flanders**

Digitally signed by: Cullen
Flanders

DN: CN = Cullen Flanders email =
cullen.flanders@arcadis.com C =
US O = Arcadis

Date: 2020.07.16 17:05:30 -04'00'

WARNING: These plans, specifications, and documents are each part of an integrated design system. Any modification, alteration, change, deletion, addition, or substitution of or to any specification(s) could result in property damage, injury, or even death, and requires a full review of the entire system by a professional engineer. Any unauthorized modification of this document may constitute unlicensed practice as a Professional Engineer and may constitute a felony (NY Education Law § 6512.1).

Certification Statement

I, Cullen M. Flanders, P.E. certify that I am currently a NYS registered professional engineer and that this *Building 55 Area Pre-Design Investigation Work Plan* was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the *Technical Guidance for Site Investigation and Remediation* (DER-10).



Cullen M. Flanders, P.E.
Professional Engineer/Engineer of Record



William McCune
Principal Geologist

BUILDING 55 AREA PRE-DESIGN INVESTIGATION WORK PLAN

Site #C734138
BMS Syracuse North Campus
Restoration Area
East Syracuse, New York

Prepared for:

Bristol-Myers Squibb Company

Prepared by:

Arcadis of New York, Inc.
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110 West Fayette Street
Suite 300
Syracuse
New York 13202
Tel 315 446 9120
Fax 315 449 0017

Our Ref:

30049894

Date:

July 16, 2020

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FIGURE

Figure 1 Proposed Soil Boring Locations

APPENDICES

Appendix A	Field Sampling and Analysis Plan and Modification
Appendix B	Community Air Monitoring Plan
Appendix C	Quality Assurance Project Plan and Modification

1 INTRODUCTION

This Pre-Design Investigation (PDI) Work Plan for the Building 55 Area details a limited scope of supplemental data collection and analysis to be performed at the Bristol-Myers Squibb Company (BMS) North Campus Restoration Area in East Syracuse, New York. The PDI results will be used to finalize the Interim Remedial Measure (IRM) work plan for the Building 55 Area. The PDI drilling and sampling activities will be implemented according to the methods described in the New York State Department of Environmental Conservation (NYSDEC)-approved *Field Sampling and Analysis Plan* (FSAP) and *Community Air Monitoring Plan* (CAMP), which are Appendices A and D of the *Remedial Investigation Work Plan* (OBG 2013). The FSAP was subsequently modified by an addendum incorporated as Appendix C of the Groundwater Pre-Design Investigation and Supplemental Sampling Work Plan which was approved by NYSDEC on September 18, 2018. Copies of the FSAP (with addendum) and the CAMP are included as Appendices A and B of this work plan.

The objective of this work is to further assess fuel oil related hydrocarbons impacts identified in proximity to the former Building 55 Area. Specifically, per Section 5.2(b)2.iii of DER10, the purpose of the Building 55 Area PrePDI is to collect supplemental subsurface data to ensure the proposed Thermal In Situ Sustainable Remedial System (TISR) is designed to address the fuel-oil related hydrocarbon impacts associated with a release from a former underground storage tank (UST). The remedial objective for TISR is to reduce hydrocarbon mass sufficiently such that natural attenuation processes can be relied upon to address dissolved hydrocarbons at concentrations above the applicable groundwater standards. During the PDI, data will be collected to allow Arcadis to properly design TISR to make sure the remedial efforts are completed in an efficient and cost-effective measure. The PDI is not being conducted to supplement the site characterization; it is being completed solely for the purpose of collecting data to support the TISR design.

This investigation focuses on a higher permeable zone within the shallow overburden soil layers observed at depths ranging from approximately 8 to 14 feet below ground surface (ft bgs) across the target treatment area. The permeable zone is constrained above and below by silts and clays, so the hydrocarbon impacts are expected to have migrated through this permeable zone.

The previous investigations within and downgradient of this area have included the collection and analysis of 13 subsurface soil samples and 12 groundwater samples for fuel oil related volatile organic compounds (VOC) and fuel oil related semi-volatile organic compounds (SVOC) from locations illustrated on Figure 1. Boring log details and the analytical results from soil and groundwater samples were used to support the development of this work plan. These boring logs also present results of field screening of soil samples using photoionization detectors (PID) with observed concentrations ranging up to 3,358 ppmv near the former UST location. The analytical results of the soil samples identified one fuel oil related VOC (1,2,4-trimethylbenzene) detected above the Restricted Use Soil Cleanup Objectives (SCO) for the Protection of Groundwater at location B55-2 and six fuel oil related SVOC (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and dibenzofuran) detected above one or more of the following SCO in a sample from location B55-1 (Restricted Use SCO – Protection of Groundwater, CP-51 SCO – Protection of Groundwater or Restricted Use – Commercial). The analytical results of the groundwater samples identified 11 fuel oil related VOC (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, ethylbenzene, isopropylbenzene, m,p-xylenes, naphthalene, n-butylbenzene, o-xylenes, sec-butylbenzene, toluene, and total xylenes) detected above the Technical and

Operational Guidance Series (TOGS) 1.1.1 Groundwater Standards/Guidance Values at location B55-2. Eight fuel oil related VOC (ethylbenzene, isopropylbenzene, m,p-xylenes, naphthalene, n-butylbenzene, o-xylenes, sec-butylbenzene, and total xylenes) were detected above criteria in one or more samples from monitoring well BDA-13WT. Naphthalene was the only fuel oil related hydrocarbon detected in monitoring wells B55-2. No fuel related hydrocarbons were detected in monitoring wells B55-1, BCP-B20-001, BCP-B20-002, BCP-B20-003, BDA-12RX, BDA-12T, BDA-12WT, BDA-14T, BDA-14WT, and BDA-14RX.

Additionally, the PDI was developed using Arcadis' knowledge of how the TISR performs. TISR, utilizing available steam from a site boiler as a heat source, has been modeled and is expected to obtain the estimated target temperature of 40 degrees Celsius at approximately 20 feet from one of the bore hole heat exchangers and the target vertical heating zone of about 5 to 15 ft bgs. Based on Arcadis' experience operating TISR and with the site model, the PDI was developed to ensure the locations with the higher concentrations of hydrocarbons will be within the radius of heating influence of the TISR.

The PDI starts near locations of known historical impacts. Using a photoionization detector (PID) and visual observations, a field geologist will advance additional borings in a manner that will allow the system make sure the area of elevated concentrations of fuel oil related hydrocarbons will be within the TISR radius of influence (ROI).

All boring advancement and soil sampling tasks will be supervised by an Arcadis field geologist and overseen by a senior geologist experienced with the proposed drilling methods. Consistent with previous phases of drilling activities, Arcadis will perform utility clearance in accordance with the FSAP and community air monitoring in accordance with the CAMP.

2 SOIL BORING ADVANCEMENT AND FIELD CHARACTERIZATION

Following the guidance in DER-10 Section 3.5.1(d) and Appendix 2A, the PDI will be performed using a PID and visual observations from a field geologist. Based on field measurements and observations, borings will be installed until the area is delineated to the north, east, south, and west of the former UST location. Horizontal delineation will be defined by field measurement of PID readings of less than 250 ppmv. The PDI field efforts will include the advancement of at least 15 direct-push soil borings advanced using a track-mounted, direct-push drill rig. All boring will be installed to the top of the till. Based on PID field screening results and visual observations, additional borings may be advanced to adequately assess the extent of the fuel oil related hydrocarbon impacts associated with the Building 55 UST release. The approximate locations of the proposed soil borings are depicted on Figure 1. Actual boring locations and numbers will be adjusted based on potential subsurface obstructions identified during the utility clearance process and/or field observations/conditions encountered while advancing the borings.

Soil samples will be collected continuously from the ground surface to the boring termination depth using a 2-inch-diameter sampling barrel containing a disposable liner. As described in Section 5.2 of the FSAP, recovered soil will be logged in the field, and the cores will be screened for VOC using a PID equipped with an 11.7 electron volt lamp. Any evidence of non-aqueous phase liquid will be recorded.

Upon completion of the soil borings, a screen-point sampler or temporary piezometer will be used to collect a grab groundwater sample for laboratory analysis. Boreholes will be backfilled with bentonite chips following soil and groundwater sample collection. The surface at each location will be restored to match the surrounding area.

3 SAMPLING AND ANALYSIS

The primary intent of the soil borings will be to further delineate the extent of fuel oil related hydrocarbon impacts based on the field characterization and screening of the collected soil samples. To help Arcadis calibrate the field observations to actual field conditions and facilitate a better estimation of time required to achieve the remedial objectives, up to 12 soil samples and 8 grab groundwater samples will be collected from boring locations and submitted for laboratory analysis. While soil samples will predominantly be selected from the interval with the highest levels of impact based on screening and field observations, soil samples shall also be selected for analysis from depth intervals below the apparent depth of highest impacts to facilitate calibration of screen results to conditions reflecting vertical attenuation of impacts. Two soil samples will also be collected from the interval immediately above the till at the locations with high levels of impact based on screening and field observations. Four soil samples will also be collected for the northern, eastern, southern, and western most borings to support the horizontal delineation of the impacts. Soil and groundwater samples, along with corresponding quality assurance/quality control samples, will be submitted to Eurofins Lancaster Environmental Laboratory for analysis of VOC in accordance with United States Environmental Protection Agency (USEPA) SW-846 Method 8260C, SVOC in accordance with USEPA SW-846 Method 8270C, and aldehydes in accordance with USEPA SW-846 Method 8315A. The laboratory analyses of the environmental samples and the associated quality assurance / quality control (QC/QC) samples will be performed in accordance with the NYSDEC-approved *Quality Assurance Project Plan* (Appendix B of the *Remedial Investigation Work Plan* [OBG 2013]) as modified by an addendum incorporated as Appendix C of the Groundwater Pre-Design Investigation and Supplemental Sampling Work Plan which was approved by NYSDEC on September 18, 2018. A copy of the QAPP (with addendum) is included as Appendix C of this work plan. Laboratory data deliverables will comply with DER-10, Appendix 2B. The data will be validated and added to the project database.

The validated analytical results will be compared to applicable NYSDEC SCO in a data summary table. The SCO comparisons will include Unrestricted Use, Restricted Use – Commercial, and Restricted Use – Protection of Groundwater. It is anticipated that the data summary table, a data usability summary report, and laboratory analytical reports will be provided to the NYSDEC within a revised version of the Building 55 IRM Work Plan.

4 SURVEY

Each boring location will be surveyed by C.T. Male Associates to the nearest 0.01 foot, and the elevation will be determined relative to North American Vertical Datum of 1988 and North American Datum of 1983.

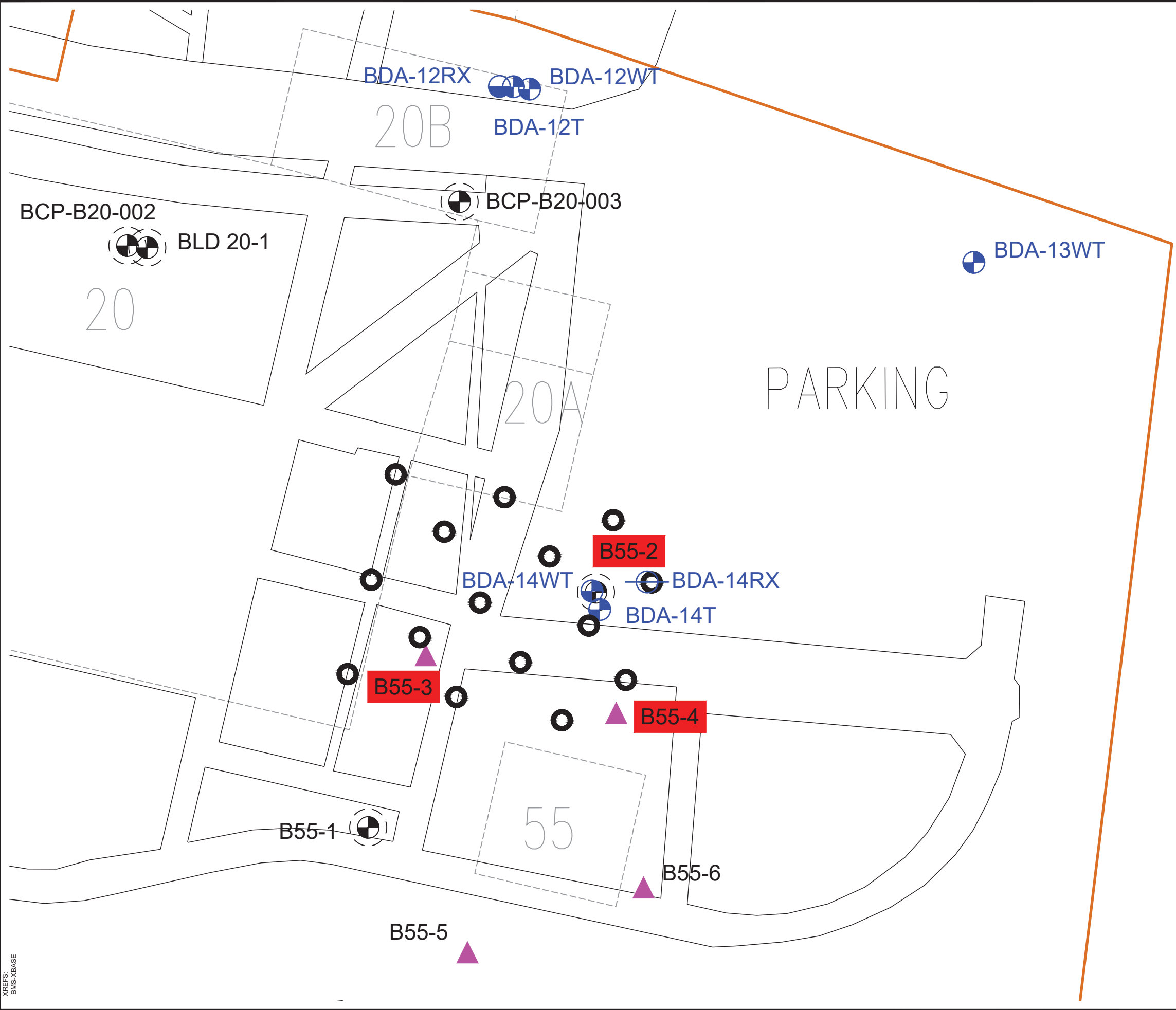
5 SCHEDULE

The fieldwork will be scheduled upon NYSDEC approval of this PDI Work Plan. We anticipate the field program will require approximately 3 weeks to complete. The results of the fieldwork will then be used to finalize the Building 55 Area basis of design, to be presented in the forthcoming Building 55 IRM Work Plan.

FIGURE



CITY: SYRACUSE, NY DIV: GROUP: EBC-IMDV DB: LD: LPOSENAUER PM: TM: W.MCCOINE Lyr: ON= OFF= REF (FRZ)
C:\Users\lposenaue\BIM 360\Arcadis\ANA - BRISTOL-MYERS COMPANY\Project Files\B55 Thermal Remedial Plot WP\2020\300488401-DWG\B55_IRMWP_03_PP_SB_LOCS.dwg LAYOUT: 3 SAVED: 5/20/2020 11:38 AM ACADVER: 23.1S (LMS TECH) PAGES: SETUP: C-LB-PDF PLOTSTYLE: TABLE: PLT\FULLCTB PLOTTED: 6/24/2020 11:15 AM BY: LPOSENAUER, LSA
XREFS: BMS-XBASE



SITE #C734138: BMS SYRACUSE
NORTH CAMPUS RESTORATION AREA
EAST SYRACUSE, NY
**BUILDING 55 AREA PRE-DESIGN INVESTIGATION
WORK PLAN**

PROPOSED SOIL BORING LOCATIONS

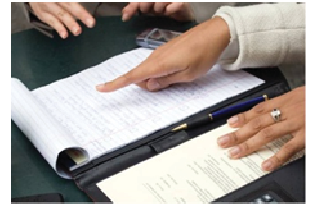
ARCADIS Design & Consultancy
for natural and built assets

FIGURE
1

APPENDIX A

Field Sampling and Analysis Plan





**Remedial Investigation
BMS Syracuse North Campus Restoration Area
Brownfield Program
East Syracuse, New York
Bristol-Myers Squibb Company**

March 2013

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1. INTRODUCTION

This Field Sampling and Analysis Plan (FSAP) has been developed by O'Brien & Gere to outline procedures to be followed during implementation of field investigation activities to support the Remedial Investigation (RI) at the Bristol-Myers Squibb Company (BMS) Syracuse North Campus Restoration Area (Site No. C734138) (Brownfield Area) located at 6000 Thompson Road in East Syracuse, New York. This FSAP is a component of the Remedial Investigation Work Plan (RIWP) developed by O'Brien & Gere for the Brownfield Area. It should be noted that not all of the activities identified in this FSAP are currently identified to be conducted; however, methods and procedures have been provided herein should such sampling be warranted.

1.1 OVERVIEW OF FIELD ACTIVITIES

The following field activities may be completed as part of the RI:

- Utility locating
- Exploratory test pits / excavations
- Soil boring and subsurface soil sampling
- Monitoring well installation and development
- Groundwater sampling
- Hydraulic conductivity testing
- Sediment sampling
- Soil vapor sampling
- Decontamination of sampling equipment
- Management of Investigation Derived Waste (IDW)

2. GENERAL FIELD GUIDELINES

2.1 SITE HAZARDS

Generally, potential hazards within the Brownfield Area will be identified during site reconnaissance by the project team prior to the initiation of RI field activities. Additional safety measures to be undertaken for the work performed as part of the RI will be addressed in the site-specific Health and Safety Plan (HASP).

2.2 UNDERGROUND UTILITIES

New York State law requires that Dig Safely of New York be notified at least two working days, and not more than 10 working days, before subsurface work is conducted. Dig Safely New York (800-272-4480) will be contacted to initiate the locating activities. Companies with subsurface utilities present will locate and mark out subsurface utility lines. However, Dig Safely New York contractors will only locate utilities on public property and rights-of-way.

Underground utilities within the Brownfield Area, including electric lines, gas lines, storm and sanitary sewers, and communication lines will be identified through a process other than Dig Safely of New York prior to initiation of drilling and other subsurface work. BMS has a requirement that prior to initiating ground-intrusive work, a written excavation permit will be issued from BMS. The excavation permit allows communication, tracking, and control of ground-intrusive activities. A copy of the excavation permit is provided as Exhibit A. Prior to scheduling any excavation activities as part of the Remedial Investigation, a form is completed identifying the contractor completing the excavation and the location, purpose, and the approximate depth of the anticipated excavation. The excavation permit is then forwarded to the BMS Engineering, EHS, and Information Management Departments for review with respect to buried utility lines or structures in the vicinity of the excavation. If additional subsurface utility locating is considered necessary, a private locating company will be contracted to locate on-site utilities that have not been identified. BMS EHS reviews the information with the contractor responsible for the work. Once this process is complete and documented, and all responsible parties have signed the form, the excavation permit is approved.

2.3 FIELD LOG BOOKS

Field activities will be documented in field log books to provide a record of the activities conducted. Entries will be of sufficient detail that a complete daily record of significant events, observations, and measurements is developed. Accordingly:

- Field books will be assigned a unique identification number.
- Field books will be bound with consecutively numbered pages.
- Field books will be controlled by the Field Manager while fieldwork is in progress.
- Entries will be written with waterproof ink.
- Entries will be signed and dated at the conclusion of each day of fieldwork.
- Erroneous entries made while fieldwork is in progress will be corrected by the person that made the entries. Corrections will be made by drawing a line through the error, entering the correct information, and initialing the correction.
- Corrections necessary after departing the field will be made by the person who entered the original information. Corrections will be made by drawing a line through the error, entering the correct information, and initialing and dating the time of the correction.

Daily field book entries, for those days when field activities are on-going, will include the following information:

- Location of field activity
- Date and time of entry
- Names, titles of any site visitors, as well as the date and time entering and leaving the site

- Weather information, for example: temperature, cloud coverage, wind speed, and direction
- Purpose of field activity
- A detailed description of the fieldwork conducted
- Sample media (e.g. soil, groundwater, etc.)
- Description of sampling point(s)
- Analytical parameters (e.g. VOCs, SVOCs)
- Date and time of collection
- Sample identification number(s)
- Field observations
- Field measurements made (e.g.; volatile organic compounds (VOCs) using a photoionization detector (PID), pH, temperature, conductivity, water level)
- References for maps and photographs of the sampling site(s)
- Information pertaining to sample documentation such as:
 - » Bottle lot numbers
 - » Dates and method of sample shipments
 - » Chain-of-custody record numbers
 - » Federal Express air bill number.

3. EXPLORATORY TEST PITS / EXCAVATIONS

Test pitting and/or excavating may be conducted during the RI, if necessary. Test pits will allow for visual characterization of subsurface soil conditions and the collection of grab soil samples. Prior to soil sample collection, headspace screening will be conducted to evaluate whether analysis of soil samples is warranted, and if so, which soils should be collected.

Prior to completing a test pit or excavation, underground utilities should be identified as discussed in **Section 2.2** of this document. Should active underground utilities be located in the vicinity of the intended excavation, hand or vacuum excavation methods should be employed, as appropriate, to confirm the location and depth prior to initiating the excavation.

The size and type of excavator used to complete the test pits will be selected based on the anticipated depth and overall size of the excavation required to meet the project objectives. At no time will field personnel enter a test pit/excavation unless it has been deemed safe to enter by an Excavation Competent person based on training and experience required by 29 CFR Part 1926 subpart P. The test pit/excavation may be classified as a confined space. If so, the BMS Confined Space Entry Permit process must be followed and proper personnel training in confined space procedures must be documented.

The sampling approach from test pits/excavations will be to bring soil samples to the surface using the backhoe or excavator to avoid entry into the test pit/excavation. Excavated soil will be placed on plastic sheeting or an equivalent impermeable surface. If grossly contaminated soil is encountered, it will be segregated for characterization and offsite disposal.

The field sampler will select and handle a soil sample(s) for analysis as described in **Section 5.2**. Descriptions of the materials encountered in the test pit/excavation will be recorded on the Test Pit Log. An example of the Test Pit Log is provided in **Appendix 1**.

4. SURFACE SOIL SAMPLING PROCEDURES

Surface soil samples will be collected from fresh soil sample collected from depths between 0 to 2-inches and 0 to 6-inches. VOCs will be analyzed from the 0 to 6-inch sample interval. The remaining analytes will be analyzed from the 0 to 2-inch interval.

Surface soil samples may be either discrete or composites. Discrete sample represents a single location in the soil column. Hand augers, disposable scoops, hand trowels, or shovels are used to collect these samples. Composite sample represents a mixture of soils from more than one location or depth at a single location. It must be recognized that compositing procedures are inappropriate for samples that will be analyzed for VOCs because agitation of the sample may result in a loss of part of the volatile fraction of the sample.

Use the following procedure when collecting a surface soil sample:

- If necessary, penetrate the soil to the appropriate sampling depth.
- If applicable, screen the area to be sampled using a PID or another appropriate screening device, and record readings in the field log. A PID is used to screen samples for two reasons:

- » To furnish a field safety measure (ambient air screening)
- » To select potentially affected soil samples (headspace screening)

The operator of the PID must be experienced in its use and aware of how factors such as temperature, humidity, or methane affect the instrument's readings.

- Using a clean tool, remove and discard a thin layer of soil from the area. Record the characteristics of the soils including grain size, content, staining, and color.
- To collect a discrete soil sample for VOC analysis, use a dedicated, disposable scoop, or its equivalent. Immediately place the VOC sample into the appropriate sample container. Soil samples for VOC analysis are not to be mixed or homogenized. Continue sampling for other parameters. Subsequent samples may be homogenized for the remaining, non-VOC analyses. Homogenization will be conducted using dedicated, disposable plastic scoops and dedicated disposable aluminum pans.
- Place the sample into appropriate sample containers. Consistent with a recent change in NYSDOH Environmental Laboratory Approval Program (ELAP) guidance dated October 17, 2012 pertaining to the collection and analysis of soil and sediment samples for VOCs, soil and sediment samples to be analyzed for VOCs as part of the Brownfield program will be collected and analyzed in accordance with USEPA Method 5035/5035A.
- Label the sample bottle in accordance with **Section 14** using indelible ink.
- Initiate chain-of-custody procedures per the QAPP.
- Place the sample containers on ice in a cooler to maintain the samples at approximately 4°C. Ship the cooler to the laboratory for analysis within 24 hours of sample collection.
- Clearly mark each location from which a sample is collected by use of a stake or flag displaying the sample number.

Samples for laboratory analysis will be submitted to an approved NYSDOH ELAP-certified laboratory under COC procedures. An example COC is included in **Appendix 2**. Analyses will be conducted using USEPA methodologies as specified in **Section 14**. Samples will be managed in accordance with the QAPP.

5. SOIL BORING AND SUBSURFACE SAMPLING PROCEDURES

Soil borings will be advanced to facilitate the collection of subsurface soil samples and the installation of monitoring wells. Subsurface soil samples will be used to develop an understanding of site-specific geologic conditions, and to document those conditions. Subsurface soil samples collected from fresh soil will also be submitted for laboratory analysis to evaluate soil quality and potential remedial activities, if necessary.

Depending on site-specific objectives and/or drilling conditions, soil borings may be advanced using direct-push, conventional hollow stem auger, or sonic drilling methods. Depth of soil borings will be consistent with the specifications in the Remedial Investigation Work Plan. If shallow refusal is encountered, the bore hole location will be moved a few feet and retried to achieve target depth. If after three (3) unsuccessful attempts to reach target depth, an evaluation will be completed to determine whether to move the boring to another location, or accept the shallow refusal.

To limit risk of spreading potentially grossly-contaminated drill cuttings in the immediate work area, plastic sheeting will be placed atop the ground surface prior to the initiation of borehole advancement. During the drilling process, the drill cuttings will be kept on the plastic sheeting until they are transferred to 55-gallon drums. In addition, prior to opening soil sampling devices, excess water will be drained from the sampler into a bucket to minimize the potential to spread contaminants. The sample device then will be opened and placed on plastic sheeting to limit potential for spreading contaminants or cross-contamination of soil samples. Collected water will be managed in accordance with **Section 12**.

5.1 SOIL BORING DRILLING METHODS

5.1.1 Direct-Push

This drilling method is typically used to collect shallow overburden soils and create boreholes for temporary monitoring well installations or soil vapor sampling points. This method is advantageous in that it typically allows for the advancement of numerous borings in a relatively short period of time. The disadvantage of this method is that it is typically limited to shallow overburden soils (less than 50 feet below grade) which exhibit relatively low densities.

5.1.2 Conventional Hollow Stem Auger Method

Hollow stem auger drilling method is typically used to collect shallow and deeper overburden soils and create boreholes for permanent monitoring well installations. This method is advantageous in that it typically allows for the advancement of borings through denser soils, and when coupled with split spoon sampling conducted in accordance with ASTM Method D1586, can provide geotechnical information. The disadvantage of this method is that it is typically more time consuming to drill and sample, and to decontaminate the equipment than direct-push methods. In addition, this method can generate a high volume of soil cuttings that may require off-site disposal depending on the depth of the boring.

5.1.3 Sonic

A sonic drill rig looks and operates very much like any conventional top-drive rotary or auger rig. The sonic drilling system employs simultaneous high frequency vibration and low speed rotational motion along with down pressure to advance the cutting shoes of the drill string. This technique provides a continuous soil core and generates minimal cuttings. Due to the true continuous sampling of the system, accurate depictions of the stratigraphy and lithology of the overburden are obtained (minimal sloughing). Additionally, few cuttings are mobilized to the surface. Most of the formation material enters the core barrel, except small amounts, that are pushed into the borehole wall.

Drilling operations take place from the drill platform, which is about 4 feet above ground. Steel drill casing and core barrel are connected to the head from the work platform/support truck and are then hoisted to vertical in the derrick. Tool joints are connected and broken by a hydraulic vise/wrench that is in the base of the derrick. The sonic head is able to pivot 90 degrees to facilitate connection of the drilling rods.

The sonic drilling system uses an override core barrel system. A 4 or 6-inch diameter 10 or 20-foot long core barrel is first advanced into the ground. This is followed by the override casing drilled to the same depth as the core barrel cutting shoe. The core barrel is then removed and cores are extruded into plastic sleeves. The core barrel is sent back down the hole where it is advanced another 10 or 20 feet followed again by the override casing. The outer casing prevents cross contamination and formation mixing and allows for a very controlled placement of wells.

5.2 SUBSURFACE SOIL SAMPLING AND FIELD SCREENING

- Soil samples will be collected continuously from the ground surface to the bottom of the borings.
- Soil samples retrieved from the borehole will be described for: 1) percent recovery; 2) soil type; 3) color; 4) moisture content; 5) texture; 6) grain size and shape; 7) consistency; 8) evidence of staining or other chemically-related impacts; and 9) any other relevant observations. In addition, soil will be screened with a PID to allow evaluation of the bulk volatile organic concentration of each soil sample.
- Soils will be described in accordance with the Unified Soil Classification System (USCS). This descriptive information will be recorded on a soil boring log form. An example of the typical soil boring log form is provided in **Appendix 3**.
- An initial screening of the soil core will be conducted using a PID equipped with an 11.7 eV lamp. The PID will be used to carefully scan the length of the soil core. Samples for headspace screening will be collected and placed in a re-sealable plastic (e.g., Ziploc®) bag filled approximately half full. The bag will be labeled with the boring number and interval sampled. After allowing the bagged soil to warm, the tip of the sample probe attached to the PID will be inserted into the bag to measure the headspace for organic vapors.
- Soil samples will be selected for analysis based on PID screening and/or visual/olfactory indications of potential impacts. Fresh soil samples will be collected from the selected material, and placed in appropriate laboratory supplied jars for the identified analyses. Consistent with a recent change in NYSDOH Environmental Laboratory Approval Program (ELAP) guidance dated October 17, 2012 pertaining to the collection and analysis of soil and sediment samples for VOCs, soil and sediment samples to be analyzed for VOCs as part of the Brownfield program will be collected and analyzed in accordance with USEPA Method 5035/5035A.
- Non-aqueous phase liquid (NAPL) testing will be conducted on soil intervals exhibiting PID responses greater than 100 parts per million (ppm) above background as follows:
 - » Perform an unaided visual inspection of the soil interval(s) where PID responses are greater than 100 ppm above background for the presence of NAPL
 - » Perform a soil jar shake test using Oil-Red-O, a hydrophobic dye, on soil intervals exhibiting PID responses greater than 100 ppm as follows:
 - › Place approximately 20 grams of soil in an unpreserved 40-ml VOA vial and add approximately 20 ml of water being sure to leave a generous air filled headspace within the vial.
 - › Cap the vial and vigorously shake the vial for 30 seconds.
 - › Add approximately 2 mg of Oil-Red-O to the soil/water mixture.
 - › Cap the vial and vigorously shake the vial for an additional 30 seconds.
 - › The presence of NAPL can be distinguished based on color development within the test vial. If NAPL is present, it will turn red in color and adhere to the glass in the headspace portion of the vial. If large quantities of NAPL are present, it may also be identifiable within the soil in the vial.
 - › Residual waste containing Oil-Red-O will be containerized separate from other IDW.
- Figure 3-3 of the RI Work Plan illustrates a sample decision tree for use during the Phase I RI. This figure provides a framework for the minimum depth of soil boring advancement, provisions for field screening of

soil samples, how to proceed with borehole advancement based on PID screening thresholds, and where to install temporary monitoring wells.

- Samples for laboratory analysis will be submitted to an approved NYSDOH ELAP-certified laboratory under Chain-of-custody procedures. An example Chain-of-custody is included in **Appendix 2**. Analyses will be conducted using USEPA methodologies as specified in **Section 14**. Samples will be managed in accordance with the QAPP.

5.3 NAPL CONTINGENCY

If non-aqueous phase liquid (NAPL) is observed visually or by using hydrophobic dye testing during soil boring advancement, then further advancement of the borehole will be suspended, and BMS EHS and the O'Brien & Gere Project Manager will be notified immediately. Provided there is no need for a temporary NAPL monitoring or collection well, the boring will be terminated. Prior to abandonment, if sufficient NAPL volume is present, a sample will be collected. The borehole will then be abandoned in accordance with **Section 5.4**.

Subsequent to abandonment of the initial borehole, additional boreholes will be advanced, as appropriate, to delineate the extent of the NAPL.

Soil cuttings containing NAPL will be segregated to the extent practicable and contained in a 55-gallon drum(s).

5.4 BOREHOLE ABANDONMENT

Borehole abandonment during the Remedial Investigation will be conducted by filling the borehole with cement/bentonite grout using a tremie pipe positioned at the bottom of the borehole. The grout column will be installed to within at least two feet of the surface. Uncontaminated soil cuttings or grout may be used to fill the top two feet. CP-43 *Groundwater Monitoring Well Decommissioning Policy* will be followed as applicable.

6. MONITORING WELL INSTALLATION AND DEVELOPMENT

Monitoring wells will be used to evaluate the hydrogeologic conditions and groundwater quality. Monitoring wells will be installed to allow characterization of groundwater levels, groundwater flow systems, and groundwater quality.

6.1 TYPES OF MONITORING WELLS

Monitoring wells may be installed in overburden (e.g., fill or till) and/or bedrock, and may be temporary or permanent depending on the project objectives. A Well Completion Log will be completed for each well installed. An example of the Well Completion Log is provided in **Appendix 4**.

6.1.1 Temporary Overburden Monitoring Well Installation and Construction

The temporary monitoring well borings may be advanced using direct-push, hollow-stem auger, or sonic drilling methods. Regardless of the drilling method, soil samples will be collected continuously. When using augers, subsurface samples will be collected using 2 ft long, 2-inch diameter split barrel samplers in accordance with ASTM Method D1586.

Temporary wells will be constructed using 1-inch inside diameter (I.D.), Schedule 40 PVC, 0.010-inch slotted screen, flush-threaded to 1-inch I.D. Schedule 40 PVC riser casing. The well screen, plug, and riser should be certified clean from the manufacturer. If they are not, they will be cleaned using a high pressure steam cleaner. In general, well screens will be 10-feet long for shallow water table wells.

The annulus around the screens will be backfilled with clean silica sand having appropriate size in comparison to the screen slot size. The filter pack will be installed in increments as the augers or casings are withdrawn to enable monitoring of progress and to prevent bridging. If bridging occurs, break the bridge before proceeding with installation. The filter pack should extend a minimum of 2 ft above the top of the screen.

A bentonite chip or pellet seal with a minimum thickness of 2 feet will be placed above the filter pack to within two feet of the ground surface. The portion of the bentonite seal installed above the water table will be manually hydrated using potable water. The remaining depth may be filled with uncontaminated soil cuttings up to the ground surface.

6.1.2 Permanent Overburden Monitoring Well Installation and Construction

Permanent monitoring wells will be used when long-term monitoring data or hydraulic conductivity testing is required. The monitoring well borings will be advanced using 4.25-inch inner diameter (ID) hollow-stem augers or 4-inch sonic casing when 2-inch wells are to be installed. During advancement of the augers or casing, soil samples will be collected continuously. When using augers, subsurface samples will be collected using 2-ft long, 2-inch diameter split barrel samplers in accordance with ASTM Method D1586. When using sonic casing, subsurface soil samples will be collected as nominal 4-inch diameter cores.

Permanent monitoring wells will be constructed with 2-inch I.D., Schedule 40 PVC, 0.010-inch slotted screen, flush-threaded to 2-inch I.D., Schedule 40 PVC riser casing. The well screen, plug, and riser should be certified clean from the manufacturer. If they are not, they will be cleaned using a high pressure steam cleaner.

In general, well screens will be 10-feet long for shallow water table wells and 5-feet long for deeper overburden wells, unless greater lengths are required to meet project objectives. In general, it is anticipated that a slot size of 0.010-inch will be used.

The annulus around the screens will be backfilled with clean silica sand having appropriate size in comparison to the screen slot size. The volume of filter pack required to fill the annular space will be calculated and compared to the volume installed. This information will be recorded in the field log book. The filter pack will be installed in increments as the augers or casings are withdrawn to enable monitoring of progress and to prevent bridging. If bridging occurs, break the bridge before proceeding with installation. The filter pack should extend a minimum of 2 ft above the top of the screen.

A bentonite chip or pellet seal with a minimum thickness of 2 feet will be placed above the filter pack. If the seal is installed above the water table, it will be manually hydrated using potable water. The remainder of the annular space will be filled with cement-bentonite grout to ground surface. The grout will be allowed to set for a minimum of 24 hours before wells are developed.

Well heads may be completed either above grade, or flush with grade. For above grade completions, the well heads will extend approximately 3-ft above grade and will be fitted with a protective casing with a lockable lid. An approximate 2-ft diameter concrete well pad will be installed around the protective casing. The well pad will be sloped away from the protective casing to shed surface water away from the well head. The well identification will be clearly visible on the inside and outside of the lid of the protective casing.

Well heads in parking lots, roadways, or other areas accessed by vehicular traffic will be completed flush with grade. Flush-mount curb boxes will be fitted over the well head and will be flush to the surrounding grade. The curb box will be set in an approximate 2-ft diameter concrete pad. A locking J-plug will be installed on top of the well.

The top of the well casing and ground surface will be marked and surveyed to 0.01 foot, and the elevation will be determined relative to a fixed benchmark or datum. The measuring point on all wells will be on the innermost PVC casing.

6.1.3 Permanent Bedrock Monitoring Well Installation and Construction

Bedrock monitoring wells will be installed using sonic drilling methods, or a combination of hollow stem auger and rock coring, air rotary, or fluid rotary drilling methods.

When using sonic methods, a 4-inch core barrel and 6-inch override casing will be used through the overburden and bedrock to the target depth. Soil samples will be collected continuously through the overburden and bedrock. The 6-inch override casing will provide a temporary seal between the overburden and bedrock. Once at the target depth, a 2-inch PVC monitoring well will be installed and centered in the 6-inch sonic casing. As the 6-inch casings is retracted, a filter pack will be installed within the annular space between the well and the 6-inch casing from the bottom of the annulus to approximately 2-ft above the well screen. An approximate 2-ft thick bentonite seal will be installed within the annulus on top of the filter pack. Cement/bentonite grout will be tremied within the annulus from the top of the bentonite seal to approximately 1 to 2-ft below grade to permanently seal the bedrock from the overburden. As the cement/bentonite grout is installed, the sonic drill head will be engaged to retract the casing and this will serve to degas the grout, and knit the grout into the borehole wall.

If augers/coring or rotary methods are used, 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. Soil samples will be collected using 2-inch diameter split-barrel samplers in accordance with ASTM Method D1586. Once bedrock is encountered, a 6-inch socket will be advanced approximately 3-ft into bedrock. A 4-inch diameter casing will be tremie grouted from the bottom of the annulus between the casing and the borehole wall to 1-2-ft below grade to provide a seal between the overburden and bedrock. The remainder of the bedrock borehole will be advanced using either a nominal 4- inch diameter tri-cone bit or, if bedrock cores are to be collected NX or HQ core barrels. Once at the target depth, a 2-inch PVC monitoring well will be installed and centered within the bedrock borehole. A filter pack will be installed within the annular space between the well and the borehole wall from the bottom of the annulus to approximately 2-ft above the well screen. An approximate 2-ft thick bentonite seal will be installed within the annulus on top of the filter pack. Cement/bentonite grout will be tremied within the annulus from the top of the bentonite seal to approximately 1 to 2-ft below grade.

Open bedrock monitoring wells may be used if they meet the project objectives. If open bedrock wells are to be used, permanent 4-inch diameter casing will extend from approximately 3-ft below the bedrock surface to grade and will be tremie grouted in place from the bottom to top. Bedrock monitoring wells may also be constructed with at least a ten foot section of appropriate slot size PVC (or other suitable well screen material) well screen and schedule 40 PVC flush-joint casing (or other suitable riser casing material) 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 bedrock wall and the PVC riser pipe will be backfilled with the appropriately sized clean silica sand 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 filter pack and hydrated. The remaining annular space will be backfilled with a cement/bentonite grout mixture to the ground surface.

Well heads may be completed either above grade, or flush with grade. For above grade completions, the well heads will extend approximately 3-ft above grade and will be fitted with a protective casing with a lockable lid. An approximate 2-ft diameter concrete well pad will be installed around the protective casing. The well pad will be sloped away from the protective casing to shed surface water away from the well head. The well identification will be clearly visible on the inside and outside of the lid of the protective casing.

Well heads in parking lots, roadways, or other areas accessed by vehicular traffic will be completed flush with grade. Flush-mount curb boxes will be fitted over the well head and will be flush to the surrounding grade. The curb box will be set in an approximate 2-ft diameter concrete pad. A locking J-plug will be installed on top of the PVC well.

6.2 MONITORING WELL DEVELOPMENT

Development will be performed by surging and purging the well, as appropriate. Following installation of the wells and prior to collection of ground water samples, each well will be developed to remove the fine material which may have settled within the monitoring wells, to remove introduced drilling fluids, and to provide better hydraulic communication with the surrounding formation. Development will consist of surging the well and removal of five well volumes using either a bailer or pump. Groundwater parameters will be recorded prior to development, after removal of each well volume during development, and at the conclusion of development. Parameters will include turbidity, pH, temperature, and specific conductance. Well development data will be recorded on a Well Development Log. An example of the Well Development Log is provided in **Appendix 5**.

Water levels will be measured in each well to the nearest 0.01 foot prior to development.

If possible, the wells will be developed until turbidity is less than 50 nephelometric turbidity units (NTUs) and until pH, temperature, and specific conductivity stabilize over the course of three successive readings. Stabilization criteria will be $\pm 3\%$ of the initial reading for temperature and specific conductance, and ± 0.1 pH units for pH. At least five (5) well volumes must be removed unless the well is purged to dryness, in which case the well will be allowed to recover to at least 50% of its static level and purged a second time. If it is determined that parameter stabilization and/or 50 NTU is not achievable due to fine-ground material and low-yielding wells, well development may cease.

Development water will be managed in accordance with **Section 12**.

Following development, wells will be allowed to recover for at least 7 days before groundwater is purged and sampled.

6.3 MONITORING WELL ABANDONMENT

There may be occasions when monitoring wells will require abandonment. For temporary monitoring wells, the approach will be to pull the PVC well materials from the borehole, and backfill the remaining open portion of the borehole with cement/bentonite grout tremied from the bottom to approximately 0.5 feet below the ground surface. The ground surface will be restored to a similar condition as the surrounding grade (*e.g.* topsoil, asphalt). For permanent overburden and bedrock monitoring wells, depending on the site-specific subsurface geologic conditions and nature of contamination, the abandonment approach will be in accordance with NYSDEC Policy CP-43 – Groundwater Monitoring Well Decommissioning Policy. Details regarding the well abandonment will be documented on the Well Decommissioning Record provided in **Appendix 6**.

7. GROUNDWATER SAMPLING PROCEDURES

Groundwater samples may be collected using various methods depending on specific project objectives. These methods may include hand bailing, pumping, or low-flow purging and sampling.

7.1 GROUNDWATER SAMPLING METHODS

7.1.1 Hand Bailing

- Synoptic Water Level Monitoring. At least two synoptic water level monitoring events will be conducted during Phase 1 of the Remedial Investigation. The first monitoring event will utilize all permanent and temporary monitoring wells at the facility. The second event will include all permanent wells and a subset of temporary wells which will be proposed by BMS during the Phase 1 work and approved by NYSDEC. The static water level and thickness of any light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing with a decontaminated oil/water interface probe. NAPL thickness will be confirmed using a clear bailer or a weighted string. The measurement will be recorded in the field book.
- Prior to commencing daily sampling activities, the groundwater quality monitoring probes/meters including pH, conductivity, and turbidity will be calibrated in accordance with the manufacturer's instructions. At a minimum, two-point calibrations will be conducted for pH, specific conductivity, and turbidity. Calibration results will be recorded in the field log notebook.
- Lower the bailer to the bottom of the well. Move the bailer up and down to suspend any material that may have settled to the bottom of the well.
- Initiate bailing of the well from the bottom. Pour the groundwater from the bailer into a graduated 5-gallon bucket to measure the volume withdrawn from the well.
- During the removal of successive well volumes, measure the water temperature, pH, specific conductivity, and turbidity with calibrated meters. Record this information on the Standard Groundwater Sampling Log. An example of the Standard Groundwater Sampling Log is provided in **Appendix 7**.
- Commence sample collection once a minimum of three well volumes have been purged and pH, temperature, conductivity, and turbidity have stabilized to within the following criteria:
 - » Temperature $\pm 3\%$ of measurement
 - » pH ± 0.1 pH units
 - » Specific conductivity $\pm 3\%$ of measurement
 - » Turbidity $\pm 10\%$ of measurement

If the well is purged dry, sample collection may commence once a sufficient volume of water is present in the well to fill the required sample bottles.

- Keep sample bottles in cooler containing ice with their caps on until they are ready to receive samples. The type of analysis for which a sample is collected determines the type of container, preservative, holding time, and filtering requirement as specified in the QAPP. Samples are transferred directly from the bailer to the container. The container should hold any necessary preservative and should be correctly labeled before the sample is transferred to it.
- When ready to fill the bottles, remove them from their transport containers. Prepare them to receive the samples.
- Inspect labels to see that the samples are properly identified.
- Arrange the sampling containers to allow for convenient filling.
- Minimize agitation of the water in the well; begin sampling by lowering the bailer slowly into the well. Lower it only far enough to fill it completely.

- Samples collected using bailers will be drained into sample bottles using a sample release device/tube at the bottom of the bailer. Samples will not be collected by pouring from the top of the bailer.
- Fill the containers that will undergo analysis for VOCs first. The VOC containers should be filled with zero headspace from one bailer, and then securely capped.
- Fill each sample container in accordance with the QAPP or other sampling outline.
- Return each sample bottle to its proper transport container.
- Record the appearance of the groundwater on the Standard Groundwater Sampling Log (**Appendix 7**).
- Samples must not be allowed to freeze.
- Record the date and time.
- Secure the well head.
- Samples for laboratory analysis will be submitted to an approved NYSDOH ELAP-certified laboratory under Chain-of-custody procedures. An example Chain-of-custody is included in **Appendix 2**. The sample containers will be labeled, placed in a laboratory-supplied cooler, with protective packaging (i.e. bubble wrap) and packed on ice (to maintain a temperature of 4° C). The cooler will be shipped no later than 48 hours after sample collection. Analyses will be conducted using USEPA methodologies as specified in **Section 14** and the QAPP. Samples will be managed in accordance with the QAPP.
- Purge water will be managed in accordance with **Section 12**.

7.1.1.2 Pumping

- Prior to the collection of groundwater samples from the permanent monitoring well network, a synoptic groundwater level monitoring event will be conducted. The static water level and thickness of any light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing with a decontaminated oil/water interface probe. NAPL thickness will be confirmed using a clear bailer or a weighted string. The measurement will be recorded in the field book.
- Prior to commencing sampling activities and daily thereafter, the groundwater quality monitoring probes/meters including pH, conductivity, and turbidity will be calibrated in accordance with the manufacturer's instructions. At a minimum, two-point calibrations will be conducted for pH, conductivity, and turbidity. Calibration results will be recorded in the field log notebook.
- Prepare the pump for operation. Follow the manufacturer's instructions.
- Pump the groundwater into a graduated 5-gallon bucket.
- During the removal of successive well volumes, measure the water temperature, pH, specific conductivity, and turbidity with calibrated meters. Record this information on the Standard Groundwater Sampling Log. An example of the Standard Groundwater Sampling Log is provided in **Appendix 7**.
- Commence sample collection once a minimum of three well volumes have been purged and pH, temperature, conductivity, and turbidity have stabilized to within the following criteria:
 - » Temperature ±3% of measurement
 - » pH ±0.1 pH units
 - » Specific conductivity ±3% of measurement
 - » Turbidity ±10% of measurement

If the well is purged dry, sample collection may commence once a sufficient volume of water is present in the well to fill the required sample bottles.

- Keep sample bottles in cooler containing ice with their caps on until they are ready to receive samples. The type of analysis for which a sample is collected determines the type of container, preservative, holding time, and filtering requirement as specified in the QAPP. Samples are transferred directly from the bailer to the container. The container should hold any necessary preservative and should be correctly labeled before the sample is transferred to it.
- When ready to fill the bottles, remove them from their transport containers. Prepare them to receive the samples.
- Inspect labels to see that the samples are properly identified.
- Arrange the sampling containers to allow for convenient filling.
- Fill the containers that will undergo analysis for VOCs first. The VOC containers should be filled with zero headspace from one bailer, and then securely capped.
- Fill each sample container in accordance with the QAPP or other sampling outline.
- Return each sample bottle to its proper transport container.
- Record the appearance of the groundwater on the Standard Groundwater Sampling Log (**Appendix 7**).
- Samples must not be allowed to freeze.
- Record the date and time.
- Secure the well head.
- Samples for laboratory analysis will be submitted to an approved NYSDOH ELAP-certified laboratory under Chain-of-custody procedures. An example Chain-of-custody is included in **Appendix 2**. The sample containers will be labeled, placed in a laboratory-supplied cooler, with protective packaging (i.e. bubble wrap) and packed on ice (to maintain a temperature of 4° C). The cooler will be shipped no later than 48 hours after sample collection. Analyses will be conducted using USEPA methodologies as specified in **Section 14** and the QAPP. Samples will be managed in accordance with the QAPP.
- Samples for laboratory analysis will be submitted to an approved NYSDOH ELAP-certified laboratory under Chain-of-custody procedures. An example Chain-of-custody is included in **Appendix 2**. Analyses will be conducted using USEPA methodologies as specified in **Section 14**. Samples will be managed in accordance with the QAPP.
- Purge water will be managed in accordance with **Section 12**.

7.1.3 Low Flow Purging and Sampling

- Equipment will be decontaminated prior to use at each location.
- Prior to the collection of groundwater samples from the permanent monitoring well network, a synoptic groundwater level monitoring event will be conducted. The static water level and thickness of any light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing with a decontaminated oil/water interface probe. NAPL thickness will be confirmed using a clear bailer or a weighted string. The measurement will be recorded in the field book.
- Prior to commencing daily sampling activities, the groundwater quality monitoring probes/meters including pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen, and turbidity will be calibrated in accordance with the manufacturer's instructions. At a minimum, two-point calibrations will be conducted for pH, conductivity, and turbidity. The dissolved oxygen probe will be checked against a zero-dissolved oxygen solution. In addition, the dissolved oxygen calibration will be corrected for local barometric pressure and elevation. Calibration results will be recorded in the field log notebook.

- The intake of the peristaltic or submersible pump will be positioned in the center of the screened interval and the upper end of the tubing will be connected to the flow through cell. Flow rate shall not exceed 0.5 liters/min (500 ml/min). Initially, a flow rate between 200 ml/min and 500 ml/min will be used. The drawdown will be monitored using a water level probe and the flow rate will be reduced if the drawdown exceeds 0.3 ft. Efforts will be made to minimize the generation of air bubbles in the sample tubing by increasing the flow rate as appropriate.
- During purging, pH, specific conductivity, temperature, ORP, dissolved oxygen, and turbidity will be monitored and recorded at time intervals sufficient to evacuate the volume of the flow-through cell. This information along with water level readings to monitor drawdown will be recorded on the Low Flow Groundwater Sampling Log. An example of the Low Flow Groundwater Sampling Log is provided in **Appendix 8**.
- Well sampling will commence after equilibration of water quality parameters. The equilibration guidelines are as follows:
 - » Temperature ± 3% of measurement
 - » pH ± 0.1 pH units
 - » Specific conductivity ± 3% of measurement
 - » Redox ±10 mV
 - » DO ±10% of measurement
 - » Turbidity ± 10% of measurement

Stabilization is achieved when three (3) successive readings are within the specified ranges above. If the water level will not stabilize even at lower flow rates then the well will not be able to be sampled using the low flow method. In this situation, the well will be pumped to dryness and sample collection may commence once a sufficient volume of water is present in the well to fill the required sample bottles.

- Prior to collecting the sample, the flow-through cell will be disconnected from the tubing. Groundwater will be allowed to flow from the tubing into the sample container carefully so as to limit aeration of the sample. If preservative is present in a container, the container will not be overfilled.
- Keep sample bottles in cooler containing ice with their caps on until they are ready to receive samples. The type of analysis for which a sample is collected determines the type of container, preservative, holding time, and filtering requirement as specified in the QAPP. Samples are transferred directly from the bailer to the container. The container should hold any necessary preservative and should be correctly labeled before the sample is transferred to it.
- When ready to fill the bottles, remove them from their transport containers. Prepare them to receive the samples.
- Inspect labels to see that the samples are properly identified.
- Arrange the sampling containers to allow for convenient filling.
- Fill the containers that will undergo analysis for VOCs first. The VOC containers should be filled with zero headspace and then securely capped.
- Fill each sample container in accordance with the QAPP or other sampling outline.
- Return each sample bottle to its proper transport container.
- Record the appearance of the groundwater on the Low Flow Groundwater Sampling Log (**Appendix 8**).
- Samples must not be allowed to freeze.
- Record the date and time.
- Secure the well head.

- Samples for laboratory analysis will be submitted to an approved NYSDOH ELAP-certified laboratory under Chain-of-custody procedures. An example Chain-of-custody is included in **Appendix 2**. The sample containers will be labeled, placed in a laboratory-supplied cooler, with protective packaging (i.e. bubble wrap) and packed on ice (to maintain a temperature of $<4^{\circ}\text{C}$). The cooler will be shipped no later than 48 hours after sample collection. Analyses will be conducted using USEPA methodologies as specified in **Section 14** and the QAPP. Samples will be managed in accordance with the QAPP.
- Purge water will be managed in accordance with **Section 12**.

8. HYDRAULIC CONDUCTIVITY TESTING

Hydraulic conductivity “slug” tests involve observing the recovery of water levels toward an equilibrium level after an initial perturbation. The perturbation may be either a sudden rise or fall in water level. During a falling head slug test, an inert rod of known volume will be quickly introduced into the well to cause a water level rise. Following equilibration of the water level a rising head slug test can be initiated by removing the slug to lower the water level. Procedures and equipment requirements may vary depending on the rate of the water-level recovery.

Select wells will be tested in accordance with the following procedures:

Initial Activities and Setup

- Determine the type of test to be performed based on the following:
 - » If the screened interval of the well straddles the water table, only use a rising head test;
 - » If the screened interval of the well is fully submerged below the water, then a rising and falling head test will be conducted
- Record appropriate data on the Hydraulic Conductivity Test Log. An example of the Hydraulic Conductivity Test Log is provided in **Appendix 9**.
- Measure the static depth to water (only wells which have fully recovered to static level conditions after drilling and development should be tested) and the depth to the bottom of the well to be tested and calculate the length of the water column.
- Clean the downhole equipment (e.g., pressure transducer, associated cable and, if used, the bailer or slug and associated line) following the decontamination procedures provided in **Section 12** before initiating test(s) at each well.
- A solid slug, that will provide a theoretical displacement of approximately 1.4 feet will be used.
- Program the data collection frequency into the data logger/pressure transducer that is suitable for the anticipated permeability of the water-bearing formation. For example, water levels in highly permeable formations will likely recover very quickly, sometimes within tens of seconds. In this case, the data collection interval should small enough to capture the anticipated high rate of recovery. Water levels in low to moderately permeable formations may take tens of minutes to hours to recover. In this case, a variable data collection frequency may be more appropriate where initially data is collected at very small intervals whereas later data collection occurs at larger intervals. This is helpful in reducing the size of the data file and subsequent data manipulation and reduction.

Rising Head Test

- Connect the pressure transducer to the data logger and lower the transducer into the well to a depth that will not interfere with the insertion of the slug but does not exceed the operating range of the transducer.
- Secure the transducer cable such that it does not slip deeper into the well. If the edges of the well casing are sharp, cover them with cloth or duct tape to protect the transducer cable.
- Check the data logger for connectivity and communication with the transducer.
- Monitor the static water level recorded by the transducer for one to two minutes.
- Insert the slug into the well such that the top of the slug is approximately 0.5 feet below the initial static water level.
- Prior to beginning the rising head test, monitor the water level for a period of time to make sure water levels have reached near-static conditions after the slug has been introduced.
- Begin data logging for 5 to 10 seconds before insertion of the slug.

- Quickly create a water level change by removing the slug from the well. Avoid entanglement of the slug and rope with the transducer cable.
- Monitor water level rise both from the data logger and by periodic hand measurements. Record hand measurements on Hydraulic Conductivity Test Log (**Appendix 9**).
- Continue to collect data until water level in the well has reached at least 5% of static, after which the test will be terminated.
- Review the data file and associated data plot to make sure data has been collected in an appropriate manner. The observed initial displacement in the transducer file should be comparable (within 95%) of the anticipated initial displacement based on the slug geometry. If not, the test will be repeated to confirm the data.

Combined Falling Head and Rising Head Test

- Double check data logger settings.
- Begin data logging for 5 to 10 seconds before insertion of the slug.
- Tie a sufficient length of polypropylene rope to the slug.
- Quickly create a water level change by inserting the slug into the well making sure to that the top of the slug has been fully submerged below the static water level, but no more than 1 ft below the static water level to avoid contact with the transducer. Avoid entanglement of the slug and rope with the transducer cable.
- Secure the rope from the slug to the well casing such that the slug will not slip deeper into the well during the test.
- Monitor water level decline both from the data logger and by periodic hand measurements. Record hand measurements on Hydraulic Conductivity Test Log (**Appendix 9**).
- Continue to collect data until water level in the well has recovered to within 5% of static, after which the test will be terminated.
- Review the data file and associated data plot to make sure data has been collected in an appropriate manner.
- Re-program the data logger/pressure transducer for the start of the rising head test.
- Double check data logger settings.
- Begin data logging for 5 to 10 seconds before removal of the slug.
- Quickly create a water level change by removing the slug from the well. Avoid entanglement of the slug and rope with the transducer cable.
- Monitor water level rise both from the data logger and by periodic hand measurements. Record hand measurements on Hydraulic Conductivity Test Log (**Appendix 9**).
- Continue to collect data until water level in the well has recovered to within 5% of static, after which the test will be terminated.
- Review the data file and associated data plot to make sure data has been collected in an appropriate manner. The observed initial displacement in the transducer file should be comparable (within 95%) of the anticipated initial displacement based on the slug geometry. If not, the test will be repeated to confirm the data.

Rising head or combined rising and falling head tests should be repeated at least twice, or ideally three times at each well.

9. SEDIMENT SAMPLING

Procedures for obtaining samples of sediment are described in this section.

9.1 Sediment Sampling Method

- Sediment sampling will be performed by wading if water depths are less than 3 feet. If water depths are greater than 3 feet, alternative measures will be implemented, which may include using a boat or floating platform. Personnel wading into the stream to collect sediment samples will enter downstream of the furthest downstream sample locations and then move upstream to collect the sample to avoid disturbing sediments or creating turbidity in the sampling location. Downstream samples will be collected before samples from further upstream locations.
- For each sediment core collected, observations of sediment type will be recorded in the field notebook.
- Sediment samples will be collected from 0-6 inch, 6-12 inch, and 24 inch intervals thereafter until refusal to hand sampling tools is encountered, or sediment is no longer observed in the sample.
- Sediment samples will be collected using push core techniques or a technique that is appropriate for the site-specific sediment type.
- Push core sampling techniques employ manual penetration of sediment using a sampling device that contains a polycarbonate tube to collect the sediment core. The device includes a check valve to allow air to escape during sediment penetration and develops a vacuum to retain the core as it is recovered. It is anticipated that 2.75 or 3-inch diameter polycarbonate tubes will be used.
- A hand auger and/or stainless steel shovel may be used in areas where the coring device will not penetrate (e.g., substrate primarily of rock and cobble).
- Upon retrieval, sediment cores will be processed in the field. Samples will be obtained from the inner portion of the core, avoiding sediment that has contacted the tube or sampling device, when possible.
- Volatile organic compound samples will be obtained first and placed in sample containers without headspace. The remainder of the sample interval will be homogenized in a stainless steel mixing bowl and distributed to the appropriate sample jars. Subsequent depth intervals will be processed in the same manner for each interval collected.
- Reusable equipment will be decontaminated prior to use at each location.

10. SOIL VAPOR SAMPLING PROCEDURE

Temporary soil vapor probes will be installed and samples collected using the procedure outlined below, and pertinent information will be recorded on the Soil Vapor (Canister) Sample Collection Field Form included **Appendix 10**:

10.1 SOIL VAPOR PROBE INSTALLATION

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

10.2 COLLECTION OF SOIL VAPOR SAMPLES

Record weather information (i.e., temperature, barometric pressure, rainfall, wind speed, and wind direction) at the beginning of the sampling event. Also, record substantial changes to these conditions that may have occurred over the past 24 to 48 hours and that do occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).

- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles).
- Identify sampling locations on a plot plan that also identifies buildings, other landmarks, and potential sources of VOC contamination to both the surface and outdoor air. Record the depth of the probe screen below grade.
- Unless sampling units will be constantly attended during sampling, a sign consistent with **Appendix 11** will be placed on the units indicating “Do Not Disturb – Air Sample Collection In Progress,” and providing contact information.

- If necessary, connect additional tubing to the tubing extending from the soil vapor probe to allow for connection to sample collection equipment.
- Calculate the volume of air in the probe, tubing (volume = $\pi r^2 h$), including any additional tubing added in the step above and the annular space between the probe and the native material if sand or glass beads were used.
- Connect a vacuum pump or gas-tight syringe (~60 cubic centimeters [cc]) to the sample tubing. At a flow rate of no more than 0.2 liter per minute (lpm), purge air from the tubing until one to three of the above-calculated air volumes are removed.
- During purging, evaluate the potential for ambient air to be introduced in the soil vapor sample through the annulus of the soil vapor probe or tubing connections using a tracer gas such as helium. The procedures for the tracer gas evaluation are described below. Note that the bentonite used in the probe installation should have sufficient time to seal before the samples are collected. The tracer gas evaluation will verify if the seal is sufficient.
- Use an evacuated 6-liter (L) Summa® passivated (or equivalent) stainless-steel canister to collect the soil vapor sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre-calibrated by the laboratory for a 4-hour sample collection at a flow rate that does not exceed 0.2 lpm. The canisters will be batch certified as clean by the laboratory.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the Chain-of-custody form for each sample.
- Connect the tubing from the soil vapor probe to the flow controller.
- Completely open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the Chain-of-Custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the Chain-of-Custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the Chain-of-custody form for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).

- Provided that no additional sampling is expected to be conducted, either pull out (if practical) or abandon in place the sampling probe. When abandoning, cut the tubing back as far down as practical and cover to surface with native soil.

10.3 TRACER GAS EVALUATION

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

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

- Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. A tracer gas detector will be attached to the valved fitting at the bottom of the chamber to verify the presence of the tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >50%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior measuring the tracer gas concentration.
- Use the tracer gas detector to measure the tracer gas concentration in the pump exhaust.
- Record the tracer gas concentrations in the chamber and in the soil vapor sample.

If the evaluation indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement of the sample collection. A non-detectable level of tracer gas is preferred; however, if the evaluation indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling.

11. VAPOR INTRUSION SAMPLING PROCEDURE

11.1 SUB-SLAB VAPOR SAMPLING

Sub-Slab Vapor Probe Installation

Temporary sampling probes will be installed using the following procedures:

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

Sub-Slab Vapor Sample Collection

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

- Purge the tubing using a vacuum pump or gas-tight syringe (~60 cc). Calculate the volume of air (volume = $\pi r^2 h$) in the tubing and purge one to three tubing volumes prior to sample collection at a rate no greater than 0.2 liter per minute (lpm).
- Use an evacuated Summa® passivated (or equivalent) canister to collect the sub-slab vapor sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre calibrated by the laboratory for the desired flow rate or duration of sample collection. The sampling flow rate should always be less than 0.2 lpm. The canisters will be batch certified as clean by the laboratory.
- Remove the protective brass plug from canister. Connect the pre calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain of custody form for each sample.
- Connect the tubing from the sub-slab vapor sampling probe to the flow controller.
- Completely open the valve on the canister. Record the time that the valve is opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling, when practical (sometimes the canister will sample over a 24-hour period and routine monitoring is not practical).
- Complete the Sub-Slab Vapor (Canister) Sample Collection Field Form and the NYSDOH building survey and chemical survey form provided as **Appendix 12**.

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

11.2 INDOOR AIR SAMPLING

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

- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles, etc.).
- Record weather information (temperature, barometric pressure, relative humidity, wind speed, and wind direction) and indoor temperature and humidity at the beginning of the sampling event. Record substantial changes to these conditions that may have occurred over the past 24 to 48 hours and that do occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Identify sampling location(s) on a floor plan that also identifies locations of HVAC equipment, chemical storage areas, garages, doorways, stairways, sumps, drains, utility perforations, north direction, and separate footing sections
- Use an evacuated Summa® passivated (or equivalent) stainless-steel canister to collect the outdoor air sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre calibrated by the laboratory for the desired flow rate or duration of sample collection. The sampling flow rate should always be less than 0.2 lpm. The canisters will be individually certified as clean by the laboratory.
- Place the canister at the sampling location. The sample should be collected from breathing height (e.g., 3 to 5 feet above ground). Either mount the canister on a stable platform or attach a length of inert tubing to the flow controller inlet and support it such that the sample inlet will be at the proper height.
- Remove the protective plug (either brass or plastic) from canister. Connect the pre calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.

- Completely open the valve on the vacuum pressure in the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling, when practical (sometimes the canister will sample over a 24-hour period and routine monitoring is not practical). During monitoring, note the vacuum pressure on the gauge.
- Complete the Indoor Air (Canister) Sample Collection Field Form and the NYSDOH building survey and chemical survey form provided as **Appendix 12**.
- Stop sample collection after the scheduled duration of sample collection, but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister or the sample results will be flagged appropriately.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain of custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the chain of custody for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).

11.3 AMBIENT AIR SAMPLING

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

- Sampling personnel must avoid activities immediately before and during the sampling that may contaminate the sample (e.g., using markers, fueling vehicles, etc.).
- Select a location upwind of the building or other area that is being evaluated. If possible, select a location upwind and near the HVAC air intake for the building being sampled.
- Record weather information (i.e., temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport).
- Use an evacuated Summa® passivated (or equivalent) stainless-steel canister to collect the ambient air sample. The canister will be provided by the laboratory, along with a flow controller equipped with an in-line particulate filter and a vacuum gauge. The flow controller will be pre calibrated by the laboratory for the desired flow rate or duration of sample collection, as defined in the site-specific work plan. The sampling flow rate should always be less than 0.2 lpm. The canisters will be individually certified as clean by the laboratory.
- Place the canister at the sampling location. If the sample should be collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet will be at the proper height.

- Unless sampling units will be constantly attended during sampling, a sign consistent with **Appendix 11** will be placed on the units indicating “Do Not Disturb – Air Sample Collection In Progress,” and providing contact information.
- Remove the protective cap (either brass or plastic) from canister. Connect the pre calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller. Record the initial canister pressure on the vacuum gauge (check equipment specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.
- Completely open the valve on the vacuum pressure in the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Document on a field form an outdoor plot sketch that indicates the building being sampled, streets, sampling location, location of potential outdoor air sources, north direction and paved areas. Also record pertinent observations such as odors, readings from field instrumentation, and significant activities in the vicinity that result in air emissions.
- Monitor the vacuum pressure in the canister routinely during sampling, when practical (sometimes the canister will sample over a 24-hour period and routine monitoring is not practical). During monitoring, note the vacuum pressure on the gauge.
- Complete the Ambient Air (Canister) Sample Collection Field Form provided as **Appendix 12**.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister or the sample results will be flagged appropriately.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain of custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. The field crew will retain a copy of the chain of custody for the project file.
- Deliver or ship the samples to the laboratory within one business day of sample collection and via overnight delivery (when shipping).

12. FIELD EQUIPMENT DECONTAMINATION AND MANAGEMENT OF INVESTIGATION-DERIVED WASTE

12.1 DECONTAMINATION AREA

A temporary decontamination area lined with polyethylene sheeting will be constructed on site for use during decontamination of the drilling equipment, if a suitable decontamination area does not exist at the Facility. Water collected from decontamination activities will be collected in 55-gallon drums and managed as described in **Section 12.3**.

12.2 EQUIPMENT DECONTAMINATION

The following procedures will be used to decontaminate equipment used during the RI activities.

- Drilling equipment such as augers, bits, rods, tools, split-spoon samplers, and tremie pipes, and backhoe and bucket will be cleaned with a high-pressure, hot water pressure washing unit before beginning work, following the completion of borings and wells, and prior to exiting the site.
- Tools, drill rods, and augers will be placed on polyethylene plastic sheets following pressure washing. Direct contact with the ground will be avoided.
- Augers, rods, and tools will be decontaminated between each drilling location according to the above procedures.
- The back of the drill rig and tools, augers, and rods will be decontaminated at the completion of the work and prior to leaving the site.

12.2.1 Sampling Equipment Decontamination

Prior to sampling, the non-dedicated sampling equipment (e.g., bowls, spoons, interface probes) will be washed with potable water and a phosphate-free detergent. Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, etc.

The sampling equipment will then be rinsed with potable water followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil, if necessary. At no time will washed equipment be placed directly on the ground.

Equipment will be wrapped in aluminum foil for storage or transportation from the designated decontamination area to the sampling location.

12.3 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

IDW produced during this project include soil, groundwater, decontamination water, personal protective equipment, and dedicated sampling equipment that may be potentially contaminated. Investigation derived wastes will be characterized as described in **Section 14**, and handled, transported, and disposed of in accordance with all applicable state and federal regulations, including but not limited to, 6 NYCRR Parts 364 and 372, where applicable. Proof of disposal at an authorized disposal/receiving facility, such as a manifest or shipping papers, must be included in the Remedial Investigation Report. Disposal options will be evaluated after characterization of the wastes.

The following paragraphs describe procedures to be followed for handling each waste material.

12.3.1 Decontamination Fluids

Hot water pressure wash and decontamination fluids will be collected in 55-gallon drums. The drums will be labeled. An example drum label is included as **Appendix 13**. The drums will be temporarily staged within the Brownfield Area as specified by BMS. If the BMS wastewater discharge permit allows and BMS provides approval, the water IDW may be discharged to the on-site BMS waste water treatment plant.

12.3.2 Drilling Cuttings

Drilling cuttings will be contained in 55-gallon drums. The drums will be labeled. An example drum label is included as **Appendix 13**. The drums will be temporarily staged in the Brownfield Area, the remainder of the Facility, or the former Fulton Iron and Steel parcel pending characterization and disposal.

12.3.3 Development and Purge Water

Development and purge water will be contained in 55-gallon drums. The drums will be labeled. An example drum label is included as **Appendix 13**. The drums will be temporarily staged in the Brownfield Area, the remainder of the Facility, or the former Fulton Iron and Steel parcel pending characterization and disposal. If the BMS wastewater discharge permit allows and BMS provides approval, the water IDW may be discharged to the on-site BMS waste water treatment plant.

12.3.4 Dedicated Sampling Equipment and Personal Protective Equipment (PPE)

Dedicated sampling equipment (e.g., direct-push sample liners, disposable polyethylene bailer and polypropylene line) and PPE will be placed in a dumpster at the BMS facility and managed as solid waste generated at the facility.

13. FIELD INSTRUMENTS AND CALIBRATION

Field analytical equipment will be calibrated prior to each daily sampling, or more frequently if required. The calibration procedures will conform to manufacturer's standard instructions. Calibration will be conducted in accordance with manufacturer's instructions such that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Instrument calibrations will be documented in the project field book. Records of instrument calibration will be maintained by the Field Team Leader. Copies of the instrument manuals will be maintained on site by the Field Team Leader. All changes to instrumentation will be noted in the field log book.

The following field instruments will be used during the investigation:

- PID with 11.7 eV lamp;
- pH probe;
- specific conductivity probe;
- temperature probe;
- ORP probe;
- dissolved oxygen probe; and
- turbidity probe.

14. ANALYTICAL PROGRAM

14.1 ENVIRONMENTAL SAMPLE ANALYSES

The laboratory samples for each media and the chemical analyses to be performed, including the quality assurance/quality control (QA/QC) samples are summarized in Table 3-1 of the RI Work Plan. A more detailed discussion of the analytical methods and procedures is provided in the QAPP.

14.2 IDW CHARACTERIZATION

Samples of the IDW generated during the investigation will be collected as needed and characterized for disposal. The objective of the sampling will be to properly characterize the waste materials held for off-site disposal, or possible reuse on-site, and to confirm the materials meet the requirements of any facility that will be receiving the material for disposal. Characterization will be based on criteria established by 6 NYCRR § 371.1. Specifically, the waste will be analyzed to determine whether it exhibits a characteristic of hazardous waste using the following methods:

- TCLP Zero Headspace Extraction (solid material only);
- TCLP VOC;
- TCLP SVOC;
- TCLP Metals;
- Corrosivity (liquids only); and
- Ignitability (liquids only).

In addition, it is possible that some materials historically released on the Site may have been listed hazardous wastes. Specifically, released material containing the following chemicals could fall within hazardous waste listings when released:

Chemical	Virgin Material	Spent Solvent Material
Acetone	U002	F003
Acetonitrile	U003	N/A
Benzene	U019	F005
n-Butyl Alcohol (Butanol)	U031	F003
Carbon Tetrachloride	U211	F001
Ethyl Acetate	U112	F003
Formaldehyde	U122	N/A
Isobutanol	U140	F005
Methylene Chloride	U080	F002
Methyl Alcohol (Methanol)	U154	F003
Methyl Ethyl Ketone (MEK)	U159	F005
Methyl Isobutyl Ketone (MIBK)	U161	F003
Pyridine	U196	F005
Toluene	U020	F005
1,1,1-Trichloroethane	U226	F002
Trichloroethylene	U228	F002
Trichlorofluoromethane	U221	F002
Triethylamine	U404	N/A
Xylene	U239	F003

Of these chemicals, many are listed solely because they exhibit the ignitability characteristic of hazardous waste. Under the hazardous waste regulations, materials that exhibit the ignitability, corrosivity, or reactivity characteristics of hazardous waste are no longer listed once they no longer exhibit the characteristic. 6 NYCRR § 371.1(d)(6). Acetone, butanol, ethyl acetate, methanol, MIBK and xylene are listed solely because they exhibit the characteristic of ignitability. Therefore, as long as the environmental media does not exhibit the

characteristic of ignitability, it will not be considered to contain a listed hazardous waste because of the presence of any of these materials.

The remaining chemicals are listed, at least in part, because they were considered toxic. These include unused, sole active ingredient, acetonitrile, formaldehyde, and triethylamine, and unused sole active ingredient or spent solvent benzene, carbon tetrachloride, isobutanol, methylene chloride, MEK, pyridine, toluene, 1,1,1-trichloroethane, trichloroethylene, and trichlorofluoromethane. Because soil and groundwater are not considered solid wastes, neither the hazardous waste mixture nor derived from rules will apply to environmental media contaminated with these chemicals. Instead, under the “contained in” policy, the environmental media is regulated as listed hazardous waste only as long as it “contains” the listed hazardous waste. NYSDEC established “action levels” to determine when a material no longer contains a listed waste in TAGM-3028—“*Contained-In*” Criteria for Environmental Media (November 30, 1992). This TAGM has been rescinded, and not replaced, but it provides the best available guidance for establishing action levels for incorporation into approved work plans. Based on this TAGM, the following action levels will be used for determining whether environmental media contains listed hazardous waste:

Chemical	Groundwater Action Level	Soil/Sediment Action Level
Acetonitrile	50 µg/L	470 mg/kg
Benzene	0.7 µg/L	22 mg/kg
Carbon Tetrachloride	5 µg/L	4.9 mg/kg
Formaldehyde	5 µg/L	21 mg/kg
Isobutanol	50 µg/L	23,000 mg/kg
Methylene Chloride	5 µg/L	85 mg/kg
Methyl Ethyl Ketone (MEK)	50 µg/L	47,000 mg/kg
Pyridine	50 µg/L	78 mg/kg
Toluene	5 µg/L	16,000 mg/kg
1,1,1-Trichloroethane	5 µg/L	7,000 mg/kg
Trichloroethylene	5 µg/L	58 mg/kg
Trichlorofluoromethane	5 µg/L	23,000 mg/kg
Triethylamine ¹	50 µg/L	470 mg/kg

Therefore, when characterizing IDW held for disposal or reuse onsite, representative samples will be analyzed to determine the concentrations of chemicals listed above. However, since acetonitrile was used only in Building 25, only material collected in the vicinity of Building 25 will be analyzed for the presence of acetonitrile. If obviously impacted material is present, it will be segregated, and a separate representative sample collected from the impacted material and analyzed.

If none of the constituents are detected, or if the constituents do not exceed the action levels listed above in a representative sample of the IDW held for disposal or reuse onsite, the IDW will not be considered a listed hazardous waste. For soils and sediments, the total amount of the constituent in the sample must not exceed the “Soil/Sediment Action Level,” and must not exceed the “Groundwater Action Level” in a TCLP extract of the sample. Groundwater samples will be compared only to the “Groundwater Action Level.” If representative samples of the material held for disposal exceed the action levels, the IDW will be managed as listed hazardous waste based on the constituents detected above the action levels.

If NYSDEC issues revised guidance for determining contained in criteria, the new guidance will be followed for IDW disposed on or after its effective date.

¹ TAGM-3028 did not contain action levels for Triethylamine. Therefore, BMS proposes to use the action level established for Acetonitrile which shows similar levels of toxicity.

14.3 FIELD QUALITY CONTROL SAMPLES

Field quality control samples will be collected and analyzed to document the accuracy and precision of the samples. Field quality control samples will be analyzed for parameters as specified in Table 3-1 of the RI Work Plan and as specified in the QAPP. The quality control samples are described as follows:

- **Trip Blank:** One trip blank will accompany each shipment of samples for VOC analysis sent to the laboratory. The trip blank will be analyzed to test for any contaminants introduced while samples are being stored or transported to the laboratory. The trip blanks will be analyzed for VOCs only.
- **Field Blank:** The purpose of the equipment blank is to detect any contamination from sampling equipment, cross-contamination from previously sampled locations, and contamination caused by conditions at sampling locations (e.g., airborne contaminants).
- **Field Duplicate:** Field duplicates are collected to determine the precision of the soil samples collected. This is achieved by compositing soil and splitting it evenly between separate sample jars. The field duplicate is not identified by the location from which it was collected on the Chain-of-Custody but should be identified in a field book for later reference during the validation process.
- **Matrix Spike and Matrix Spike Duplicate:** These samples are laboratory quality control samples and will be completed as part of the laboratory analytical batch quality control. These samples will be collected in the same manner as the field duplicates. Both the matrix spike and matrix spike duplicate will be collected at the same sample location.

14.4 SAMPLE LOCATION NUMBERING SYSTEM

Each sample that is collected will be designated by a unique sample identification number. The following information will be utilized to identify samples for the RI.

Each sample will be given a unique alphanumeric identifier in accordance with the following classification system:

Table 14-4 Sample Identification Format

Sample Type	Sample Location	Depth Code	QC Identifier	Date
SB – Soil Boring MW- Monitoring Well SED - Sediment AA- Ambient Air SV-Soil Vapor	Number referenced to a sample location map	Depth in feet of sample interval (0-0.5, 2-4, 10-12, etc.)	TB-Trip Blank FD-Field Duplicate EB–Equipment Blank MS-Matrix Spike MSD-Matrix Spike Duplicate	Numeric Date (010111)

Sample locations will be referenced to their location with respect to specific AOCs or areas of interest. For example the sample location for Building 1 would be B1. In those areas where previous soil borings or wells have been completed, the numbering scheme will consider the existing location identifications.

Field duplicate samples will be assigned identifiers that do not allow the laboratory to distinguish them as field duplicates. Each sample container will be labeled prior to packing for shipment. The sample identifier, site name, date and time of sampling, and analytical parameters will be written on the label in waterproof ink and recorded in the field book.

14.5 CHAIN-OF-CUSTODY

For aqueous and solid samples, Chain-of-Custody records will be kept starting at the time that sample containers are placed in the coolers for transportation to the laboratory. One completed Chain-of-custody record must be kept with each sample cooler at all times.

Example Chain-of-custody forms are provided in **Appendix 2**. The laboratory will provide Chain-of-custody forms with the sample containers.

The following measures will be taken when completing a Chain-of-Custody record:

- Chain-of-Custody forms will be completed in waterproof, non-erasable ink.
- Chain-of-Custody forms will be completed neatly using printed text. If a simple mistake is made, the error will be lined out with a single line and initialed and dated.
- Each separate sample entry will be unique.
- The use of "Ditto" or quotation marks to indicate repetitive information in columnar entries should be avoided. If numerous repetitive entries must be made in the same column, a continuous vertical arrow will be used between the first entry and the next different entry.
- When more than one Chain-of-Custody form is used for a single shipment, each form will be consecutively numbered using the "Page ___ of ___" format.
- If necessary, additional instructions will be placed directly onto the Chain-of-custody form.
- Acronyms used on a Chain-of-Custody form will be defined.

More detailed information pertaining to completion of the Chain-of-Custody form is provided in the QAPP.

For air samples, in addition to the Chain-of custody form, the Field Test Data Sheet (FTDS) must be completed for each sample canister and included with the sample shipment. The FTDS is initiated by the laboratory and accompanies the canisters to and from the Site. The form includes the following information:

- Site information
- Canister size, serial number, and flow controller number
- Sampling dates and shipping date
- Sampling information: ambient temperature and barometric pressure, canister pressure, sampling times, and interior temperature (where applicable)
- Laboratory information: flow rates (shipping out from laboratory and received from Site) canister pressure (initial and final)
- Date container shipped out and received back, canister certification number, individual certification number and signature of gas chromatography/mass spectrometry (GC/MS) analyst.

Additional information pertaining to sample Chain-of-custody and shipping requirements are provided in the QAPP.

Test Pit Log

TEST PIT LOG

SITE: _____ JOB #: _____
OBG FIELD SUPERVISOR: _____ TEST PIT: _____
WEATHER: _____ DATE: _____

DEPTH (FT)	HNU (ppm)	DESCRIPTION
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

NOTES:

TEST PIT PLOT PLAN:

Chain of Custody Form

Sheet No. _____

Phone: _____

[illegible]

(2) Type = grab, composite

Relinquished by: _____		Date	Time	Received by: _____		Date	Time
of: _____				of: _____			
Use this space if shipped via courier (e.g. Fed. Ex.)				*attached delivery/courier receipt to Chain of Custody			
Relinquished by: _____		Date	Time	Courier Name: _____		Date	Time
of: _____				tracking #: _____			
Relinquished by: _____		Date	Time	Received by: _____		Date	Time
of: _____				of: _____			

Boring Log

[illegible]

Monitoring Well Completion Log

WELL COMPLETION LOG

Well ID: _____

Project: _____
Location: _____
Project No.: _____

Client: _____
Date Drilled: _____
Date Developed: _____

Inspection Notes:

Inspector: _____
Drilling Contractor: _____
Type of Well: Environmental Monitoring Well

Static Water Level (ft bmp): _____ Date: _____
Measuring Point: Top of PVC
Total Depth of Well (ft bmp): _____

Drilling Method - Overburden:

Type: HSA Diameter: 4 1/4" ID
Casing: NA

Sampling Method - Overburden:

Type: Split-Spoon Diameter: 2" OD
Weight: 140 # Fall: 30"
Interval: _____

Riser Pipe Left in Place:

Material: Sch 40 PVC Diameter: 2" ID
Length: _____ Joint Type Flush Thread

Screen:

Material: Sch 40 PVC Diameter: 2" ID
Slot Size: _____ Joint Type Flush Thread

Filter Pack:

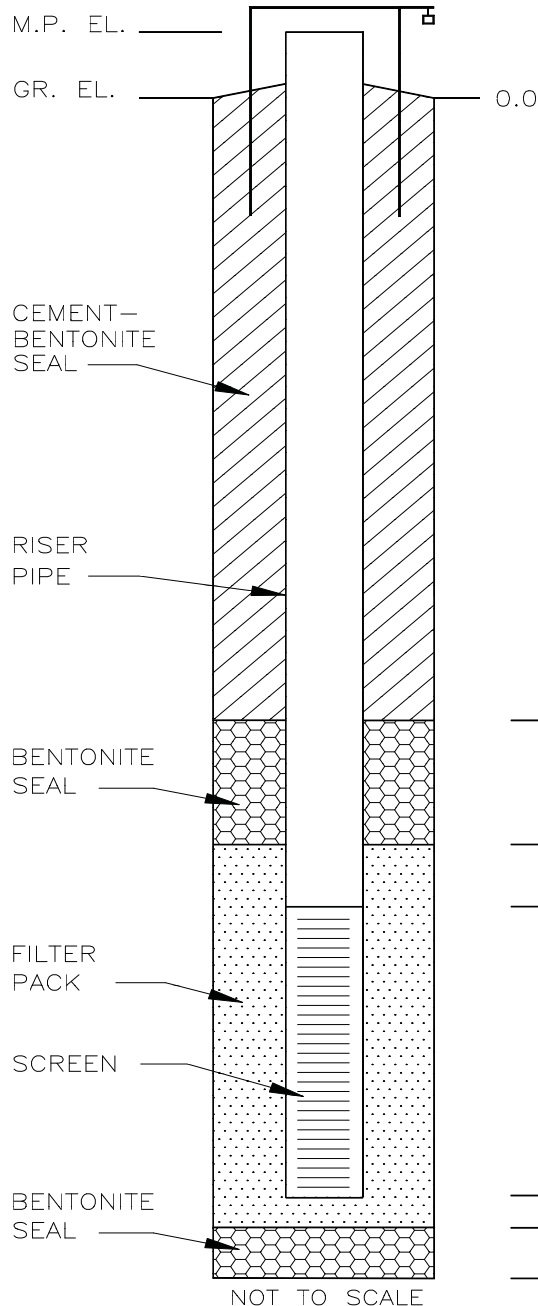
Type: Sand Grade: _____
Interval: _____

Seal(s):

Type: Cement-Bentonite Interval: _____
Type: Bentonite Pellets Interval: _____
Type: Bentonite Pellets Interval: _____

Locking Casing: ☒ Yes ☐ No

WELL CONSTRUCTION DETAIL



*Monitoring Well
Development Log*

Well ID:

Site :

Well information:

Well Volumes	Volume of Water Removed (Gallons)	Temperature °C	pH s.u	Conductivity mS/cm or µS/cm	Turbidity (NTU)	Approximate Flow Rate (gal/min)	Hydrometer	Depth to Water (ft.)
Start								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Development Water Characteristics:

Sheen/Free Product

NOTES:

Geologist Signature:

*Well Decommissioning
Record*

WELL DECOMMISSIONING RECORD

DECOMMISSIONING DATA (Fill in all that apply)		WELL SCHEMATIC*	
<u>OVERDRILLING</u>		Depth (feet)	
Interval Drilled			
Drilling Method(s)			
Borehole Dia. (in.)			
Temporary Casing Installed? (y/n)			
Depth temporary casing installed			
Casing type/dia. (in.)			
Method of installing			
<u>CASING PULLING</u>			
Method employed			
Casing retrieved (feet)			
Casing type/dia. (in.)			
<u>CASING PERFORATING</u>			
Equipment used			
Number of perforations/foot			
Size of perforations			
Interval perforated			
<u>GROUTING</u>			
Interval grouted (FBLs)			
# of batches prepared			
<u>For each batch record:</u>			
Quantity of water used (gal.)			
Quantity of cement used (lbs.)			
Cement type			
Quantity of bentonite used (lbs.)			
Quantity of calcium chloride used (lbs.)			
Volume of grout prepared (gal.)			
Volume of grout used (gal.)			
COMMENTS:			

* Sketch in all relevant decommissioning data, including:
interval overdrilled, interval grouted, casing left in hole,
well stickup, etc.

Standard Groundwater Sampling Log

Standard Ground Water Sampling Log

Date _____
 Site Name _____
 Location _____
 Project No. _____
 Personnel _____

Weather _____
 Well # _____
 Evacuation Method _____
 Sampling Method _____

Well Information:

Depth of Well * _____ ft.
 Depth to Water * _____ ft.
 Length of Water Column _____ ft.
 Volume of Water in Well _____ gal.(s)
 3X Volume of Water in Well _____ gal.(s)

Water Volume /ft. for:

2" Diameter Well = 0.163 X LWC

4" Diameter Well = 0.653 X LWC

6" Diameter Well = 1.469 X LWC

Volume removed before sampling _____ gal.(s)
 Did well go dry? _____

* Measurements taken from _____ Well Casing _____ Protective Casing _____ (Other, Specify)

Instrument Calibration:

pH Buffer Readings

4.0 Standard _____
 7.0 Standard _____
 10.0 Standard _____

Conductivity Standard Readings

84 S Standard _____
 1413 S Standard _____

Water parameters:

Gallons Removed

Temperature Readings

pH Readings

Conductivity Readings uS/cm

Turbidity Readings Ntu

initial _____	initial _____	initial _____	initial _____	initial _____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Water Sample:

Time Collected _____

Physical Appearance at Start

Color _____
 Odor _____
 Turbidity (> 100 NTU) _____
 Sheen/Free Product _____

Physical Appearance at Sampling

Color _____
 Odor _____
 Turbidity (> 100 NTU) _____
 Sheen/Free Product _____

Samples collected:

Container Size	Container Type	# Collected	Field	Filtered	Preservative	Container pH

Notes: _____

*Low Flow Groundwater
Sampling Log*

Low Flow Ground Water Sampling Log

Date	_____	Personnel	_____	Weather	_____
Site Name	_____	Evacuation Method	_____	Well #	_____
Site Location	_____	Sampling Method	_____	Project #	_____

Well information:	

Depth of Well *		ft.		* Measurements taken from Top of Well Casing Top of Protective Casing (Other, Specify)
Depth to Water *		ft.		
Length of Water Column		ft.		

Start Purge Time: _____

[illegible]

End Purge Time: _____

Water sample:

Time collected: _____	Total volume of purged water removed: _____
Physical appearance at start	Physical appearance at sampling
Color _____	Color _____
Odor _____	Odor _____
Sheen/Free Product _____	Sheen/Free Product _____

Analytical Parameters:

[illegible]

Hydraulic Conductivity Test Log

Manually conducted K-Test:

[illegible]

*Soil Vapor Sample Collection
Field Forms*

Soil Vapor (Canister) Sample Collection Field Form

Project # _____ Consultant _____
Project Name _____ Collector _____

Sample ID

Start Date/Time _____ Vacuum gauge "zero" ("Hg) _____
End Date/Time _____ Start Pressure ("Hg) _____
Canister ID _____ End Pressure ("Hg) _____
Flow controller ID _____ End pressure > "zero"? _____
Sampling duration (intended) _____
Associated ambient air sample ID _____ Depth of sample point below grade _____

Tubing type used _____ Length of tubing _____ cm Tubing volume _____ cc
Volume purged _____ cc @ _____ min 1 to 3 volumes purged @ < 200cc/min? _____
Chamber tracer gas conc. _____ Tracer gas conc. during purging _____

Weather Conditions during Probe Installation:

Air temperature (°F) _____ Rainfall _____ Wind direction _____
Barometric pressure _____ Wind speed (mph) _____

Substantial changes in weather conditions during sampling or over the past 24 to 48 hrs:

Weather Conditions at Start of Sampling:

Air temperature (°F) _____ Rainfall _____ Wind direction _____
Barometric pressure _____ Wind speed (mph) _____

Substantial changes in weather conditions during sampling or over the past 24 to 48 hrs:

Site Plan showing sample location, buildings, landmarks, potential soil vapor and outdoor air sources, preferential pathways

Comments: _____

Soil Vapor Canister Signage

A red octagonal sign with a white border, containing white text. The text is centered and reads: "DO NOT DISTURB", "AIR SAMPLE", "COLLECTION IN", "PROGRESS", "FOR INFORMATION CONTACT:", "ANNE LOCKE", "BRISTOL-MYERS SQUIBB", and "(315) 432-2660".

DO NOT DISTURB

**AIR SAMPLE
COLLECTION IN
PROGRESS**

FOR INFORMATION CONTACT:

ANNE LOCKE

BRISTOL-MYERS SQUIBB

(315) 432-2660

***Sub-Slab, Indoor Air,
Ambient Air, and NYSDOH
Indoor Air Quality
Questionnaire and Building
Inventory Field Forms***

Ambient Air (Canister) Sample Collection Field Form

Project # _____ Consultant _____
Project Name _____ Collector _____

Sample ID _____ Vacuum gauge "zero" ("Hg) _____
Start Date/Time _____ Start Pressure ("Hg) _____
End Date/Time _____ End Pressure ("Hg) _____
Canister ID _____ End pressure > "zero"? _____
Flow controller ID _____ Sampling duration (intended) _____

Tubing type used _____ Length of tubing _____ cm Tubing volume _____ cc
Volume purged _____ cc @ _____ min 1 to 3 volumes purged @ < 200cc/min? _____

Weather Conditions at Start of Sampling:

Air temperature (°F) _____ Rainfall _____ Wind direction _____
Barometric pressure _____ Relative humidity _____ Wind speed (mph) _____

Substantial changes in weather conditions during sampling or over the past 24 to 48 hrs:

Site Plan showing sample location, building(s) being sampled, building HVAC inlet, outdoor air sources, wind direction



Comments: _____

Indoor Air (Canister) Sample Collection Field Form

Project # _____ Consultant _____
Project Name _____ Collector _____

Sample ID _____ Vacuum gauge "zero" ("Hg) _____
Start Date/Time _____ Start Vacuum ("Hg) _____
End Date/Time _____ End Vacuum ("Hg) _____
Canister ID _____ End Vacuum > "zero"? _____
Flow controller ID _____ Sampling duration (intended) _____
Associated ambient air sample ID _____ Associated sub-slab vapor sample ID _____

Tubing type used _____ Length of tubing _____ cm Tubing volume _____ cc
Volume purged _____ cc @ _____ min 1 to 3 volumes purged @ < 200cc/min? _____

Weather Conditions at Start of Sampling:

Air temperature (°F) _____ Rainfall _____ Wind direction _____
Barometric pressure _____ Relative humidity _____ Wind speed (mph) _____

Substantial changes in weather conditions during sampling or over the past 24 to 48 hrs:

Indoor air temp (°F) _____ Indoor relative humidity (%) _____
Building Survey and Chemical Inventory Form Completed? _____ Photograph IDs _____

Floor Plan showing sample location, HVAC equipment, indoor air sources, preferential pathways

Comments: _____

Sub-slab Vapor (Canister) Sample Collection Field Form

Project # _____ Consultant _____
Project Name _____ Collector _____

Sample ID _____ Vacuum gauge "zero" ("Hg) _____
Start Date/Time _____ Start Pressure ("Hg) _____
End Date/Time _____ End Pressure ("Hg) _____
Canister ID _____ End pressure > "zero"? _____
Flow controller ID _____ Sampling duration (intended) _____
Associated indoor air sample ID _____ Associated ambient air sample ID _____

Tubing type used _____ Length of tubing _____ cm Tubing volume _____ cc
Volume purged _____ cc @ _____ min 1 to 3 volumes purged @ < 200cc/min? _____

Weather Conditions at Start of Sampling:

Air temperature (°F) _____ Rainfall _____ Wind direction _____
Barometric pressure _____ Wind speed (mph) _____

Substantial changes in weather conditions during sampling or over the past 24 to 48 hrs:

Indoor air temp (°F) _____ Indoor relative humidity (%) _____
Building Survey and Chemical Inventory Form Completed? _____ Photograph IDs _____

Floor Plan showing sample location, HVAC equipment, indoor air sources, preferential pathways



Comments: _____

Appendix B

Indoor air quality questionnaire and building inventory

As discussed in Section 2.11, products in buildings should be inventoried every time indoor air is sampled to provide an accurate assessment of the potential contribution of volatile chemicals. In addition, the type of structure, floor layout and physical conditions of the building being studied should be noted to identify (and minimize) conditions that may interfere with the proposed testing.

Toward this end, a blank copy of the NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory is provided in this appendix. Also provided is an example that demonstrates how the form should be completed properly.

**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
Industrial

School
Church

Commercial/Multi-use
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	
1 st Floor	
2 nd Floor	
3 rd Floor	
4 th 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)

Yes, use dry-cleaning infrequently (monthly or less)

Yes, work at a dry-cleaning service

No

Unknown

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

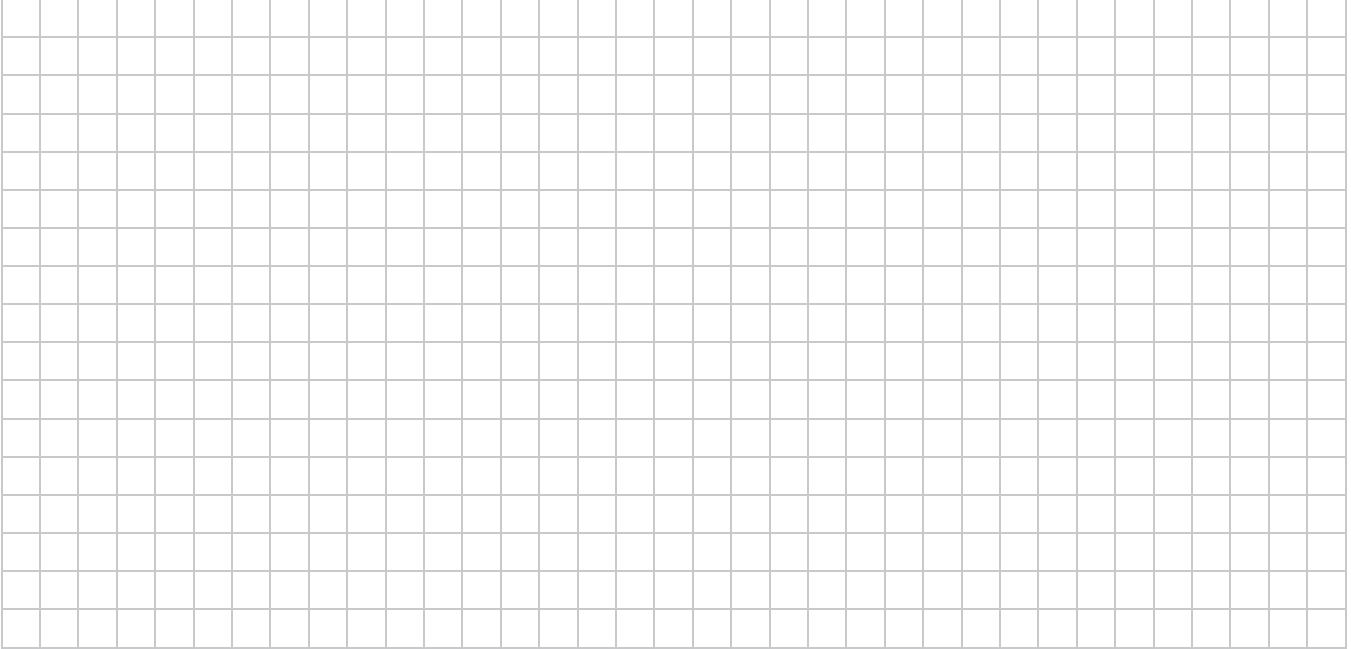
c. Responsibility for costs associated with reimbursement explained? Y / N

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

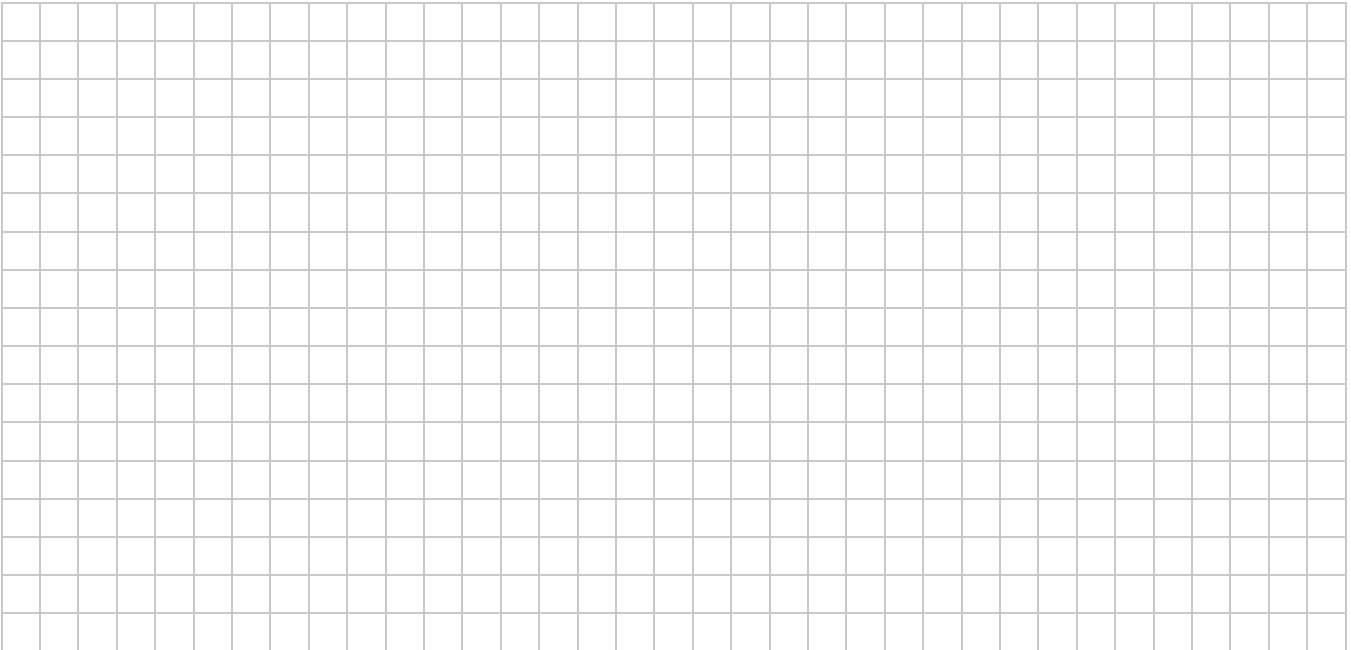
11. FLOOR PLANS

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.

[illegible]

* 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.**

Example

1

Correct

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 Mary Jones Date/Time Prepared 10/22/04 10:00am

Preparer's Affiliation XYZ Consulting Phone No. 518-555-1212

Purpose of Investigation Thomasville Soil Vapor Intrusion Investigation (Site #32141)

1. OCCUPANT:

Interviewed: (Y)/N

Last Name: Smith First Name: Carol

Address: 25 Main Street Thomasville, New York 25230

County: Albany

Home Phone: 518-556-2222 Office Phone: 518-556-2400

Number of Occupants/persons at this location 2 Age of Occupants 36, 10

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

Interviewed: Y (N)

Last Name: White First Name: Frank

Address: 64 Mountain Road Bainbridge, New York 26390

County: Dutchess

Home Phone: 845-876-1301 Office Phone: 845-227-2430

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential
Industrial

School
Church

Commercial/Multi-Use
Other:

Example Correct 2

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

<u>Ranch</u>	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? NA

If the property is commercial, type?

Business Type(s) NA

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

Other characteristics:

Number of floors 1

Building age 20 years

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

Basement air flows up to 1st floor through plumbing waste line and domestic water line floor penetrations

Airflow near source

Yes, furnace/oil tank area open to rest of basement

Outdoor air infiltration

Outdoor air enters at loose bilco doorway openings, and at sill plate near furnace.

Infiltration into air ducts

Basement air flows into bottom of hot air unit and in loose cold air return joints.

Example Correct 3

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: 6 (feet)

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

Floor drain in laundry area

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)

<u>Hot air circulation</u>	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	<u>Fuel Oil</u>	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: gas

Boiler/furnace located in: Basement Outdoors Main Floor Other _____

Air Conditioning: Central Air Window units Open Windows None

Example Correct

4

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.

Cold air return ductwork on ceiling in basement. Cold air return joints appear loose.

7. OCCUPANCY

Basement / Is lowest level occupied? Full time Occasionally ☒ Seldom Almost Never

Level General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)

Basement	<u>Storage and laundry</u>
1 st Floor	<u>living area and bedrooms</u>
2 nd Floor	
3 rd Floor	
4 th 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 etc.)

☒ Y / N / NA
Please specify lawnmower, car

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? w/in week - windex, tilex

i. Have cosmetic products been used recently?

☒ Y / N When & Type? yesterday - hairspray

Example Correct

5

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? carpet in dining room

l. Have air fresheners been used recently?

Y / ☒ N When & Type? _____

m. Is there a kitchen exhaust fan?

☒ Y / ☐ N If yes, where vented? outside

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, automechanic or autobody shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist etc.)

If yes, what types of solvents are used? hair salon dyes, alcohols, peroxides, acetone

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: June 2000

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: not applicable

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

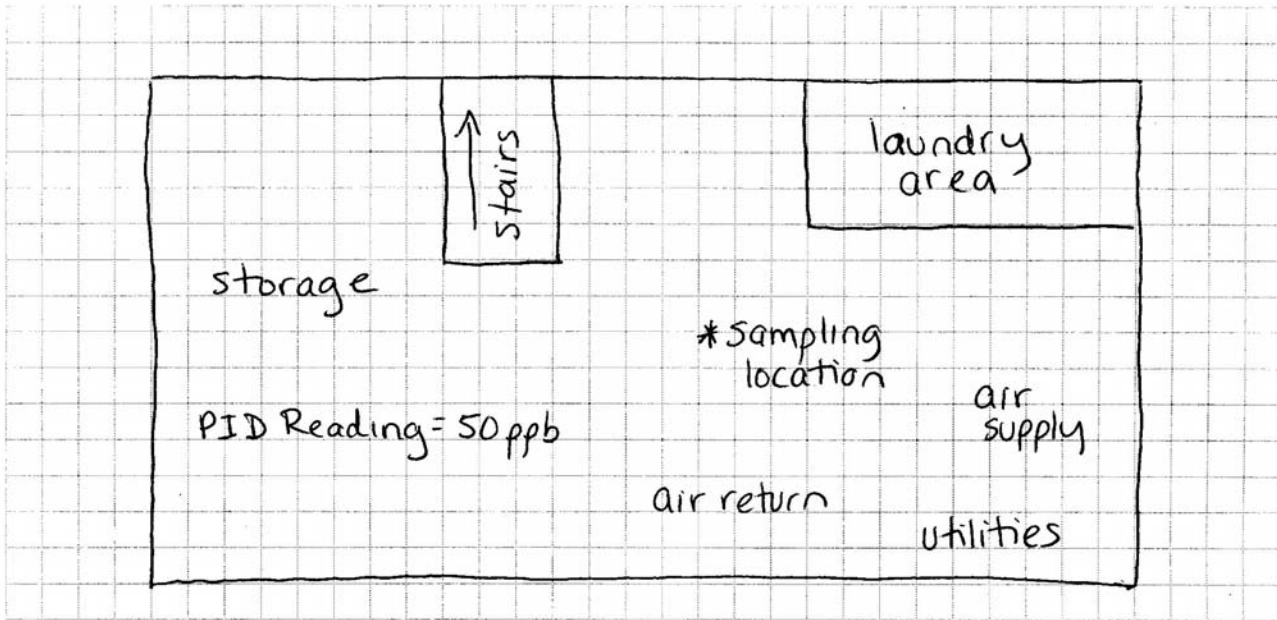
Example Correct

6

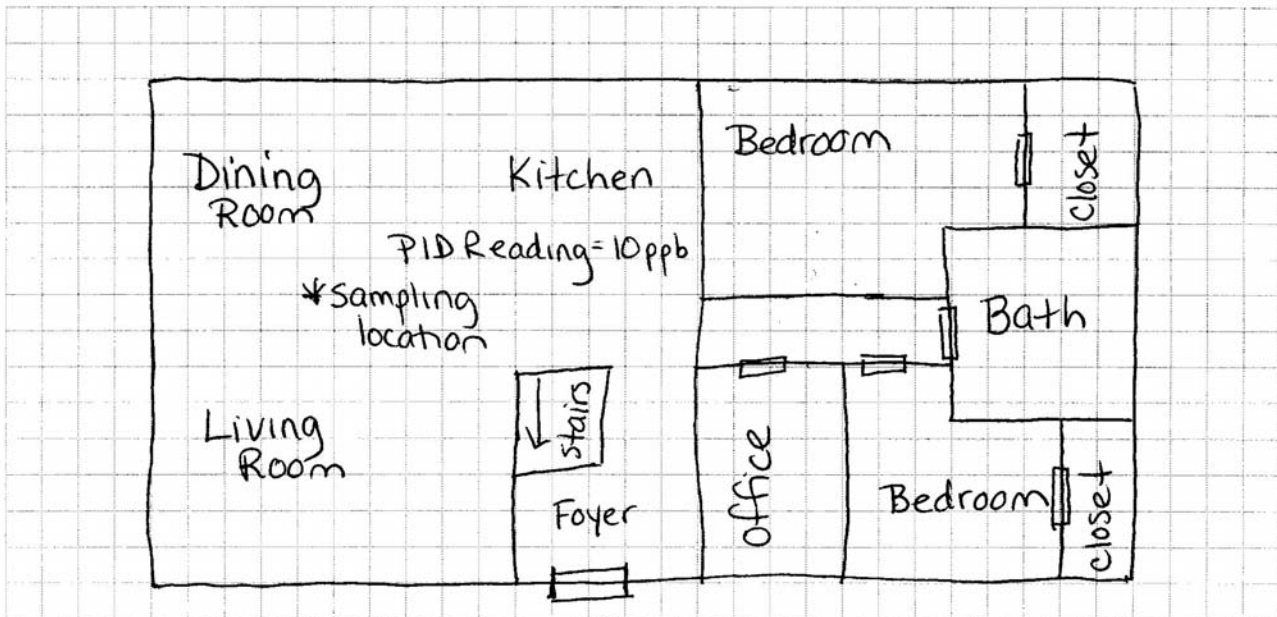
11. FLOOR PLANS

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:

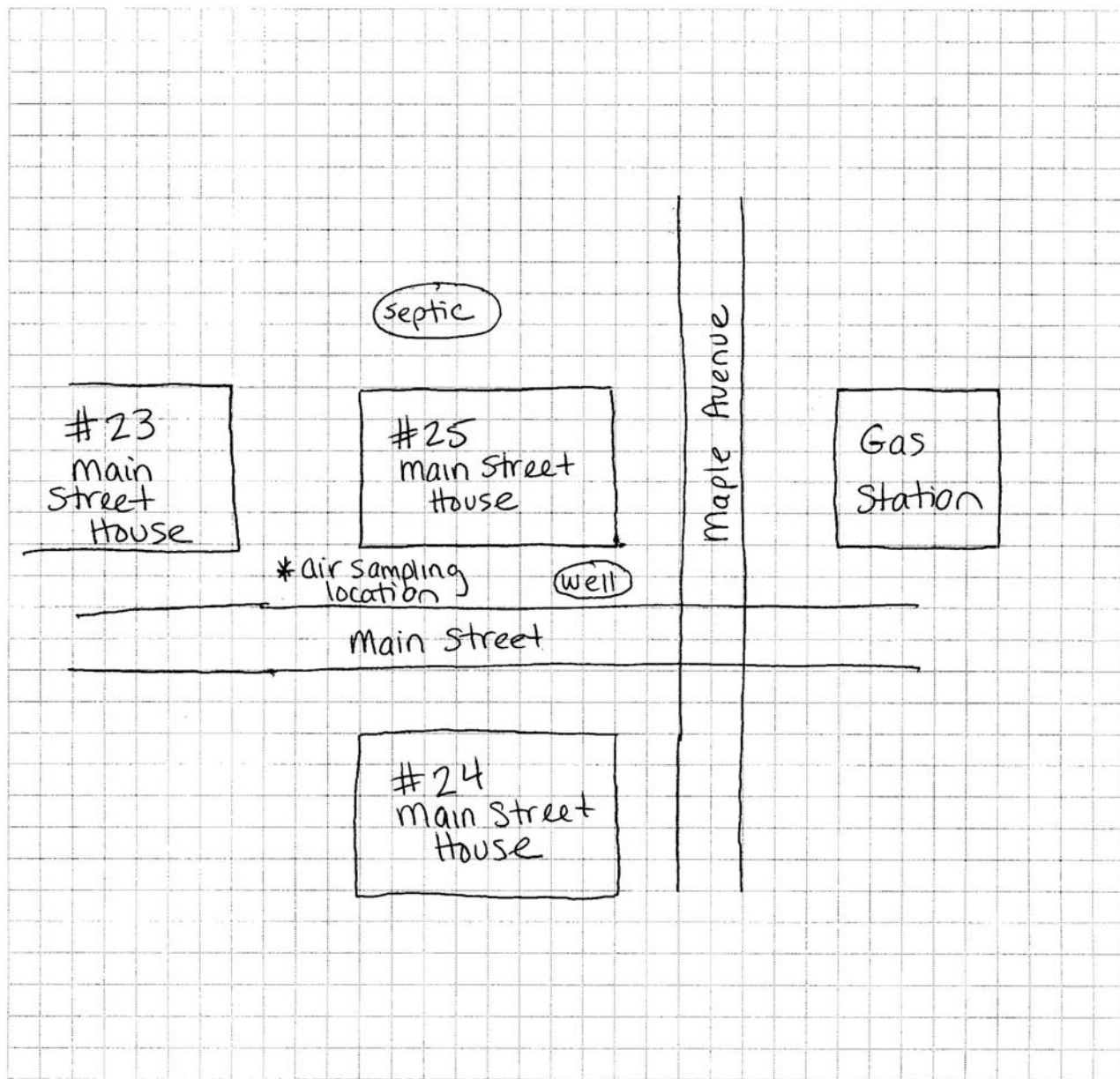


Example Correct 7

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.



Wind direction = NE

Example Correct

8

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: RAE photoionization detector

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

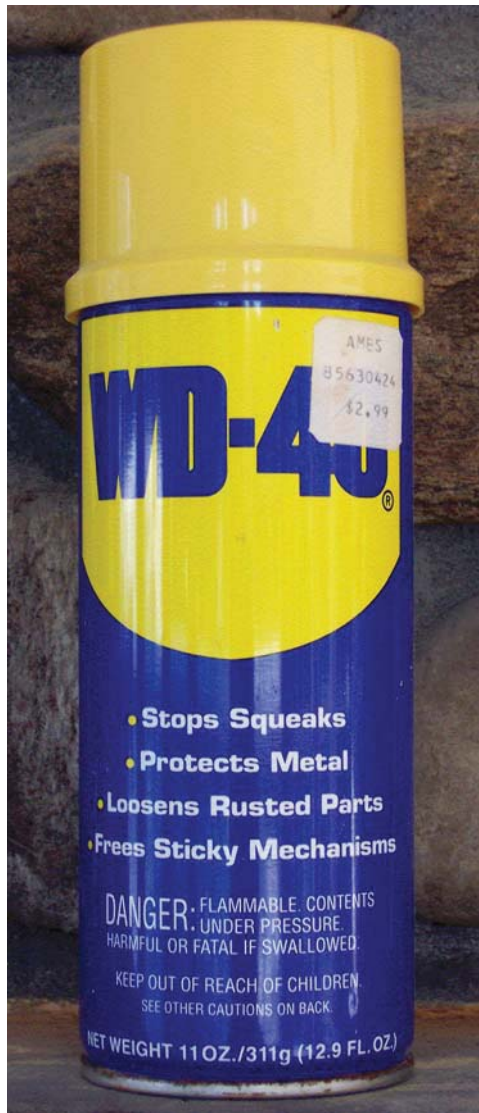
Location	Product Description	Size (oz.)	Condition*	Chemical Ingredients	Field Instrument Reading	Photo** Y/N
Kitchen	WD-40	12oz	UO	See photo	10 ppb	Y
garage	mineral spirits	24oz	U	benzene, toluene	15 ppb	N
garage	American Semi-Gloss latex paint	64oz	U	titanium dioxide, ethylene glycol, aluminum hydroxide, 2,2,4-trimethyl 1,3-pentanedial isobutyrate, Vinyl acetate	2 ppb	N
garage	Krylon Semi-gloss oil paint	64oz	D	butane, propane, titanium dioxide, xylene, ethylbenzene, acetone, MEK, butanol, MIBK	10 ppb	N
garage	Rustoleum	12oz	U	talc, calcium carbonate, titanium dioxide, xylene, ethylbenzene, acetone, liquified petroleum gases, pentaerythritol	4 ppb	N
garage	Deep 6 Double Strength Insect Repellent	8oz	D	propane, isobutane, N,N-Diethyl-meta-tolamide Di-n-propyl isocinchomeronate	0.5 ppb	N
base-ment	12 cans latex paint	128oz	U	talc, titanium dioxide, Kaolin clay, 2,2,4-trimethyl-1,3-pentanedial isobutyrate, vinyl acetate	0	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.

Product Inventory Attachment — 25 Main Street, City

WD-40 FRONT



WD-40 INGREDIENTS

HARMFUL OR FATAL IF SWALLOWED:
Contains petroleum distillates. If
swallowed, **DO NOT** induce vomit-
ing. Call physician immediately.
Use in a well-ventilated area.
**DELIBERATE OR DIRECT INHALATION
OF VAPOR OR SPRAY MIST MAY BE
HARMFUL OR FATAL.**

This page is intentionally blank.

Drum Label

THIS CONTAINER ON HOLD PENDING ANALYSIS	
CONTENTS _____ _____ _____ ORIGIN OF MATERIALS _____ ADDRESS _____ CONTACT _____	
DO NOT TAMPER WITH CONTAINER AUTHORIZED PERSONNEL ONLY	

www.accuform.com • reorder# MHZW28

DRUM LABEL EXAMPLE

Excavation Permit

**BRISTOL-MYERS SQUIBB
SYRACUSE DIVISIONS
EXCAVATION PERMIT**

Pike Excavation Permit Request
Pike Tracking No: TP- _____
Schedule Ref No: _____

In Case of Emergency, Call Extension 2300 (outside phone: 315-432-2300)

This permit must be issued for any: (1) mechanized/powered digging or drilling into soil; (2) digging or drilling into concrete, including building floors and foundations; and (3) manual digging, regardless of depth. The Technical Services Department may waive the permit requirement for manual digging up to 24 inches deep if it is determined that no underground interferences exist in the immediate area. A copy of all applicable underground drawings available in the Technical Services Department files must be maintained along with this document at the job site for the duration of the work.

When underground obstructions (pipes, conduit, etc.) are uncovered which have not been identified on the permit drawings, excavation will stop immediately in this area until such obstructions are identified and approval to resume excavation is given by Syracuse Site Engineering.

SECTION 1: General Information

Date Permit Initiated: _____ Permit No.: _____

Job Location: _____

Description of Work: _____

Excavation Contractor: _____

Type of Job: ☐ New Construction ☐ Planned Repair ☐ Emergency Repair

Greater than 4' Depth Anticipated? ☐ Yes ****If YES, Section 3 is required.**** ☐ No

SECTION 2: Authorization to Begin Work

Start Date: _____ Est. Completion Date: _____

DRAWING NO.(S) ISSUED W/ PERMIT: (Check off all that apply & add others if not listed):

☐ D-Y-4853	Signal Dist.	☐ E-Y-601	Power Dist.
☐ E-Y-278	Fire Water	☐ E-Y-606	Sewers (North)
☐ E-Y-279	Natural Gas	☐ E-Y-607	Sewers (South)
☐ E-Y-280	City Water	☐ E-Y-621	Tower Water
☐ E-Y-282	Chilled Water		

Add'l. Required Dwgs: _____

Excavator must stake area before digging?	☐ Yes	☐ No
BMS Representative required at the work site?	☐ Yes	☐ No
Atmospheric hazards expected/possible while excavating?	☐ Yes *	☐ No
Excess soils/spoils anticipated?	☐ Yes *	☐ No

* indicates that a Yes response requires elaboration in the Special Requirements section below.

Special Requirements: _____

NOTES:

- Hand digging is required when within four (4) feet of known active utility lines until exact location(s) have been unearthed.
- Work is to immediately stop if unusual soil conditions, such as odor or color concerns, are encountered. Consult with your BMS contact.
- The excavator must provide a "competent person," qualified per OSHA requirements, for the entire length of the job.
- When utility lines are located that do not appear correctly on the appropriate drawing(s), the excavator shall mark the affected drawing(s) and provide such mark-ups to their BMS contact.
- If shoring is to be installed, efforts must be made to protect installing personnel in accordance with OSHA requirements.

Authorization Granted by (print/sign):

BMS – Tech Sves Representative: _____ Date: _____

BMS – IM Representative: _____ Date: _____

BMS – BHS Representative: _____ Date: _____

Requirements/Job Information Acknowledged by (print/sign):

BMS Project/Job Sponsor: _____ Date: _____

Excavator – Competent Person: _____ Date: _____

Excavator – Equipment Operator: _____ Date: _____

SECTION 3: Excavation/Trenching Entry Authorization

☐ Not Applicable

**** This section is only required for those excavations greater than 4' deep ****

Approximate Depth: _____ Other Dimensions: _____

Protection Method: ☐ Trench Shield
☐ Shoring System [Type: _____]
☐ Sloping (min. acceptable for type C soil is 1.5 run: 1.0 rise or approx. 34 deg.)

Soil Type: ☐ A ☐ B ☐ C (default)

Soil Testing Performed: ☐ Yes ☐ No

Potential atmospheric hazards for entrants? ☐ Yes ☐ No If YES, record readings below:

Testing Results: % O2 [OK: 19.5-22.0]: _____ VOC (ppm): _____ [contact EHS if >10]

Special Requirements: _____

NOTES:

- If trench needs to be de-watered, contact EHS for approval of disposal method.
- Ensure Line Opening, Hot Work and/or Confined Space Entry permits are obtained, as necessary.
- Review potential overhead electrical line interference, ladder/equipment condition and need for freeze protection in advance.

I have reviewed the Permit requirements, inspected the excavated area(s), and am satisfied that the necessary precautions are being undertaken in accordance with OSHA regulations.

Excavator – Competent Person: _____ Date/Time: _____

I have reviewed the Permit requirements, inspected the excavated area(s), and am satisfied that the Competent Person has performed an appropriate assessment of the excavation. [NOTE: Obtain EHS assistance, as needed.]

BMS Project/Job Sponsor: _____ Date/Time: _____

SECTION 4: Closeout

For repairs, has the area been returned to its original state/condition? ☐ Yes ☐ N/A

For new construction, has the area been left in its intended state, free of safety hazards? ☐ Yes ☐ N/A

Area is free of excess soils / spoils? ☐ Yes ☐ N/A

Satisfactory completion confirmed by (print/initials): _____ Date: _____

FORWARD COMPLETED PERMIT AND ANY MARKED-UP DRAWINGS TO SITE ENGINEERING

FIELD SAMPLING AND ANALYSIS PLAN (FSAP) ADDENDUM

Select sections of the project Field Sampling and Analysis Plan (FSAP) (O'Brien and Gere Engineers, 2013) are updated herein to address field investigation activities that are proposed in the *Groundwater Remedy Pre-Design Investigation and Supplemental Sampling Work Plan* but not previously included in the FSAP or an addendum. Specifically, the additional activities include sampling and analysis for analytes and parameters not previously included in the remedial investigation, the use of Bio-Trap[®] samplers, and microcosm treatability testing. Sampling for poly- and perfluoroalkyl substances (PFAS) in particular requires specific sampling equipment, personal protective equipment (PPE), and procedures distinct from those used for other target analytes.

Section 7: Groundwater Sampling Procedures

High-density polyethylene (HDPE) tubing will be used for groundwater purging and analytical sampling for all analytes and parameters. Teflon-lined tubing has been used in the past, but cannot be used for PFAS sampling. HDPE tubing does not contain PFAS and is inert to volatile organic compounds (VOC) and other analytes.

Section 7.2: Specialized Sampling Methods

Refer to the *Poly- and Perfluorinated alkyl substances (PFAS) Field Sampling Guidance* (Arcadis 2017) for detailed sampling protocols for collecting groundwater samples for PFAS analysis.

Bio-Trap[®] samplers are a specialized sampling device for subsurface microbial communities. Bio-Trap[®] samplers will be provided by Microbial Insights (Knoxville, Tennessee). Microorganisms colonize the sampler during a 30 to 90 day incubation period, then the entire sampling device is sent to the laboratory for analysis of microbial community characteristics. Bio-Trap[®] samplers will be deployed soon after delivery from the lab. Prior to deployment, samplers will remain sealed and stored on ice or in a refrigerator. Bio-Trap[®] samplers will not be allowed to freeze, or to sit in ice melt water. Clean gloves will be worn while handling each Bio-Trap[®] sampler. Bio-Trap[®] samplers will be deployed at the approximate mid-point of the saturated screened interval at designated monitoring wells. Following retrieval, each Bio-Trap[®] sampler will be double-bagged and all recovered Bio-Trap[®] samplers will be shipped to the laboratory for the earliest possible arrival the following day.

Groundwater samples will be collected for microcosm treatability testing in sterile (autoclaved) 2.5-liter amber glass jugs provided by the Arcadis Treatability Laboratory (Durham, North Carolina). The jugs will be filled to near-zero headspace, sealed, and shipped to the laboratory for the earliest possible arrival the following day. Specific shipping instructions will be provided by the laboratory.

Section 12.2.1: Sampling Equipment Decontamination

Field sampling equipment will require cleaning between uses. For groundwater sampling, between uses, decontaminate the flow-through cell and any non-dedicated equipment (i.e., interface probe or depth to water meter) that comes into contact with well water. Detergent should be free of PFAS or 1,4-dioxane.

For example, trace concentrations of 1,4-dioxane may be present in Liquinox® and Dawn® dishwashing detergent.

After donning a new pair of nitrile gloves:

- Rinse sampling equipment with detergent. Scrub equipment with a plastic brush if needed;
- Rinse two times with distilled water or deionized water;
- Rinse one time with “PFAS-free” water; and
- Collect all rinsate in a sealed pail for disposal. Do not reuse decontamination solutions between sampling locations.

Some sampling containers for other analyses may not be PFAS-free. Therefore, PFAS samples will be collected first, and sampling containers for PFAS will remain separate from other sampling containers.

Do not place the decontaminated equipment on aluminum foil or wrap equipment in aluminum foil. Do not allow sampling equipment components to come into contact with the following materials:

- aluminum foil;
- low-density polyethylene (LDPE);
- glass;
- polytetrafluoroethylene (PTFE, Teflon™) materials, including sample bottle cap liners with a PTFE layer; or
- plumbers thread seal tape.

APPENDIX B

Community Air Monitoring Plan



COMMUNITY AIR MONITORING PLAN BMS SYRACUSE NORTH CAMPUS RESTORATION AREA

INTRODUCTION

The currently ongoing Syracuse Facilities Transformation Project will remove idle buildings and equipment, demolish the vacant obsolete manufacturing buildings and transform the Bristol-Myers Squibb Syracuse Site into a “penicillin-free” pharmaceutical facility. Site preparation has begun, and actual demolition began in 2011 and is expected to conclude in the first half of 2013.

In addition to the Transformation Project, BMS has entered a portion of its facility into the New York State Brownfield Cleanup Program (BCP). The BCP Agreement was effective on October 18, 2011, and the Brownfield Area is shown on Figure 1. Following completion of the current phase of the Transformation Project, six major “non-pen” buildings will remain in use on the Brownfield Area, and the remainder of the area will be transformed to an attractive “park-like” campus to enhance the continuing operating facility.

The Remedial Investigation (RI) under the BCP is expected to be initiated during 2013, following completion of the current phase of the Transformation Project.

OBJECTIVES AND AIR MONITORING APPROACH

This Community Air Monitoring Plan (CAMP) has been developed to describe air monitoring to be implemented during ground-intrusive activities associated with the Brownfield RI and Transformation Projects within the Brownfield Area.

Based on investigations completed to date, volatile organic compounds (VOCs) have been detected in the soil and groundwater in limited areas within the Brownfield Area. The VOCs found most frequently are methylene chloride and methyl isobutyl ketone (MIBK).

Ground-intrusive activities within the Brownfield Area will consist of the following:

- Excavations ranging from small diameter boreholes to removal of building slabs and large areas of asphalt associated with the Transformation Project.
- Advancement of soil borings and installation of monitoring wells associated with the Brownfield Project RI.

Air monitoring will assess potential air quality impacts from VOCs and particulates (dust) to the surrounding community and site workers/visitors present on the BMS facility but outside of the Brownfield Area. The air monitoring program described herein was developed using the New York State Department of Health (NYSDOH). Generic Community Air Monitoring Plan (gCAMP) guidance for evaluation of potential airborne contaminant releases as a direct result of construction and investigative work activities¹.

COMMUNITY RECEPTORS

Except for the Thompson Road boundary, property immediately adjacent to the Brownfield Area is owned by BMS. Figure 2, Land Use, shows the current land use for properties surrounding the Brownfield Area.

¹ New York State Department of Environmental Conservation, Division of Environmental Remediation, DER-10/Technical Guidance for Site Investigation and Remediation (Appendix 1A - Generic Community Air Monitoring Plan, New York State Department of Health and Appendix 1B - Fugitive Dust and Particulate Monitoring), May 2010.

Thompson Road borders the Brownfield Area to the west. Beyond Thompson Road is a residential neighborhood. None of the residential properties face on Thompson Road. South of the residential neighborhood on the corner of Burnet Avenue and Thompson Road is an automobile dealership/body shop.

To the north, proceeding clockwise from Thompson Road and beyond the adjacent BMS property, the next adjacent landowner is CSX Corporation (CSX) which holds title to the railroad right-of-way. Beyond CSX's property, is a supermarket, followed by James Street. Land use on the opposite side of James Street is primarily commercial and light industrial.

The CSX right-of-way continues along the northeast boundary of the BMS property. Beyond the CSX right-of-way, proceeding further to the east is a series of light industrial and commercial facilities and several residences located on the west side of West Manlius Street. On the east side of West Manlius Street, there is a mix of commercial and residential properties. Proceeding toward the southeast along this BMS property line, the non-Brownfield BMS property provides a progressively wider buffer with non-BMS adjacent properties.

To the south, beyond a substantial buffer of non-Brownfield BMS property, Bristol-Myers Squibb's main campus facility is bounded by Burnet Avenue. Beyond Burnet Avenue, there are light industrial and commercial facilities, as well as additional BMS property, including the wastewater pretreatment plant. Beyond that is the I-690 corridor.

AIR MONITORING OVERVIEW

As outlined in the gCAMP guidance, the air monitoring program will include monitoring for particulate and VOCs. Particulate monitoring will consist of continuous real-time air monitoring of particulate matter less than 10 micrometers (PM₁₀) in diameter upwind and downwind of the work site during daily ground-intrusive activities. VOC monitoring will consist of continuous real-time air monitoring of total VOCs (TVOCs) at a minimum of one upwind location and one downwind location during daily ground-intrusive activities using a real-time TVOC meter.

AIR MONITORING EQUIPMENT

Equipment to be used for the air monitoring program will be as follows:

- Dust meter capable of detecting particulate matter less than PM₁₀ in diameter – TSI DustTRAK, Thermo Fisher DataRam, or similar. The DustTRAK and DataRam meters are photometric light-scattering instrument that continuously measure airborne particulate concentrations from 0.1 micrograms per cubic meter (µg/m³) to greater than 100 milligrams per cubic meter (mg/m³) and record the results in time-weighted average (TWA) concentrations that can be set by the operator.
- Photoionization detector (PID) equipped with an 11.7eV (or higher) lamp to monitor for VOCs (MiniRAE 2000 or similar) equipped with data logging capabilities and alarm functions. The MiniRAE 2000 is a UV-light photoionizing detector (PID) that continuously measures TVOC concentrations from 0.1 to 10,000 parts per million (ppm), and records the results in TWA concentrations that can be set by the operator.
- 5 ppm isobutylene calibration gas cylinders for daily PID calibration.
- Tripod with Environmental Enclosure and a signal light, audible alarm and/or pager for each monitoring station.
- Flagging or similar material to be used to assess wind direction in the vicinity of the field activity.

Manufacturers' cut sheets for representative particulate and VOC monitoring instruments that may be utilized during the CAMP implementation are provided in Attachment 1.

AIR MONITORING LOCATIONS

The number of air monitoring locations used will depend on how many work areas are active at a particular time, the areal extent of those work areas, and the presence of buildings that may locally influence prevailing wind directions. For the purpose of this CAMP, except to the extent that the location is not accessible, the downwind perimeter of the work area is defined as a distance of 200 ft from the open excavation or boring or the boundary of the Brownfield Area, whichever is closer. When a location is not accessible, an alternate location will be selected based on good engineering judgment and NYSDEC will be informed. Equipment requirements are as follows:

- An upwind monitoring station consisting of one VOC and one particulate (dust) meter shall be placed in a location that is out of the influence of the work area(s). If offsite activities are occurring that may contribute to air quality (particulate or VOCs) upwind of the work area(s) the upwind monitoring station should be placed at a location between that source and the work area(s).
- For work areas consisting of individual excavations with total open area of less than 500 square feet (ft²) or individual or closely grouped borings, air monitoring will be conducted using one VOC and particulate monitoring station located at the perimeter of the work area. If the Brownfield Area perimeter boundary lies within 200-ft of the work area(s), then downwind air monitoring are expected to be conducted at the Brownfield Area perimeter boundary.
- For work areas consisting of excavations or removals that are greater than 500 ft² of open area or multiple borings that are spread out, air monitoring will be conducted using one or more downwind VOC and particulate monitoring stations. The number of downwind VOC and particulate monitoring stations required to effectively monitor air quality will be based on the size and orientation of the work area(s) relative to the prevailing wind direction.
- Site wind conditions will be evaluated for each work area. The prevailing wind direction will visually monitored by using the wind sock present on top of Building 25. In addition, a flag will be affixed to the excavating and/or drilling equipment to assess local variations that may result from the presence of on-site structures.
- The number and location of air monitoring stations will be selected at the beginning of each work day by the air monitoring technician based on the extent and orientation of the work area(s) relative to the prevailing wind direction. Air monitoring stations will be relocated as necessary during the work day if the work area changes and/or the prevailing wind direction changes.
- Particulate monitoring will not be conducted during periods of rain or heavy snow since water entering the sample inlet may damage the analyzer.

PARTICULATE MONITORING

The monitoring approach and action criteria described below are based on guidance contained in the NYSDOH gCAMP. Accordingly, action levels for particulates, discussed below, are based on 15-minute TWA concentrations. Each downwind dust meter will be programmed to set off an alarm and alert the on-site air monitoring technician (either visual or audible alarm, or via radio or cellular pager) when instantaneous particulate levels are greater than 100 µg/m³. When alerted to an alarm, the monitoring technician will mobilize to the monitoring station indicating the alarm condition. The technician will evaluate the instantaneous dust meter readings to evaluate whether they are trending upward or downward and sustained above the 100 µg/m³ over the 15-minute period. In addition, the technician will compare the downwind 15-minute TWA particulate readings to the upwind 15-minute TWA particulate readings to evaluate whether a corrective response is required.

Action criteria and corrective responses will be as follows:

- If the downwind 15-minute TWA particulate level is 100 $\mu\text{g}/\text{m}^3$ above the upwind 15-minute TWA particulate level, or if visible airborne dust is observed leaving the site perimeter, then dust suppression techniques must be employed by the excavation and/or drilling contractor. Work may continue with dust suppression techniques provided that downwind 15-minute TWA particulate levels do not exceed 150 $\mu\text{g}/\text{m}^3$ above the upwind 15-minute TWA particulate level, and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, the downwind 15-minute TWA particulate levels are greater than 150 $\mu\text{g}/\text{m}^3$ above the upwind 15-minute TWA particulate levels, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and/or other controls are successful in reducing the downwind particulate concentration to less than 150 $\mu\text{g}/\text{m}^3$ of the upwind level and in preventing migration of visible dust off-site.

VOC MONITORING

The monitoring approach and action criteria described below will be based on guidance contained in the NYSDOH gCAMP. Accordingly, action levels for TVOCs, discussed below, are based on 15-minute TWA concentrations. Each downwind VOC monitor will be programmed to set off an alarm and alert the on-site air monitoring technician (either visual or audible alarm, or via radio or cellular pager) when instantaneous downwind TVOC levels are greater than 5 parts per million (ppm). When alerted to an alarm, the monitoring technician will mobilize to the monitoring station indicating the alarm condition. The technician will review the instantaneous TVOC readings to evaluate whether they are trending upward or downward and sustained over a 15-minute period. In addition, the technician will compare the downwind 15-minute TWA TVOC readings to the upwind 15-minute TWA TVOC reading to evaluate whether corrective response is required.

With the exception of two areas on the Brownfield (Building 25 complex and Building 45), VOC monitoring will be conducted using a PID equipped with an 11.7 eV lamp. When working in the Building 25 complex and Building 45 area, a flame ionization detector (FID) will be used in conjunction with the PID in the breathing zone of the workers in the exclusion zone to allow for detection of acetonitrile. Acetonitrile, which has an ionization potential of 12.2eV, was used within the Building 25 complex and stored in Building 45, and was transferred between these two locations via overhead piping. The Permissible Exposure Limit (PEL) for acetonitrile is 40 ppm. The response factor of the FID for acetonitrile is 1. Should the FID reading be 25 ppm above background in the breathing zone, the FID will be moved to the downwind monitoring location and used to monitor ambient air concentrations for 15 minutes.

Action criteria and corrective responses for the PID and FID, if used, will be as follows:

- If the 15-minute TWA ambient air concentration of TVOCs at the downwind monitoring station(s) monitors exceeds 5 ppm above the upwind monitoring station for the 15-minute TWA, work activities must be temporarily halted and monitoring continued. If the downwind TVOC level readily decreases (per instantaneous readings) to less than 5 ppm above the upwind level, work activities can resume with continued monitoring.
- If the downwind 15-minute TWA TVOC levels persist in excess of 5 ppm above the upwind level, but are less than 25 ppm above the upwind level, work activities must be discontinued until the source of vapors have been identified, and controls/countermeasures have been taken to abate emissions. During the discontinuation of work, air monitoring will continue to be conducted. After these steps, work activities can resume provided that the TVOC levels at the downwind monitoring station(s) located 200-ft downwind of the work area(s), or half the distance to the nearest potential receptor or residential/commercial structure (but in no case less than 20 feet) is less than 5 ppm above the upwind station for the 15-minute TWA.

- If the 15-minute TWA TVOC level is above 25 ppm at the downwind monitoring station(s), ground-intrusive activities must be shut down until an effective means of suppression of VOCs can be developed.

CONTROL MEASURES

If the air monitoring indicates that either dust control measures, vapor control measures, or both measures are required, these measures will be implemented by the excavation and/or drilling contractor in accordance their dust control plan and/or vapor control plan. Typical dust control measures include the use of water or mist fences. Procedures to control VOC emissions include minimizing the amount of excavation area open at any one time by covering portions of the excavation area with plastic sheeting, soil or foam.

QUALITY CONTROL AND QUALITY ASSURANCE

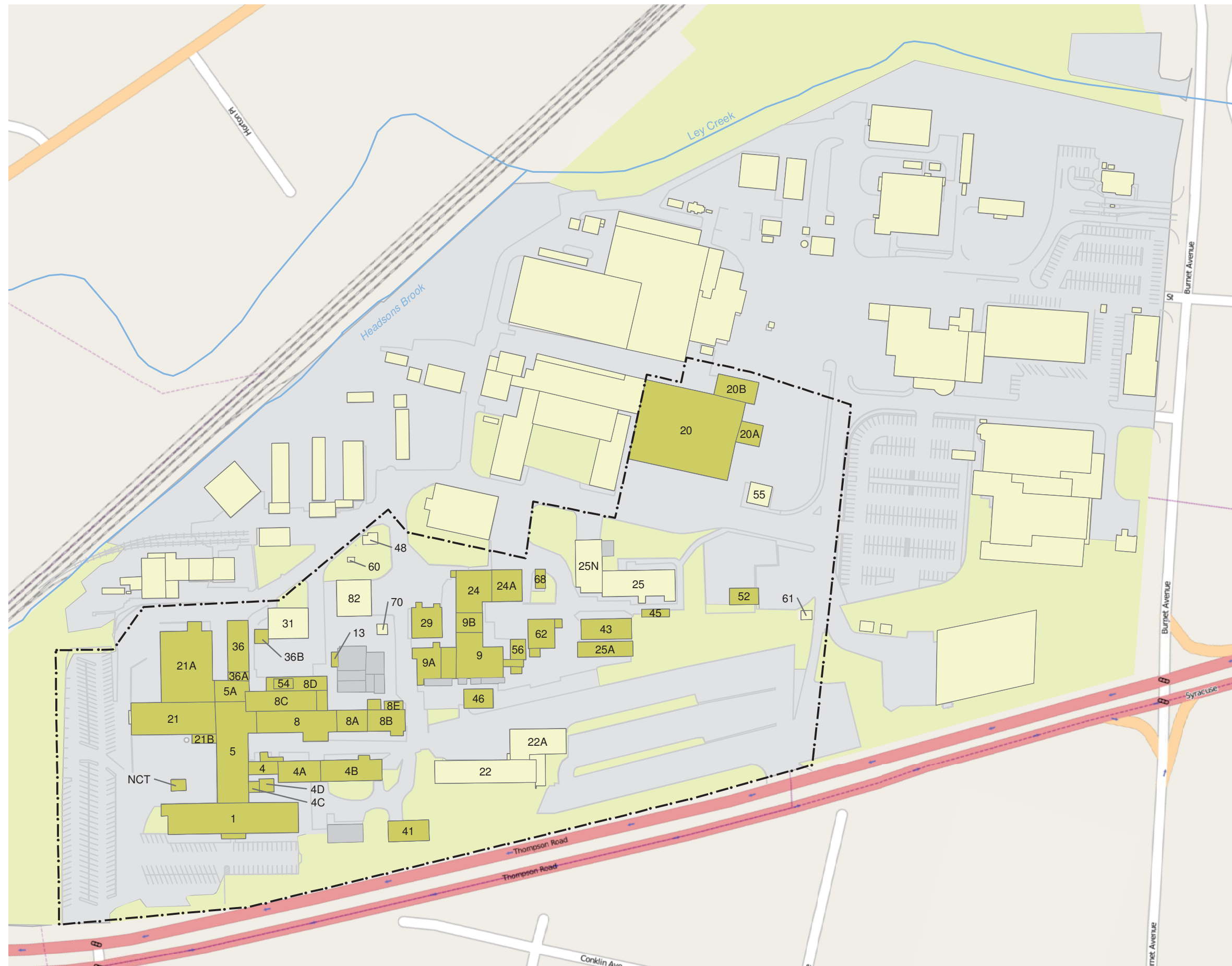
Zero and span calibration checks for VOC meters will be conducted by the air monitoring technician at the beginning of each day following applicable manufacturer's calibration guidelines. Zero calibration checks for the dust meters will be performed on the first day of each monitoring week by the air monitoring technician following applicable manufacturer's calibration guidelines. A Daily Field Calibration Form is provided in Attachment 2.

Records of daily field activities, summary of daily air quality measurements, and documentation of general observations, notes, and control measures implemented, if any, will be documented on an Air Quality Monitoring Daily Summary log. In the event that an alarm is triggered for reasons not directly associated with releases from ground-intrusive activities (e.g. exhaust or particulates from vehicles passing the monitoring station) this information will also be documented on the Air Quality Monitoring Daily Summary log. An example of the Air Quality Monitoring Daily Summary log is provided in Attachment 3.

Should wind direction change during ground-intrusive work, the air monitoring technician will evaluate the need to re-position the air monitoring stations. If an air monitoring station is re-positioned, the air monitoring technician will document this on the Air Quality Monitoring Daily Summary log.

DATA MANAGEMENT AND REPORTING

Data will be manually downloaded to a laptop computer at the end of each day. A separate electronic file folder will be established for each day of activity. Background levels, exceedances of action levels, and a summary of response actions taken as recorded on the Air Quality Monitoring Daily Summary logs will be stored electronically with the data downloads. The data and the field logs will be retained by BMS and will be transmitted to the State (NYSDEC and NYSDOH) upon request.



— BROOK / CREEK

 BROWNFIELD AREA

STATUS AFTER TRANSFORMATION

 BUILDING TO REMAIN

 BUILDING REMOVED

BRISTOL-MYERS SQUIBB
SYRACUSE, NEW YORK

BROWNFIELD AREA

FEBRUARY 2012
2874

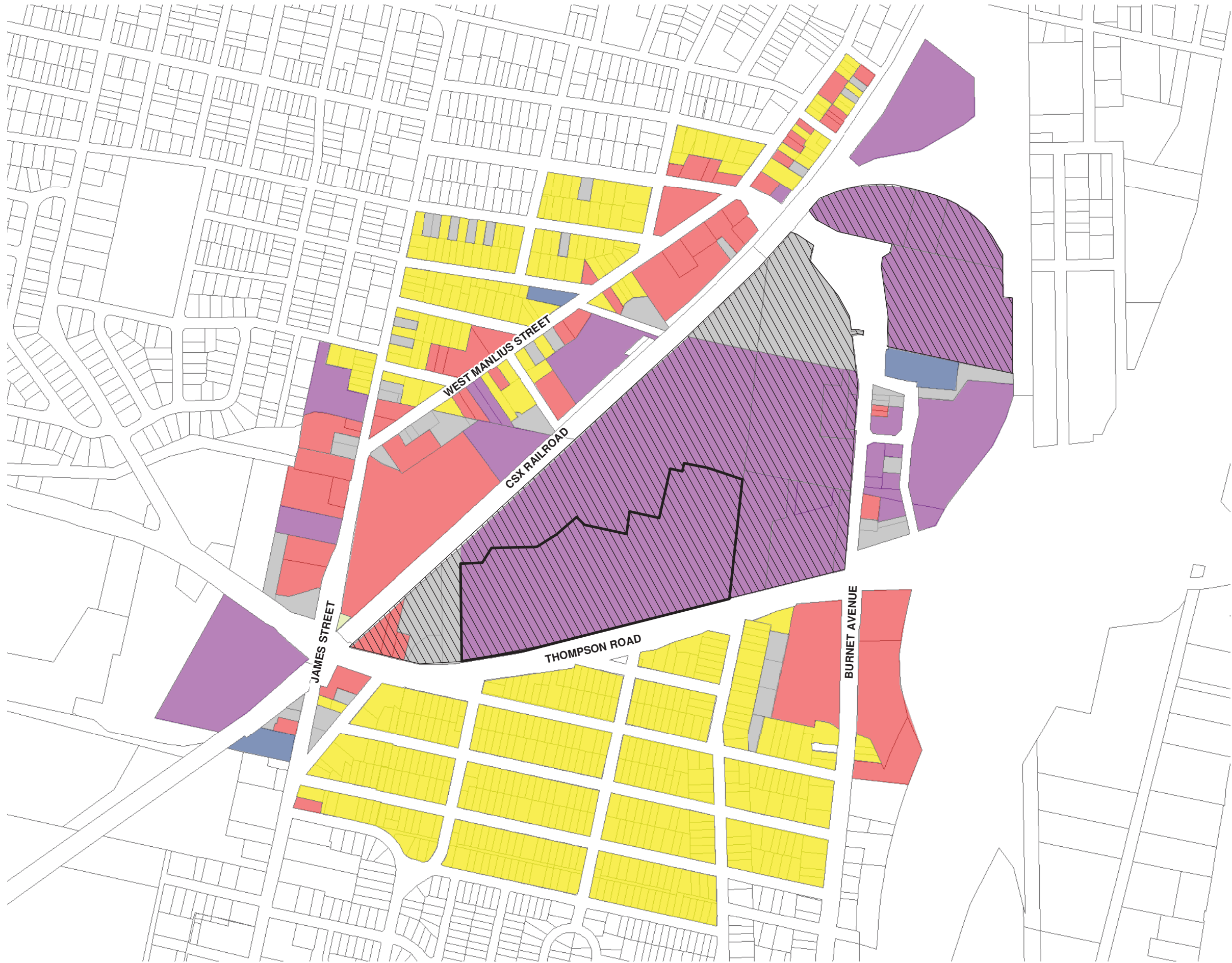


FIGURE 2



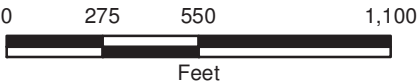
LEGEND

- BMS PROPERTY
- BROWNFIELD AREA BOUNDARY
- UNDETERMINED PROPERTY
- PUBLIC SERVICE PROPERTY
- VACANT PROPERTY
- INDUSTRIAL PROPERTY
- RESIDENTIAL PROPERTY
- COMMERCIAL PROPERTY

NOTE: SOURCE OF PROPERTY INFORMATION
IS FROM SYRACUSE-ONONDAGA COUNTY
G.I.S. ON THE WEB
www.maphost.com/syracuse-onondaga
PARCEL INFORMATION ASSOCIATED WITH THE
BMS FACILITY HAS BEEN UPDATED TO REFLECT
CURRENT USE

BRISTOL-MYERS SQUIBB
SYRACUSE, NEW YORK

LAND USE



SEPTEMBER 2011
2874.47694

*Dust and VOC Monitoring
Instruments –
Manufacturers' Information*

DataRAM 4™ - Model DR-4000

Portable particle sizing aerosol monitor/data logger Dual Wavelength Nephelometer



Real-time airborne particulate concentration and size measurements

The DataRAM 4™ (Model DR-4000) continuously monitors the real-time concentration and median particle size of airborne dust, smoke, mist, and fumes. In addition, air temperature and humidity are displayed. With appropriate particle discriminators it provides measurements correlated with PM10, PM2.5, PM1.0, and respirable fractions. It's patented two-wavelength particle detection system provides the volume median particle diameter of the sampled aerosol, over a concentration range of up to 400 mg/m³. Unlike typical particle counting devices, the DR-4000 is totally immune to particle coincidence errors, even at the highest concentrations. Volume median particle sizes down to 0.05 µm can be measured by this unique spectral nephelometric technique.

Expandable to a complete characterization system

A variety of accessories extend the capabilities of the DR-4000 to serve a wide range of monitoring and sizing applications. Aerodynamic particle size separators measure specific size groups such as the thoracic, respirable, PM10, PM2.5, and PM1.0 fractions. An omnidirectional sampling inlet and an in-line mist and fog elimination heater are available for ambient air monitoring. An isokinetic sampling probe/nozzle kit enables duct /stack monitoring.

Monitors mass concentrations of fine particulate (PM 2.5)

The DR-4000 monitors the concentrations of fine particulates in ambient air by a combination of aerodynamic size preselection, two-wavelength nephelometry, and concurrent sensing/correction for relative humidity. This patented technique provides a continuous measurement of PM2.5, independent of particle size and moisture - *without heating, diffusion drying, or denuding the sample stream.*

Measure scattering, angstrom coefficients, and visual range

DR-4000 measures the scattering coefficient at two wavelengths (in units of inverse megameters) and computes the coefficient at the reference wavelength of 550 nanometers, as well as the angstrom exponent (a measure of atmospheric fine particle size). Based on the 550 nm scattering coefficient, the instrument then calculates the visual range in kilometers.

Complete digital communications

The DR-4000 has both RS232 and RS485 data ports for two-way digital communications. Special, Windows™ compatible software (provided with the instrument) facilitates data transfer either in real-time or from the logged memory. All operational and programming functions can be controlled from a remote location through the RS485 communications port. Sampling start and stop as well as data transfer can be controlled via modem or other digital transmission paths.

Self-calibrating internal filter

A 37 mm membrane filter (adapter provided) can be used in place of the zeroing HEPA filter cartridge for gravimetric calibration and/or chemical analysis of collected particulates. The DR-4000 is easily calibrated by adjusting the calibration constant to agree with gravimetric measurements obtained from the on-board filter. As the photometric response of the instrument is exactly linear over its entire operating range, only single point gravimetric calibration is needed. The second point of the straight response line is the zero concentration obtained by self-purging.

DataRAM 4™ - Model DR-4000

Portable particle sizing aerosol monitor/data logger Dual Wavelength Nephelometer

Specifications

Concentration measurement range (auto-ranging):

Referred to gravimetric reference calibration (NIST traceable)
with SAE Fine test dust (mmd = 2 to 3 μm , $\sigma_g = 2.5$, as aerosolized)
0.0001 to 400 mg/m^3

Precision/repeatability (2-sigma):

At 25°C

For single-wavelength concentration sensing

$\pm 1\%$ of reading or $\pm 0.001 \text{ mg}/\text{m}^3$, whichever is greater
(1-second averaging)
 $\pm 0.3\%$ of reading or $\pm 0.0003 \text{ mg}/\text{m}^3$, whichever is greater
(10-second averaging)

Accuracy:

Referred to gravimetric reference calibration (NIST traceable)
with SAE Fine test dust (mmd = 2 to 3 μm , $\sigma_g = 2.5$, as aerosolized)
 $\pm 2\%$ of reading $\pm$ precision

Resolution:

0.1% of reading or 0.0001 mg/m^3 , whichever is greater

Scattering coefficient range:

10^{-7} to 0.4 m^{-1} (resolution: 3 significant digits, maximum)

Visual range (@ $\lambda = 550 \text{ nm}$):

0.001 to 337 km (resolution: 3 significant digits, maximum)

Ångström coefficient measurement range:

0.0 to 4.0

Particle sizing range (log-normal, $\sigma_g = 2.0$, $m = 1.50$):

0.05 to 4 μm

Particle size range of maximum response (concentration measurements):

0.08 to 10 μm

Temperature measurement range:

5°F to 140°F (-15°C to 60°C); accuracy: 0.05°C

Relative humidity measurement range (@ 25°F):

0 to 100% (accuracy: 2%, noncondensing)

Sampling flow rate range (user selectable):

1.0 to 3.0 liters/min.
(accuracy: 0.05 liters/min., adjustability: 0.1 liters/min.)

Measurement/display integration time range (user selectable):

1 to 60 sec. (selectable in 1-sec. steps)

Measurement/display update frequency:

1 per sec.

HEPA filter cartridge replacement frequency (typical):

Less than 1 per 5 yrs (@ < 1 mg/m^3)

Alarm level range (user selectable):

Selectable over entire measurement range

Data logging averaging periods (user selectable):

1 sec. to 24 hrs (selectable in 1-sec. increments)

Data logging memory capacity:

50,000 data points in up to 99 tags (data groups)

Programmable zeroing periods (user selectable):

1 to 168 hrs (selectable in 1-hr increments; if enabled, logging period must be more than 10 min.)

Elapsed time readout range:

1 sec. to 100,000 hrs (over 11 yrs),
in sec., min., and hrs

Digital communications:

RS232/RS485: full duplex, 9600 baud, software-controlled,
device-filtered

Computer requirements:

IBM-compatible PC, Windows™ 95 or higher; 8 MB memory or more

Analog outputs (user selectable):

0 to 5 V and 4 to 20 mA, with selectable full scale ranges
between 0.1 and 400 mg/m^3

Power:

- Internal battery: rechargeable, sealed lead-acid, 6.5 Ahr, 6 V, 20-hr run time between charges (typical)
- AC line: universal voltage charger/power supply (included), 100-250 V, 50-60 Hz (CE marked)
- Optional solar power system (Model DR-SOL)

Alarm outputs:

- Alarm switch: 30 V (off, open), 2.5 A (on, closed)
- Alarm signal: 0 V (off), 5 V (on) (1 mA maximum load current)
- Audio alarm (back panel): More than 65 dB @ 1 m

Operating environment:

14°F to 122°F (-10°C to 50°C); 10 to 95% RH, noncondensing

Storage environment:

-4°F to 158°F (-20°C to 70°C)

Dimensions:

5.28 in. (134 mm) H x 7.25 in. (184 mm) W x 13.63 in. (346 mm) D

Weight:

11.7 lbs (5.3 kg)

Safety approvals and certifications:

The DataRAM 4 complies with US FCC rules (Part 15)
and has received CE certification.

Standard accessories included:

- Universal voltage battery charger/power supply
- Standard HEPA filter cartridge
- Analytical filter holder
- PC communications software disk
- Digital output cable
- Carrying case and instruction manual

500 Technology Court Smyrna, GA 30082

800-241-6898 (toll free in USA) ■ 770-319-9999 (outside USA) ■ 770-319-0336 (fax)

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Exposure Monitoring

DUSTTRAK™ Aerosol Monitor

The DUSTTRAK™ Aerosol Monitor measures aerosols in a wide variety of environments, from offices and industrial workplaces to outdoor environmental and construction sites. TSI's DUSTTRAK provides reliable exposure assessment by measuring particle concentrations corresponding to PM10, PM2.5, PM1.0 or respirable size fractions.

The DUSTTRAK is a portable, battery-operated laser photometer which gives you a real-time digital readout with the added benefits of a built-in data logger. Suitable for clean office settings as well as harsh industrial workplaces and outdoor applications, the DUSTTRAK detects potential problems with airborne contaminants such as dust, smokes, fumes and mists.

The DUSTTRAK is easy to use, too. You can perform quick spot checks or you can program the advanced logging modes for long-term sampling. You can program the start/stop times, recording intervals and other parameters. You can even set up the instrument for continuous unattended operation.

The DUSTTRAK's new continuous analog output and adjustable alarm output allow remote access to real-time particle concentration data. Applications include site perimeter monitoring, ambient monitoring, process area monitoring and other remote uses. The alarm output with user-defined setpoint alerts you when upset or changing conditions occur. This feature allows you to program a switch closure at a concentration value of your choosing.

*Now With
Analog and
Alarm
Outputs*



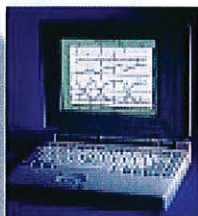
The DUSTTRAK provides a real-time measurement based on 90° light scattering. A pump draws the sample aerosol through an optics chamber where it is measured. A sheath air system isolates the aerosol in the chamber to keep the optics clean for improved reliability and low maintenance.



Specifications

Model 8520 DUSTTRAK Aerosol Monitor

Sensor Type	90° light scattering
Range	0.001 to 100 mg/m ³ (Calibrated to ISO 12103-1, A1 test dust)
Resolution	±0.1% of reading or ±0.001 mg/m ³ , whichever is greater
Zero Stability	±0.001 mg/m ³ over 24 hours using 10-second time-constant
Particle Size Range	0.1 to approximately 10 micrometers
Flow Rate	Adjustable 1.4 to 2.4 l/min (1.7 nominally)
Temperature Coefficient	+0.001 mg/m ³ per °C (for variations from temperature at which the DUSTTRAK was zeroed)
Operating Temperature	32° F to 120° F (0°C to 50°C)
Storage Temperature	-4° F to 140° F (-20°C to 60°C)
Operating Humidity	0 to 95% rh (non-condensing)
Time Constant	Adjustable from 1 to 60 seconds
Data Logging	31,000 data points (21 days of logging once/minute)
Logging Interval	Adjustable from 1 second to 1 hour
Physical	
External Dimensions	8.7 in. × 5.9 in. × 3.4 in. (221 mm × 150 mm × 87 mm)
Instrument Weight	3.3 pounds with batteries (1.5 kg)
Serial Interface	RS-232 1200 baud
Power	
AC	AC adapter (included)
Battery	Four C-size alkaline batteries (included)
Battery Run-time	Alkaline 16 hours
Analog Output Specifications	
Analog Output Voltage	0 to 5 VDC
Analog Output Scaling ¹	0 to 100 mg/m ³ 0 to 10.0 mg/m ³ 0 to 1.00 mg/m ³ 0 to 0.100 mg/m ³
Output Impedance	0.01 ohm
Maximum Output Current	15 mA



The DUSTTRAK comes complete with TSI's TRAKPRO™ Data Analysis Software to allow you to perform a more comprehensive analysis of your measurement results. This exclusive Windows®-based program helps you generate the detailed graphs and reports needed to effectively communicate your findings.

Specifications are subject to change without notice.
Windows is a registered trademark of the Microsoft Corporation.

Alarm Output Specifications

Type	Non-latching, MOSFET solid state (polarized) ² analog switch
Setpoint Range ¹	0.010 to 100 mg/m ³
Maximum Voltage	15 VDC
Maximum Current	1 Amp
Deadband	-5% of alarm setpoint
Connector	4-Pin, Mini-DIN connector

¹ User selectable through TRAKPRO™ Data Analysis Software.

² See TSI Application Note ITI - 074 for important wiring information.

Ordering Information

Model	Description
8520	The DUSTTRAK Aerosol Monitor and accessories includes: Auxiliary Analog and Alarm Outputs, Carrying Case, Alkaline Batteries, TRAKPRO™ Data Analysis Software, Filter, Computer Cable, 25-pin to 9-pin Adapter, Operation Service Manual, Calibration Certificate, 10 mm Nylon Dorr-Oliver Cyclone, Inlet Conditioning Kit 1.0 and 2.5 µm, Sampling Extension Tube, Miscellaneous Service Tools and Two-Year Warranty.

Optional Accessories

Model	Description
8520-1	Environmental Enclosure



TSI

TSI Incorporated

500 Cardigan Road, Shoreview, MN 55126 USA

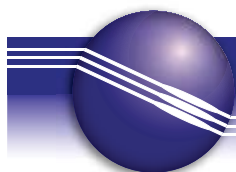
Tel: 651 490 2811 Toll Free: 1 800 874 2811 Fax: 651 490 3824 E-mail: answers@tsi.com

TSI Germany—Tel: +49-241-523030 Fax: +49-241-5230349 E-mail: tsigmbh@tsi.com

TSI Sweden—Tel: +46-18-52-70-00 Fax: +46-18-52-70-70 E-mail: tsi@tsi.se

For current information
www.tsi.com





MiniRAE 2000

Portable Handheld VOC Monitor

The rugged MiniRAE 2000 is the smallest pumped handheld volatile organic compound (VOC) monitor on the market. Its Photoionization Detector's (PID) extended range of 0 to 10,000 ppm makes it an ideal instrument for applications from environmental site surveying to HazMat/Homeland Security.

Key Features

- **Proven PID technology** The patented sensor provides a 3-second response up to 10,000 ppm and sets a new standard for resistance to moisture and dirt.
- **Wireless communication enabled and certified**
- **Self-cleaning lamp and sensor** The patented self-cleaning lamp and sensor minimize the need for maintenance and calibration.
- **The MiniRAE 2000 lamp and sensor can be taken apart in seconds for easy maintenance without tools!**
- **Measure more chemicals than with any other PID.** With over 100 Correction Factors built into the MiniRAE 2000 memory and the largest printed list of Correction Factors in the world (300+), RAE Systems offers the ability to accurately measure more ionizable chemicals than any other PID. When a gas is selected from the MiniRAE 2000's library, the alarm points are automatically loaded into the meter.
- **User friendly** screens make it easy to use for simple applications and flexible enough for sophisticated operations.
- **Drop-in battery** When work schedules require putting in more than the 10 hours supplied by the standard NiMH battery, the drop-in alkaline pack supplied with every MiniRAE 2000 lets you finish the job.
- **Rugged Rubber Boot** The standard rubber boot helps assure that the MiniRAE 2000 survives the bumps and knocks of tough field use.
- **Strong, built-in sample pump** draws up to 100 feet (30 m) horizontally or vertically.
- **Tough, flexible inlet probe**
- **Large keys** operable with 3 layers of gloves.
- **Easy-to-read display** with backlight.
- **Stores up to 267 hours of data** at one-minute intervals for downloading to PC.
- **3-year 10.6 eV lamp warranty**

Applications

HazMat/Homeland Security

- Initial PPE (personal protective equipment) assessment
- Leak detection
- Safety perimeter establishment and maintenance
- Spill delineation
- Decontamination
- Remediation

Industrial Hygiene/Safety

- Confined Space Entry (CSE)
- Indoor Air Quality (IAQ)
- Worker exposure studies

Environmental

- Soil and water headspace analysis
- Leaking underground storage tanks
- Perimeter fence line monitoring
- Fugitive emissions (EPA Method 21)
- Vapor recovery breakthrough
- Landfill monitoring

 **AutoRAE Compatible**

 **Wireless**



ver12_04.07

www.raesystems.com

ATEX



MiniRAE 2000

Specifications*

Detector Specifications

Size	8.2" L x 3.0" W x 2.0" H (21.8 x 7.62 x 5.0 cm)
Weight	20 oz with battery pack (553 g) w/o rubber boot
Sensor	Photoionization sensor with standard 10.6 eV or optional 9.8 eV or 11.7 eV UV lamp
Battery	• Rechargeable, external, field-replaceable Nickel-Metal-Hydrate (NiMH) battery pack • Alkaline battery holder (for 4 AA batteries)
Operating Period	10 hours continuous operation
Display	Large LCD, backlight activated manually, by alarms or by darkness
Keypad	1 operation and 2 programming keys
Direct Readout	• VOCs as ppm by volume • High and low values • STEL and TWA (in hygiene mode) • Battery and shut down voltage
Alarms	90 dB buzzer and flashing red LED to indicate exceeded preset limits: • High: 3 beeps and flashes per second • Low: 2 beeps and flashes per second • STEL and TWA: 1 beep and flash per second • Alarms automatic reset or latching with manual override • Optional plug-in pen size vibration alarm • User adjustable alarm limits
Calibration	Two-point field calibration of zero and standard reference gas. Calibration memory of 8 calibration gases, alarm limits, span values and calibration date
Datalogging	267 hours (at one-minute intervals) with date/time. Header information includes monitor serial number, user ID, site ID, date and time
Sampling Pump	• Internal, integrated flow rate of 400 cc/min • Sample from 100' (30 m) horizontally or vertically
Low Flow Alarm	Auto shut-off pump at low flow condition
Communication	Download data and upload instrument set-up from PC through RS-232 link to serial port. Wireless communication enabled and certified (requires RAElink2 and ProRAE Remote to use)
Temperature	14° F to 104° F (-10° C to 40° C)
Humidity	0% to 95% relative humidity (non-condensing)
EM/RFI	Highly resistant to EMI /RFI. Compliant with EMC Directive 89/336/EEC
IP-rating	IP-55: protected against dust, protected against low-pressure jets of water from all directions
Hazardous Area Approval	• US and Canada: UL and cUL, Classified for use in Class I, Division 1, Groups A, B, C and D hazardous locations • Europe: ATEX II IG EEx ia IIC T4
Attachment	Durable bright yellow rubber boot w/belt clip & wrist strap
Warranty	Lifetime on non-consumable components (per RAE Systems Standard Warranty), 3 years for 10.6V PID lamp, 1 year for pump and battery

*Specifications are subject to change

**Performance based on isobutylene calibration

Default Sensor Settings**

Gas Monitor (ppm)	Range (ppm)	Resolution Time (T90)	Response
VOCs	0 to 99.9 ppm	0.1 ppm	< 3 sec
	100 to 10,000 ppm	1 ppm	< 3 sec

MiniRAE 2000 and Accessories

Monitor only includes:

- RAE Systems UV lamp: 10.6 eV, 9.8 eV or 11.7 eV as specified
- ProRAE Suite software package for Windows® 98, NT, 2000 and XP
- Computer interface cable
- 5-inch Flex-I-Probe
- External filter
- Rubber boot with belt clip
- Alkaline battery adapter
- Tool kit
- Lamp cleaning kit
- Nickel-Metal-Hydrate (NiMH) battery
- 120/230 V AC/DC wall adapter (if specified)
- Operation and maintenance manual

Monitor with accessories kit adds:

- Hard transport case with pre-cut foam padding
- 5 porous metal filters and O-rings
- Organic vapor zeroing adapter
- Gas outlet port and tubing

Optional calibration kit adds:

- 10 ppm isobutylene calibration gas, 34L
- Calibration regulator and flow controller

Optional Guaranteed Cost of Ownership Program:

- 4-year repair and replacement guarantee
- Annual maintenance service

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raesales@raesystems.com	China	8610 58858788
	Asia	+852 2669 0828

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Daily Field Calibration Form

BMS Syracuse North Campus Restoration Area Program Bristol-Myers Squibb Company East Syracuse, NY	Date:	Station ID:
	Operator(s):	Project No.:
	Test Parameters: Particulates and Total VOCs	

CALIBRATION STANDARDS

Instrument	Zero	Span
Particulates (PM₁₀):	HEPA Filter	<i>No field span check</i>
VOCs:	UHP Zero air	5 ppm Isobutylene

CALIBRATION CHECK TOLERANCE LIMITS

Instrument	Zero	Span
Particulates (PM₁₀):	≥ 0.0 and $\leq 10 \mu\text{g}/\text{m}^3$	None
VOCs:	≥ 0.0 and ≤ 0.2 ppm	$\leq \pm 10\%$ of span

CALIBRATION CHECK RESULTS

DUST (PARTICULATE) MONITOR

Station #	Time	Instrument S/N	Zero	Span	In Tolerance?	Comments
1				NA		
2				NA		
3				NA		
4				NA		
5				NA		
6				NA		
7				NA		
8				NA		

VOC MONITOR

Station #	Time	Instrument S/N	Zero	Span	In Tolerance?	Comments
1						
2						
3						
4						
5						
6						
7						
8						

COMMENTS

*Air Quality Monitoring Daily
Log*

General Project Information

BMS Syracuse North Campus Restoration Area Program Bristol-Myers Squibb Company East Syracuse, NY	Today's Date:
	Operator:
	Weather:
	General Activity Description

UPWIND STATIONS

Monitor	Location	15 min TWA Range		Start Time	End Time
		TVOCs	Particulates		
Upwind #1					
Upwind #2					

DOWNWIND STATIONS

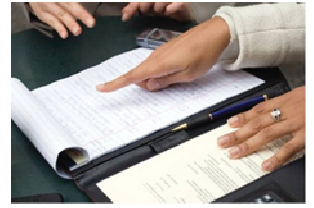
Monitor	Location	15 min TWA Range*		Start Time	End Time
		TVOCs	Particulates		
Downwind #1					
Downwind #2					
Downwind #3					
Downwind #4					
Downwind #5					
*Alarm Response Summary: (If exceedance place "Y" after range)					
Response Levels	TVOCs: 5 ppm STOP WORK and Control Source 25 ppm – STOP Work until controls work Particulates : 100 µg/m3 – Control Dust 150 µg/m3 – STOP WORK until controls work				

General Observations and Notes (visible dust, control details)

APPENDIX C

Quality Assurance Project Plan





**Remedial Investigation
BMS Syracuse North Campus Restoration Area
East Syracuse, New York
Site No. C734138
Bristol-Myers Squibb Company**

March 2013

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LIST OF ACRONYMS/ABBREVIATIONS

%D	Percent difference
%R	Percent recovery
%RSD	Percent relative standard deviation
ACS	American Chemical Society
APHA	American Public Health Association
AWWA	American Water Works Association
BFB	Bromofluorobenzene
BMS	Bristol-Myers Squibb Company
CCB	Continuing Calibration Blank
CCV	Continuous Calibration Verification
CLP	Contract laboratory program
COC	Chain-of-custody
COD	Coefficient of Determination
CV	Coefficient of variation
DBMS	Database management system
DCHA	Dicyclohexylamine
DFTPP	Decafluorotriphenylphosphine
DMA	N, N-dimethylaniline
DQO	Data quality objective
DSR	Duplicate sample result
DUSR	Data Usability Summary Report
EB	Equipment blank
EDD	Electronic disk deliverable
ELAP	Environmental Laboratory Approval Program
FTDS	Field Test Data Sheet
GC/MS	Gas chromatography/mass spectrometry
GW	Groundwater
HASP	Health and Safety Plan
ICB	Initial Calibration Blank
ICP	Inductively coupled plasma
ICSA	Interference check sample A
ICSAB	Interference check sample AB
ICV	Initial Calibration Verification
ID	Identification
IDL	Instrument detection limit
LCS	Laboratory control sample
MDL	Method detection limit
MEK	Methyl ethyl ketone
MIBK	Methyl isobutyl ketone
MS/MSD	Matrix spike/matrix spike duplicate
MSB	Matrix spike blank

NIST	National Institute of Standards and Technology
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSR	Original sample result
PCB	Polychlorinated biphenyl
PID	Photoionization Detector
PPE	Personal protective equipment
QA/QC	Quality assurance/quality control
QAM	Quality assurance manual
QAO	Quality Assurance Officer
QAPP	Quality assurance project plan
QL	Quantitation limit
RPD	Relative percent difference
RF	Response factor
RT	Retention time
RSD	Relative standard deviation
SCO	Soil Cleanup Objectives
SCG	Standards, criteria, and guidance
SDG	Sample delivery group
SOP	Standard operating procedure
SVOC	Semivolatile organic compound
TB	Trip blank
TIC	Tentatively identified compounds
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WEF	Water Environment Federation

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed by O'Brien & Gere for field sampling, laboratory analysis, and reporting of subsurface soil, groundwater, and soil vapor to support the Remedial Investigation (RI) at the Bristol-Myers Squibb Company (BMS) Syracuse North Campus Restoration Area (Site No. C734138) (Brownfield Area) located at 6000 Thompson Road in East Syracuse, New York. This QAPP is a component of the RI Work Plan (RIWP) developed by O'Brien & Gere for the Brownfield Area.

This QAPP has been prepared using the following documents as guidance:

- United States Environmental Protection Agency (USEPA). 2006a. EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5. Washington, D.C.
- New York State Department of Environmental Conservation (NYSDEC). 2010. DER-10 Technical Guidance for Site Investigation and Remediation. Albany, NY.

The QAPP will assist in generating data from environmental samples of a known and acceptable level of precision and accuracy. It provides information regarding the project description and personnel responsibilities and sets forth specific procedures to be used during sampling of environmental media, field activities and laboratory analyses. Personnel participating in the field investigation and laboratory analyses will follow the procedures in this QAPP.

The following QA topics are addressed in this document:

- Project background and description
- Data quality objectives and criteria
- Project organization and responsibilities
- Special training requirements
- Documentation
- Sampling design and method requirements
- Sample handling and custody
- Analytical method requirements
- Laboratory quality assurance/quality control (QA/QC) procedures
- Field QA/QC procedures
- Instrumentation/equipment testing and maintenance
- Calibration and frequency
- Inspection requirements for supplies
- Data acquisition requirements
- Data management
- Assessment and response actions
- QA reports to management
- Data review and management
- Data validation and usability
- Reconciliation with user requirements

2. PROJECT BACKGROUND AND SCOPE

This section describes the general scope of work and project objectives for the activities to be performed during the Remedial Investigation. The specific project scope and objectives and Brownfield Area history are presented in the Remedial Investigation Work Plan.

2.1 PROJECT BACKGROUND

The Brownfield Area lies within the BMS Syracuse facility, and beginning with construction of Building 1 in 1943 until 2007, the Area was used for manufacture and packaging of antibiotic pharmaceuticals, including penicillin and cephalosporin. The Remedial Investigation is being performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP). The Brownfield Cleanup Agreement (BCA) between BMS and NYSDEC was executed on October 18, 2011. A detailed description of the history of the site, potential areas of concern, and the approach of the Remedial Investigation is described in the Remedial Investigation Work Plan.

2.2 PROJECT SCOPE

The RI will be conducted in a phased approach. The first phase of the RI will consist of collection of groundwater, surface and subsurface soil in the identified Areas of Concern. After this initial work, soil vapor and sediment sampling and installation of downgradient wells will be completed. The scope of subsequent phases of RI will depend on the results generated during the first phase. The results from the RI will be utilized to develop a Conceptual Brownfield Model, assemble appropriate remedial action objectives (RAOs), and identify the recommended remedial alternative for the Brownfield Area.

The sample containers, preservation, QC samples and holding times applicable to this project are presented in Table 1. The analytical methods, method detection limits (MDLs), quantitation limits (QLs), target analytes and regulatory criteria applicable to this project are presented in Tables 2-1A, 2-1B, 2-2, 2-3 and 2-4.

2.2.1 Laboratory Analysis

All samples of environmental media will be submitted for analysis to a laboratory that is certified by the Environmental Laboratory Approval Program (ELAP) of the New York State Department of Health (NYSDOH).

The sample containers, preservation, QC samples and holding time applicable to this project are presented in Table 1. The MDLs and QLs for target analytes listed in Tables 2-1A, 2-1B, 2-2, 2-3 and 2-4, or the most recent detection limits for those target analytes, will be reported by the laboratory on the sample result sheets. Tables 2-1A, 2-1B, 2-2, 2-3 and 2-4 also present the applicable regulatory criteria which will be used to evaluate the analytical data.

The laboratory will provide the required sample collection and shipment containers for the sampling program.

Communications with the consultant relative to the analysis of environmental media samples will be documented by the laboratory in analytical data packages.

Data results will be reported in hard-copy and electronic versions as specified in Section 16.

2.2.2 Data Validation

Data validation will be performed on the data collected for the Brownfield Area Remedial Investigation utilizing the NYSDEC Data Usability Summary Report (DUSR) guidance (NYSDEC, 2010). Data will be evaluated during validation using the QA/QC criteria established in the methods, the quality control requirements and corrective actions listed in Tables 3-1A, 3-1B, 3-1C, 3-2, 3-3, 3-4, 3-5, 3-6, 3-7A, 3-7B and 3-8 and laboratory established control limits.

Data affected by excursions from the previously described QA/QC criteria will be qualified using USEPA Region II data validation guidance and professional judgment. The application of these validation guidelines will be

modified to reflect method and QAPP requirements, where applicable. Upon request of the data validator, the laboratory will provide additional or supplemental information within three working days of the request during the validation process.

The specific data quality requirements including precision, accuracy, representativeness, completeness, comparability, and sensitivity will be assessed during data validation. Data usability with respect to the data quality objectives and data uses will be compared to the project requirements. In the event that the completeness objective of 95% is not achieved, at the discretion of the Project Manager (defined in Section 4.3.2), new samples may be collected.

2.2.3 Audits

At the discretion of the Project Manager (defined in Section 4.3.2), a field audit and laboratory audit may be performed during the Brownfield Area Remedial Investigation. Additional audits may be required if issues that would severely limit the use of the sample data are identified during the investigation. Corrective action procedures will be implemented in the event of unacceptable audit results, as defined herein.

2.2.4 Documentation

The analytical laboratory will provide an EQuIS 4-file EDD populated with the latest NYSDEC valid values. Valid values are provided at the following link: <http://www.earthsoft.com/products/edp-format-for-nysdec> . The EDD must comply with the NYSDEC's Environmental Data Submission electronic data deliverable (EDD) format, all data generated will be submitted to the NYSDEC in an EDD format. Data will be managed in a relational data base management system (DBMS). Laboratory analytical data will be provided in EDD format for direct upload into the DBMS. Data validation qualifiers will be entered into the DBMS and checked independently.

Records will be incorporated into the final project files for the samples. The field logs, data packages, and records will be included in the project files, which will be archived by the Project Manager (defined in Section 4.3.2) for a period no less than ten years.

3. DATA QUALITY OBJECTIVES AND CRITERIA

The Data Quality Objective (DQO) Process, as it has been applied to the Brownfield Area Remedial Investigation activities, comprises the following steps, consistent with guidance presented in the USEPA *Guidance for the Data Quality Objectives Process* (EPA QA/G-4), February 2006. The DQO Process establishes the acceptance criteria, which serve as the basis for collecting data of sufficient quality and quantity to support the goals of the Brownfield Area Remedial Investigation activities.

3.1 DQO PROCESS

The process consists of the following seven iterative steps for the DQO process:

- **Step 1 - State the problem** - The Brownfield Area Remedial Investigation activities need to identify, evaluate, and confirm contamination of environmental media associated with and emanating from the Brownfield Area.
- **Step 2 - Identify the goal of the study** - The Brownfield Area Remedial Investigation activities will be utilized to identify, evaluate and confirm the presence of Brownfield Area-related contaminants in environmental media at and emanating from the Brownfield Area. The nature and extent of contamination at or emanating from the Brownfield Area will provide a basis for evaluating potential exposures and selecting and developing remedial alternatives, consistent with the intended future use of the Brownfield Area.
- **Step 3 - Identify information inputs (the data types that will be required before project decisions can be made)** - Site history that addresses the source of any contaminants previously identified will be presented in the RI Work Plan. The primary data types that will be required are analytical results from sampling of environmental media at and in the vicinity of the Brownfield Area.
- **Step 4 - Define the boundaries of the study (the spatial and temporal features pertinent for decision making)** - The Investigation will be performed in and around the Brownfield Area which is located in the Town of DeWitt and Village of East Syracuse in Onondaga County, New York. The Brownfield Area generally encompasses approximately 24 acres and includes the area formerly associated with the production of penicillin and other related products from the 1940's through approximately 2007.
- **Step 5 - Develop the analytic approach (how will the study results be analyzed and conclusions derived from the data)** - Results of contaminants identified in the environmental media at concentrations above applicable SCGs will provide a basis for identifying potential exposures and selecting and developing remedial alternatives for the Brownfield Area.
- **Step 6 - Specify performance or acceptance criteria (performance or acceptance criteria that the collected data will need to achieve)** - Data must be of known quality to withstand scientific and legal challenges relative to its intended purpose. Completeness is the measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. Based on evaluation of the data in terms of precision, accuracy, representativeness, comparability, and sensitivity, a completeness objective of 95% of the data set has been established for these Brownfield Area Remedial Investigation. Additional sampling may be warranted if the completeness objective is not met.
- **Step 7 - Develop the plan for obtaining data** - The environmental media samples will be collected and analyzed as described in this QAPP.

To meet the DQOs for these Brownfield Area Remedial Investigation, environmental data will be compared to the following NYS SCGs where applicable:

- Title 6 of the Official Compilation of New York Codes, Rules, and Regulations (6NYCRR Part 375) – Remedial Program Soil Cleanup Objectives;
- 6NYCRR Part 703 – Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations – New York State Class GA Groundwater Standards;

- *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*, Division of Water Technical and Operational Guidance Series 1.1.1;
- CP-51 – Soil Cleanup Guidance;
- Guidance for Evaluating Soil Vapor Intrusion in the State of New York; and
- Technical Guidance for Screening Contaminated Sediments.

3.2 ANALYTICAL LEVELS

Analytical levels as defined by USEPA as follows:

- **Screening Data** – Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantitation, although the quantitation may be relatively imprecise. At least 10% of the screening data will be confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality. During the Brownfield Area Remedial Investigation activities, dissolved oxygen, temperature, oxidation-reduction potential, pH, turbidity, and specific conductance may be measured in the field. Solid samples collected from geoprobe/soil borings, and sediments may be screened for volatile organic compounds (VOCs) by a photoionization detector (PID).
- **Definitive Data** – Definitive data are generated using rigorous analytical methods, such as USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data in the form of paper printouts or computer-generated electronic files. Data may be generated at the Brownfield Area or at an off-Brownfield Area location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be identified. The level of QC that will be performed for the definitive data involves the QC efforts described in Section 10, calibration procedures described in Section 13, analytical methods listed in Table 1, and QC requirements and corrective actions listed in Tables 3-1 through 3-8. Laboratory control limits for accuracy and precision, will be used to evaluate the sample data.

The QA/QC program described in this QAPP was developed in order to assess adherence to DQOs described previously. The remainder of this QAPP describes the specific approaches that will be taken to achieve the required DQOs.

Precision describes the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements that have been made in an identical manner, compared to their average value. Precision can be expressed in a variety of manners that include absolute methods such as deviation from the mean or median values, standard deviation and variance, or relative methods (*e.g.*, relative deviation from the mean or median). The overall precision will be determined through the analysis of field duplicates, laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples.

Accuracy is defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement is. Accuracy is expressed in terms of absolute or relative error. Accuracy will be determined through analysis of spiked samples and the analysis of standards with known concentrations.

Representativeness refers to the degree to which a sample taken from the Brownfield Area accurately reflects the matrix at the Brownfield Area. It is a qualitative parameter that is most concerned with the design of the sampling program. Factors that should be considered in the determination of representativeness include appropriateness of sampling and analytical methodologies, representativeness of the selected media, and representativeness of the selected analytical procedures. Representativeness will be achieved by the use of procedures for the collection and preservation of samples as described in the Work Plan and the methods in this QAPP.

Comparability refers to the use of consistent procedures, second source reference standards, reporting units, and standardized data format with document control. Adherence to standard procedures and the analysis of external source standard materials maximizes the probability that data generated from a particular method at a given laboratory can be validly compared to the data of another. This QAPP has been written to provide data that will be comparable to other data collected, as standard methods will be utilized for these Brownfield Area Remedial Investigation activities.

Completeness refers to the process of obtaining the required data as outlined in the investigation-specific Work Plan. Completeness is also defined as the percentage of measurements judged to be useable. Samples for which the critical data points fail completeness objectives will require reanalysis of samples (within the specified holding times) until the DQOs are met. The completeness goal has been specified at 95% for these Investigation activities.

Sensitivity refers to a measurable concentration of an analyte that has an acceptable level of confidence. MDLs are the lowest concentration of an analyte that can be measured with 99% confidence that the analyte concentration is greater than zero. QLs are levels above the MDLs at which the laboratory has demonstrated the quantitation of analytes.

3.3 FIELD SAMPLING OBJECTIVES

The objective of the field sampling program is to obtain samples that represent the environmental matrix being investigated. This will be accomplished through the use of proper sampling techniques and equipment as presented in the Work Plan.

Field screening activities may not require sample collection but, nonetheless, involve measurements for which QA concerns are appropriate. The primary QA objective of field screening is to obtain reproducible measurements to a degree of accuracy consistent with the intended use of the measurements and to document measurement procedures.

3.4 LABORATORY OBJECTIVES

To obtain data of a quality sufficient to meet the project DQOs, the laboratory will adhere to the specific analyses and QA/QC requirements in the analytical methods listed in Table 1. The methods cited in this QAPP provide data of sufficient quality for comparisons to the regulatory criteria. The laboratory Standard Operating Procedures (SOPs) and Quality Assurance Manual (QAM) will be made available to the data validators upon request.

4. PROJECT ORGANIZATION AND RESPONSIBILITY

The consultant will be responsible for project management and sample collection. Any laboratory performing the analyses will be certified by the NYSDOH Environmental Laboratory Approval Program (ELAP). Responsibilities for key project team members are summarized below. Individual resumes will be available upon request.

4.1 REGULATORY AGENCY

The NYSDEC Project Manager will have oversight authority for each Brownfield Area Remedial Investigation.

4.2 BMS PROJECT MANAGER

The BMS Project Manager will be responsible for the execution of each phase of the project, including corresponding and coordinating activities with NYSDEC.

4.3 CONSULTANT KEY PERSONNEL

4.3.1 Project Officer

The Project Officer will have overall responsibility for meeting the stated project objectives. In addition, the Project Officer will be responsible for providing the Project Manager with access to corporate resources.

4.3.2 Project Manager

The Project Manager will be responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The Project Manager's primary function is to meet the technical, financial, and scheduling objectives and milestones and to provide direction to the Project Team.

4.3.3 Quality Assurance Officer

The Quality Assurance Officer (QAO) will manage and be responsible for QA/QC review of data generated during the Brownfield Area activities. Data validation will be overseen by the QAO. If QA problems or deficiencies requiring special action are identified, the QAO and Project Manager will determine the appropriate corrective action. The QAO will be responsible for follow-up and oversight of corrective action implementation to the satisfaction of BMS and the NYSDEC representative.

4.3.4 Data Validator

Data Validators will be responsible for review of laboratory data for compliance with the project-specific DQOs and for such parameters as precision, accuracy, representativeness, comparability, and completeness. Data Validators will notify the QAO of any major QA deficiencies. Data validation will be overseen by the QAO.

4.3.5 Field Team Leader

The Team Leaders will support the Project Manager. The Field Team Leaders will be responsible for directing and coordinating the day-to-day activities of the various resource specialists and will report directly to the Project Manager on a daily basis while field activities are underway. The Field Team Leaders will be present during sampling activities and will keep a general log describing activities conducted during the Brownfield Area Remedial Investigation, which will include the identification of personnel entering the Brownfield Area and the recording of general observations regarding Brownfield Area activities.

4.3.6 Field Sampling Personnel

Field Sampling Personnel will be responsible for collection, packaging, preservation, and shipping of environmental samples in accordance with the Work Plan, QAPP and applicable NYSDEC requirements.

4.4 LABORATORY MANAGEMENT

The laboratory that will perform analyses for these Investigation activities will be determined in the future. The analytical laboratory certification number will be provided by the laboratory.

4.4.1 Laboratory Project Manager

The Laboratory Project Manager will be responsible for the following tasks:

- Coordinating laboratory analysis;
- Supervising in-house chain-of-custody (COC);
- Scheduling sample analysis;
- Overseeing data review; and
- Overseeing preparation of analytical reports.

It will also be the responsibility of the Laboratory Project Manager to approve final analytical reports prior to submission to the Consultant.

4.4.2 Laboratory Quality Assurance Manager

The Laboratory QA Manager will be responsible for overview of the laboratory QA, overview of the QA/QC documentation, and conducting detailed data review. The Laboratory QA Manager will decide if laboratory corrective actions are required in addition to seeing that laboratory SOPs are followed.

4.4.3 Laboratory Sample Management Supervisors

The Laboratory Sample Management Supervisors will be responsible for the following tasks:

- Receive and inspect incoming sample containers;
- Record condition of incoming sample containers;
- Sign appropriate documents;
- Verify chain-of-custody and its correctness;
- Notify Laboratory Project Manager of sample receipt and inspection;
- Assign unique identification number and customer number, and enter these numbers into sample receiving log;
- Initiate transfer of samples to appropriate lab sections; and
- Control and monitor access/storage of samples and extracts.

Primary responsibility for project quality rests with the Laboratory Project Manager. Independent QA will be provided by the Laboratory QA Manager prior to release of data to the Consultant.

5. SPECIAL TRAINING REQUIREMENTS

As described in the Health and Safety Plan developed for the Brownfield Area Remedial Investigation, field personnel must comply with the training requirements for hazardous waste operations in accordance with 29 CFR 1910.120(e). Each individual must have successfully completed a 40-hour course for intrusive work and, minimally, a 24-hour course for non-intrusive work. In addition, each individual must have completed an 8-hour refresher course within the last 12 months if the initial training was more than 12 months ago. Personnel acting in the capacity of a Brownfield Area supervisor (*e.g.*, directly responsible for supervising employees engaged in hazardous waste operations) will also have successfully completed an 8-hour supervisor training course.

6. DOCUMENTATION

At the discretion of the Project Manager, this QAPP will be amended by the QAO, as necessary, when guidelines and regulatory documents are revised or if site requirements necessitate such changes. Any modification to the QAPP must be approved by NYSDEC. Whenever the QAPP is amended, the project personnel will receive the amended copy of the QAPP and outdated copies will be removed from circulation.

Field sampling operations and procedures will be documented by on-site personnel in bound field logbooks. Documentation of sampling operations and procedures will include the following:

- Procedures for preparation of reagents or supplies that become an integral part of the sample;
- Procedures for recording location and specific considerations associated with sample collection;
- Specific sample preservation method;
- Calibration of field instruments;
- Submission of field-based blanks, where appropriate;
- Potential interferences present at the Brownfield Area;
- Field sampling equipment and containers including specific identification numbers of equipment;
- Sampling order;
- Decontamination procedures; and
- Identity of field personnel.

The analytical data results will be reported by the laboratory to the Project Manager using NYSDEC Category B deliverables format and EDDs that comply with the NYSDEC's requirements. The data packages will also be provide in electronic format.

A comprehensive case narrative that describes the following information will be included in the data package:

- Cross reference list that includes field sample identification name, laboratory identification number, and sample dates for each sample in the sample delivery group (SDG) included in the data package;
- Documentation of methodologies utilized to prepare and analyze samples and references;
- Detailed documentation of QC, sample shipment, and analytical problems encountered in processing samples for the data package;
- Documentation of re-analyses, internal QC processes used, corrective actions taken, and resolution of corrective actions taken; and
- Documentation of communications made with the Project Manager and QAO during the data generation process.

The laboratory will provide two hard copies and one electronic copy of the data packages within 4 weeks of receipt of the last sample in a sampling event at the laboratory. Field logs, data packages, and records will be included in the project file which will be archived for a period of ten years.

7. SAMPLING DESIGN AND METHOD REQUIREMENTS

7.1 SAMPLING NETWORK

The types of methods, sample matrices, and numbers of samples to be collected for the Investigation are presented in the Work Plan and **Table 1**. The specific parameters for each method and the associated laboratory QLs and MDLs are listed in **Tables 2-1 through 2-4**.

7.2 SAMPLE LOCATIONS AND DESIGNATIONS

A sample designation system will be used to identify samples for laboratory analysis. A list of the unique identifiers used for each sample will be maintained in the project logbook by the Field Team Leaders. Sample locations and a Brownfield Area map are presented in the Work Plan.

Each sample that is collected will be designated by a unique sample identification number as outlined in the FSAP. Field duplicates will also be identified with a unique sample identification number, such that the laboratory will not be aware of the sample location utilized as the blind duplicate. The field sampling personnel will note the duplicate sample in the logbook so that this information will be available when the laboratory data is reviewed.

7.3. SAMPLING PROCEDURES

Specific sampling procedures are presented in the Work Plan. Procedures for soil vapor sampling and QC sample collection are discussed below.

7.3.1 Soil Vapor Sampling Procedure

Canister vacuum will be measured with a National Institute of Standards and Technology (NIST)-traceable digital vacuum gauge (calibrated within the previous 12 months). Procedures for measurement of helium using field equipment are included in manufacturer's instructions, which will be reviewed by the field staff prior to the commencement of field activities.

Soil vapor samples will be collected into evacuated, individually or batch certified-clean, 1-L or 6-L pre-evacuated canisters supplied by the certified laboratory. Vacuum readings of the canisters will be obtained and documented prior to sample collection and upon completion of sampling. Sample identification, vacuum readings, flow controller identification numbers, and other relevant information will be recorded on appropriate soil vapor collection field forms. Canisters must be returned to the laboratory within 15 days of evacuation and shipment to the Brownfield Area for sampling due to the loss of pressure during storage.

7.3.2 Field Duplicate Sampling Procedure

Field duplicate samples will be collected from the same location as the parent sample and will be analyzed for the same parameters as the parent sample. The actual identification of the duplicate QC samples will be recorded in the field logbook. One field duplicate QC sample will be collected for every 20 samples collected or one per matrix for less than 20 samples for each analysis type.

7.3.3 Matrix Spike/Matrix Spike Duplicate Sampling Procedure

The MS/MSD samples will be collected from the same location as the parent sample and will be analyzed for the same parameters as the parent sample. Each sample will be labeled with the same number as the original sample, designated as MS or MSD, and submitted to the laboratory for the appropriate analyses. One MS and MSD sample will be collected for every 20 samples or one per matrix for less than 20 samples for each analysis type.

7.3.4 Field/Equipment Blank Sampling Procedure

A field/equipment blank will be prepared for sampling when a particular piece of sampling equipment is employed for sample collection and subsequently decontaminated in the field for use for additional sampling. The blank water used to generate the field blank will be provided by the laboratory using the same source of water as that used to prepare method blanks. The field/equipment blank will be composed in the field by collecting, in the appropriate container for the water, a blank water rinse from the equipment after execution of the last step of the proper field decontamination protocol. The identical bottle to bottle transfer technique will be used to generate the field blank. Preservatives or additives will be added to the field blank, where appropriate, for the sampling parameters. One field blank will be collected for every 20 samples or one per matrix for less than 20 samples for each analysis type. The field/equipment blank will be analyzed for the same parameters as the samples collected the same day that the field blank was generated.

7.3.5 Trip Blank Procedure

A trip blank will be included in the cooler used to ship aqueous and solid samples for VOC analysis. The trip blank is designed to address possible sample contamination from transportation between the Brownfield Area and the laboratory. A trip blank will be prepared by the laboratory using the same preservation technique as that used to prepare the sample containers from the same source as the method blank water and sent to the Brownfield Area in the cooler with the other sample containers. Non-aqueous samples collected utilizing methanol preservation will require trip blanks prepared using the same technique as that used to prepare the samples containers. Trip blanks are not opened in the field but travel with the sample containers. One trip blank will be sent to the laboratory for analysis in each cooler that contains samples that have been collected for VOCs.

7.4 DECONTAMINATION OF SAMPLING EQUIPMENT

Sampling methods have been developed to minimize the possibility of cross-contamination. The FSAP describes specific decontamination procedures that will be followed based on the type of equipment that is used.

8. SAMPLE HANDLING AND CUSTODY

8.1 SAMPLE CUSTODY AND PROCEDURES

Chain-of-custody (COC) procedures will be instituted and followed throughout the investigation. These procedures include field custody, laboratory custody, and evidence files. Samples are physical evidence and will be handled according to strict COC protocols. The QAO must be prepared to produce documentation that traces the samples from the field to the laboratory and through analysis. The USEPA has defined custody of evidence as follows:

- In actual possession;
- In view after being in physical possession;
- In a locked laboratory; and
- In a secure, restricted area.

8.2 SAMPLE PREPARATION

Quality Assurance measures for this project will begin with the sample containers; pre-cleaned containers will be purchased from a USEPA-certified manufacturer (I-Chem 200 or equivalent). For soil vapor sample collection, certified-clean sample SUMMA™ canisters will be provided by the laboratory. The laboratory that certifies the SUMMA™ canisters as clean must also conduct the analysis of the samples. The laboratory will begin a field test data sheet (FTDS), which will follow the canister to the field and back to the laboratory. The FTDS does not replace the need for a chain of custody to be completed in the field and follow the sample canisters from the field to the laboratory.

Table 1 lists the proper sample container, sample volumes, preservation, and holding times. Table 3-1B describes the canister preparation requirements. The maximum time canisters can be held on-site prior to sample collection is 15 days after shipment of the canister by the laboratory.

Immediately after collection, aqueous and solid samples will be transferred to properly labeled sample containers and properly preserved. Sample canisters will be labeled. Samples requiring refrigeration for preservation will be promptly transferred to coolers packed with wet ice and/or ice packs. If field storage is required, the samples will be stored in a secured storage facility and a cooler temperature of 4°C will be maintained.

8.3 FIELD CUSTODY PROCEDURES

The field sampler is personally responsible for the care and custody of the sample until transferred. The field logbook will be used to note information regarding collection of samples and any observations. All entries will be signed and dated. Field logbooks will be waterproof and bound. The logbook will be dedicated to the project and pages will not be removed. Corrections will be made by drawing a single line through the incorrect data and initialing and dating the correction that was made to the side of the error. An initialed diagonal line will be used to indicate the end of an entry or the end of the day's activities.

The following information will be recorded in the field logbook by the field sampling team:

- Location of field activity;
- Date and time of entry;
- Names, titles of any site visitors, as well as the date and time entering and leaving the site;
- Weather information, for example: temperature, cloud coverage, wind speed, and direction;
- Purpose of field activity;
- A detailed description of the fieldwork conducted;
- Sample media (e.g. soil, groundwater, etc.);
- Description of sampling point(s);

- Analytical parameters;
- Date and time of collection;
- Sample identification number(s);
- Field observations;
- Field measurements made (e.g.; volatile organic compounds (VOCs) using a photoionization detector (PID), pH, temperature, conductivity, water level);
- References for maps and photographs of the sampling site(s); and
- Information pertaining to sample documentation such as:
 - » Bottle lot numbers;
 - » Dates and method of sample shipments;
 - » Chain-of-custody record numbers; and
 - » Federal Express air bill number.

A completed sample identification label or tag will be sequentially numbered, attached to each investigative or QC sample, and placed with the sample in a shipping container. The identification on the label/tag must be sufficient to enable cross-reference with the logbook. The sample label/tag will be recorded using waterproof, non-erasable ink and will be attached to the sample container using adhesive.

The sample labels/tags will contain the following information:

- Sample number identification;
- Project number;
- Date and time of sample collection;
- Designation of the sample as a grab or composite;
- Type of sample matrix;
- Sample location;
- Signature of the sampler;
- Whether the sample is preserved or unpreserved;
- Space for laboratory sample number (only on the sample tag); and
- General types of analysis to be performed.

8.4 CHAIN OF CUSTODY PROCEDURES

COC records will be kept starting in the field when sample collection is completed and kept with the sample containers placed in the coolers for transportation to the laboratory. One completed COC record must be kept with each sample cooler at all times.

For soil vapor samples, the external COC commences with the preparation of the canisters at the laboratory for shipment to the investigator. The laboratory will initiate the COC record and transfer the canister under strict COC to the field representative.

The following measures will be taken when completing a COC record:

- Chain-of-custody and sample collection forms will be completed in waterproof, non-erasable ink;
- Chain-of-custody forms will be completed neatly using printed text. If a simple mistake is made, the error will be lined out with a single line, initialed, and dated;
- Each separate sample entry will be sequentially numbered;
- The use of "Ditto" or quotation marks to indicate repetitive information in columnar entries should be avoided. If numerous repetitive entries must be made in the same column, a continuous vertical arrow will be used between the first entry and the next different entry;

- When more than one COC form is used for a single shipment, each form will be consecutively numbered using the "Page ___ of ___" format;
- If necessary, additional instructions will be placed directly onto the COC form; and
- Acronyms used on a COC form will be defined.

The COC form will contain the following information:

- Project identification and number;
- Sample description/location;
- Required analysis;
- Date and time of sample collection;
- Type and matrix of sample;
- Number of sample containers;
- Analysis requested/comments;
- Sampler signature/date/time;
- Date and signature of the field representative;
- Date and signature of the laboratory representative;
- Carrier used to ship coolers; and
- Air bill number (if shipped by a commercial carrier).

In the case that high concentrations are suspected to be present in the samples, a note to that effect will be included on the COC form.

For soil vapor samples, the Field Test Data Sheet (FTDS) must be completed for each sample canister in addition to the standard COC. The FTDS is initiated by the laboratory and accompanies the canisters to and from the Brownfield Area. The form will include the following:

- Brownfield Area information;
- Canister size, serial number, and flow controller number;
- Sampling dates and shipping date;
- Sampling information: ambient temperature and barometric pressure, canister pressure, sampling times, and interior temperature (where applicable);
- Laboratory information: flow rates (shipping out from laboratory and received from Brownfield Area), canister pressure (initial and final); and
- Date container shipped out and received back, canister certification number, individual certification number and signature of gas chromatography/mass spectrometry (GC/MS) analyst.

The FTDS will be completed and copied, and the original and one copy of each will be placed in a sealed Ziploc® bag in the shipping container and the second copy retained for the project file.

Environmental samples will be packed prior to shipment using the following procedures:

- Select a sturdy cooler or box for soil vapor canisters in good repair and clean. Secure and tape the cooler drain plug with fiber or duct tape;
- Be sure the lids on all bottles are tight (*i.e.*, will not leak, *etc.*), and baggies are sealed;
- For aqueous and solid samples, place ice that has been placed in heavy-duty polyethylene bags and properly sealed on top of or between the samples. Pack samples securely to eliminate breakage during shipment with ice packs to maintain the inside temperature at approximately 4°C;
- Sampling containers will be packed with packing materials. When possible, sample container preparation and packing for shipment will be completed in a well-organized and clean area. Sample containers will be prepared for shipment by wiping containers clean of debris/water using paper towels. Paper towels will be disposed with the personal protective equipment (PPE);

- Place the COC record into a Ziploc® plastic bag, tape the bag to the inner side of the cooler lid, and close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Two custody seals will be affixed to the latch and lid of the box or cooler. The number of the security seal will be recorded on the COC form. The custody seals will consist of adhesive-backed tape that easily rips if it is disturbed. The field sampler will initial and date the seal. The seals must be broken to open the cooler and will indicate tampering if the seal is broken before receipt at the laboratory; and
- A label containing the name and address of the shipper will be placed on the outside of the container.

The field sampling team will transport or ship the cooler via an overnight delivery service or hand deliver to the laboratory. Prior to shipment of sample coolers, the field sampling team will contact the laboratory to notify the laboratory of the shipment.

Samples will remain in the custody of the sampler until transfer of custody is completed. Transfer will include:

- For Samples being shipped:
 - » Signature of sampler to acknowledge relinquishing the samples prior to sealing of the sample cooler; and
 - » Signature of the Laboratory Sample Custodian on the COC form to acknowledge receiving the samples;
- For samples being hand-delivered:
 - » Delivery of samples to the Laboratory Sample Custodian;
 - » Signature of the of the sampler relinquishing the samples; and
 - » Signature of the Laboratory Sample Custodian on the COC form to acknowledge receiving the samples.

The field sampling team will ship the coolers or boxes containing canister samples containing environmental samples to the laboratories identified for this project by commercial carrier. Samples will not be shipped to another laboratory without the permission of the Project Manager.

The COC document will be completed by the field sampler and provided for each sample cooler. When transferring the possession of samples, individuals relinquishing and receiving will sign, date, and note the time on the COC. Custody of samples must be continuous between parties, and time gaps must not be present. Each shipment of samples to the laboratory must have its own COC record with the contents of the shipment, method of shipment, name of courier, and other pertinent information written on the record. The original record accompanies the shipment, and the copies are kept with the field logbook and distributed to the Project Manager. A copy of the COC will be faxed or emailed to the laboratory and Project Manager on the same day of sample shipment. Freight bills, postal service receipts, and bills of lading will be retained as permanent documentation.

If a carrier is used to take samples between the sampler and the laboratory, the air bill tracking number must be written on the chain-of-custody. Samples will be shipped or transported within 24 hours of being collected and will arrive at the laboratory no later than 48 hours after sample collection.

8.5 LABORATORY CHAIN OF CUSTODY PROCEDURES

Laboratory custody procedures continue when the samples are received by the laboratory. When the samples arrive at the laboratory, the Laboratory Sample Custodian will sign the courier's air bill or bill of lading (unless hand-delivered) and will note the cooler temperature on the COC form. If the cooler temperature is greater than 4°C, where applicable, the Project Manager will be notified. If the samples were shipped, the courier's air bill number will be attached to the COC, and the air bill number will be written on the COC form. If the cooler arrives at the laboratory after hours, an external COC will be properly filled out and will accompany the cooler until the laboratory receives the cooler.

The Laboratory Sample Custodian's duties and responsibilities upon sample receipt will be to:

- Document receipt of samples by signing the record with the date and time of sample receipt;
- Note the cooler temperature on the COC form (where appropriate);

- Inspect sample shipping containers for the presence or absence of custody seals (only if shipped via overnight courier) and for container integrity;
- Sign the appropriate forms or documents, verify, and record the agreement or disagreement of information on sample documents and, if there are discrepancies, record the problem and notify the Project Manager;
- Assign a number for each sample upon receipt. That sample number will be placed on the sample label which will remain attached to the sample container;
- Log sample information into the laboratory sample tracking system;
- Label sample with a unique, sequential laboratory sample number; and
- Place samples in the walk-in cooler or sample storage area that is a secure, limited-access storage.

If QC samples have not been properly identified during sample collection, the Laboratory Project Manager will contact the Project Manager to assign QC samples prior to the start of sample analysis.

The laboratory will immediately contact the Project Manager if issues pertaining to sample condition or documentation are detected (*e.g.*, broken security seal; broken, open, or otherwise compromised sample containers; or COC information in disagreement with sample labels).

At the laboratory, the analysts will be required to log samples and extracts in and out of storage as the analysis proceeds. There must not be a lapse in the custody for the sample containers and exchanges of custody must be documented on the form. Samples will be returned to secure storage at the close of business. Care must be exercised to properly complete, date, and sign records needed to generate the data package.

Procedures to be followed by the laboratory include:

- Samples will be handled by the minimum number of people possible;
- The laboratory will set aside a secured sample storage area consisting of a clean, dry, refrigerated, isolated room;
- A specific person will be designated sample custodian. Incoming samples will be received by the custodian, who will indicate receipt by signing the COC form;
- The custodian will ensure samples that are heat-sensitive, light-sensitive, radioactive, or require special handling in other ways are properly stored and maintained prior to analysis;
- The analytical area will be restricted to authorized personnel only; and
- After sample analyses are complete, the analytical data will be kept secured and released to authorized personnel only.

8.6 FINAL EVIDENCE FILES

The final evidence file will be the central repository for documents that constitute evidence relevant to sampling and analysis activities as described in this QAPP. The Consultant is the custodian of the evidence file and maintains the contents of evidence files for the Brownfield Area, including relevant records, reported, logs, field notebooks, pictures, subcontractor reports, and data reviews.

Copies of the laboratory data packages will be stored by the laboratory for incorporation into the sample file. The Laboratory Project Manager will be responsible for laboratory data packages.

Upon completion of the analyses, the Project Manager will assimilate the field and laboratory data. In this way, the file for the samples will be generated. The final file for the sample will be stored and will consist of the following:

- Laboratory data packages, including summary and raw data from the analysis of environmental and QC samples, chromatograms, mass spectra, calibration data, work sheets, and sample preparation log;
- Chain-of-custody and sample collection records;
- Data validation reports;

- Field notebooks and data;
- Field collection report;
- Pictures and drawings;
- Progress and QA reports;
- Contractor and subcontractor reports; and
- Correspondence.

The evidence file must be maintained in a secured, limited access area until submittals for the project have been reviewed and approved and for a minimum of ten years past the submittal date of the final report.

9. ANALYTICAL METHOD REQUIREMENTS

9.1 ANALYTICAL METHODS

The analytical methods being utilized for the Brownfield Area Remedial Investigation activities are presented in **Table 1**. The laboratories will utilize the analytical methods and additional requirements listed in this QAPP. The most recent laboratory control limits for accuracy and precision will be used to evaluate the sample data. The QC requirements and corrective actions listed in **Tables 3-1 through 3-8**, which augment the method requirements, will be followed by the laboratory. In the event of an analytical system failure, the Laboratory Project Manager will identify the situation and provide corrective action guidance. The QAO will be notified and the situation will be documented in the data package.

QLs may only be achieved in an undiluted sample free of matrix interferences or of high concentrations of target analytes. Established QLs may not be achievable without impacting the instrument quality if matrix interferences are encountered or if high concentrations of target compounds are present. The Laboratory Project Manager and QAO will discuss these situations before the laboratory proceeds with sample analysis. Samples may be diluted only if analytes of concern generate responses in excess of the upper calibration range or linear range of the instrument.

Samples will undergo clean-up procedures applying appropriate USEPA methods for the following situations:

- For solid samples analyzed for semivolatile organic compounds (SVOCs) or polychlorinated biphenyls (PCBs) with QLs that are elevated above the project QLs due to matrix interferences;
- Gas chromatography peaks are not adequately separated to correctly identify target analytes; and
- Where matrix interference prevents accurate quantification and identification of target analytes.

The clean-up, extraction, and sample preparation methods will be listed in the data package.

If the laboratory has taken appropriate actions and matrix interferences prevent the laboratory from achieving the laboratory QLs, the QAO will be contacted as soon as the situation is identified. The Laboratory Project Manager will document in the data package case narrative how the laboratory demonstrated good analytical practices in order to attempt to achieve the specified QLs.

Additional requirements of the laboratory are:

- Blanks will not be subtracted from target analyte results;
- Results for solid samples will be reported on a dry weight basis; and
- If required, tentatively identified compounds (TICs) will be generated for VOC and SVOC analyses as described in Tables 3-1A and 3-2, respectively.

9.2 DETECTION LIMITS

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The QL is the lowest concentration that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operations.

The lowest initial calibration standard will establish the laboratory QLs for each analysis. The laboratory will report non-detected aqueous and solid sample results to the MDLs. For the remaining aqueous and solid data, results that are less than the QLs but greater than the MDLs will be reported by the laboratory using the “J” flag. The laboratory will report soil vapor sample results to the QLs. The QLs and MDLs for target analytes listed in **Tables 2-1 through 2-4** or the most recent MDLs and QLs will be reported by the laboratory on the sample result forms.

10. LABORATORY QA/QC PROCEDURES

A brief description of laboratory QA/QC analyses is presented in the following sections. **Tables 3-1 through 3-8** summarize the laboratory QC checks, frequency of analysis, control limits, and laboratory corrective actions for the analytical methods.

10.1 GC/MS TUNING

Tuning and performance criteria are established to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample-specific; conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

10.2 CALIBRATION

Compliance requirements for satisfactory instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of analysis, and continuing calibration and performance checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

10.3 BLANKS

Corrective action procedures are implemented for blank analyses if target compounds are detected at concentrations greater than the requirements presented in corrective action **Tables 3-1 through 3-8**. The criteria for evaluation of blanks apply to any blank associated with a group of samples. If problems with a blank exist, data associated with the project must be carefully evaluated to determine whether or not there is an inherent variability in the data for the project, or if the problem is an isolated occurrence not affecting other data.

A method blank is an analyte-free blank that undergoes the preparation procedures applied to a sample. These samples are analyzed to examine whether sample preparation and analysis techniques result in sample contamination. The laboratory will prepare and analyze a method blank with each group of a maximum of 20 samples that are extracted, digested, or analyzed at the same time.

A reagent blank consists of laboratory analyte free water and any reagents added to a sample during analysis only, or straight solvent. This type of sample is analyzed to evaluate whether contamination is occurring during analysis of a sample. A reagent blank is usually analyzed following highly contaminated samples to assess the potential for cross-contamination during analysis.

For soil vapor samples, an instrument blank is an unused, certified canister that has not left the laboratory that undergoes the preparation procedures applied to a sample. These samples are analyzed to monitor target analyte carryover on the instrument when necessary.

10.4 INTERNAL STANDARDS PERFORMANCE

Internal standards, which are compounds not found in environmental samples, will be spiked into samples, blanks, MS/MSDs, matrix spike blanks (MSBs), and laboratory control samples (LCSs) at the time of sample preparation for applicable methods. Internal standards will meet the criteria specified in the corrective action tables.

10.5 SURROGATE EVALUATION

Accuracy and matrix biases for individual samples are monitored for organic analyses using surrogate additions for applicable methods. Surrogates are compounds similar in nature to the target analytes; the surrogates are spiked into environmental samples, blanks, and quality control samples prior to sample preparation for organic analyses.

The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. The review and validation of data based on specific sample results is frequently subjective, since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems.

10.6 LABORATORY CONTROL SAMPLES OR MATRIX SPIKE BLANKS

The LCSs or MSBs are standard solutions that consist of known concentrations of the complete list of target analytes spiked into laboratory analyte-free matrix. They are prepared or purchased from a certified manufacturer from a source independent from the calibration standards to provide an independent verification of the calibration procedure.

These QC samples are prepared and analyzed following the same procedures employed for environmental sample analysis to assess method accuracy independently of sample matrix effects. The laboratory prepares and analyzes a LCS or MSB with each group of 20 samples of similar matrix that are extracted, digested, or analyzed at the same time. Percentage recoveries are evaluated to assess the efficiency of the preparation and analysis method independent of environmental sample matrix effects.

10.7 MS/MSD AND LABORATORY DUPLICATE SAMPLES

The MS/MSD and laboratory duplicate analyses are performed on environmental samples at a frequency of one for every 20 samples of similar matrix for each analysis type. The MS/MSD samples are spiked at the laboratory with the complete list of target analytes. The MS/MSD and laboratory duplicate data are generated to evaluate precision and accuracy of the analytical method with respect to sample matrices.

10.8 ANALYTE IDENTIFICATION AND QUANTITATION

The objective of the qualitative criteria is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). The identification criteria can be applied much more easily in detecting false positives than false negatives. Negatives or non-detected compounds, on the other hand, represent an absence of data and are much more difficult to assess.

The objective for quantitative requirements is to maximize the accuracy of data and sensitivity of the instrument. Samples are analyzed undiluted to maximize sensitivity unless sample screening indicates the presence of high concentration target analytes. Samples are reanalyzed at the appropriate dilution when concentrations exceed the linear calibration range to maximize accuracy.

Interferences will be identified and documented. Samples are diluted only if analytes of concern generate responses in excess of the linear range of the instrument.

10.9 CORRECTIVE ACTION

Generally, the following corrective actions are taken by the laboratory. When calibration, instrument performance, or blank criteria are not met, the cause of the problem is located and corrected, and the analytical system is recalibrated. Sample analysis does not begin until calibration, instrument performance, and blank criteria are met. The analyses of these samples are investigated, when MS, reference standard, or duplicate analyses are out of control. Depending on the results of the overall QC program for the sample set, the data may be accepted, accepted with qualification, or determined to be unusable.

The QC analysis will be re-prepared and reanalyzed if data are determined to be unusable through the application of the corrective actions listed in this QAPP. If QC criteria are met upon reanalysis, only the new results are reported. If QC criteria are still not met upon reanalysis, both sets of sample results will be reported, and the QAO will be notified of the situation at the time of sample analysis.

If problems arise with procedures or guidelines set forth herein, the QAO and Project Manager, in conjunction with NYSDEC, will formulate an appropriate corrective action.

10.10 CONTROL LIMITS

Control limits are either listed in the appropriate methods or are established separately for respective matrix types for surrogate, LCS, MSB, MS/MSD, and duplicate analyses. Control limits can be considered action limits. The laboratory-established limits are defined as ± 3 standard deviations of the mean and correspond to 99.7% confidence limits of a normal distribution curve. Unless previously established, the laboratory will establish control limits for each analyte of concern using a minimum of 20 data points. The control limits are updated by the laboratory on an annual basis. Therefore, the most recent control limits will be used to evaluate data.

10.11 PREVENTATIVE MAINTENANCE

Preventative maintenance procedures are carried out on laboratory equipment in accordance with the laboratory procedures. Maintenance activities are recorded in laboratory documents.

10.12 DATA ASSESSMENT PROCEDURES

The procedures employed by the laboratory to assess the quality of data generated in the laboratory include, but are not limited to, the following:

- Determination of analytical precision per method;
- Determination of analytical accuracy per method;
- Determination of analytical completeness; and
- Determination of MDLs and QLs.

Data quality reviews by analysts, supervisors, managers, laboratory directors, and QA personnel contribute to the total process.

Precision and accuracy may be assessed utilizing control charts. Control charts will consist of line graphs that provide a continuous graphic representation of the state of each analytical procedure. The standard deviation of the mean of the QC measurement is calculated, and the upper and lower warning limits are set at ± 2 standard deviation units. The upper and lower control limits are set at ± 3 standard deviation units. Acceptable data are realized when results fall between the lower and upper warning limits. If the QC value falls between the control limit and the warning limit, the analysis should be reviewed as possibly out of control.

In general, the accuracy of the methods will be determined by spiking the sample matrix with the analyte and analyzing reference materials with known concentrations. The spiking levels will be selected to reflect the concentration range of interest. Percent recoveries of the spikes and reference materials will be calculated and compared to the established limits.

The precision of the methods will be determined by the analysis of MSD, laboratory duplicate, and field duplicate samples. The precision will be evaluated by calculating the relative percent deviation (RPD) for the duplicates. Relative percent deviation calculations will be compared to the established limits.

The definitions and equations used for the assessment of data quality are discussed below.

- Accuracy – Accuracy is a measure of the nearness of an analytical result, or a set of results, to the true value. It is usually expressed in terms of error, bias, or percent recovery (%R). Normally, the term accuracy is used synonymously with percent recovery. It describes either the recovery of a synthetic standard of known value, or the recovery of a known amount of analyte (spike) added to a sample of known value. The %R or accuracy can be calculated by using:

$$\%R = (\text{observed value}/\text{true value}) \times 100 \quad (\text{for standards})$$

$$\%R = [((\text{conc. spike} + \text{sample conc.}) - \text{sample conc.} \times 100)]/\text{conc. spike} \quad (\text{for spikes})$$

- Precision – Precision refers to the agreement or reproducibility of a set of duplicate results among themselves without the assumption of any prior information as to the true result. It is usually expressed in terms of the percent difference (%D) or RPD. The %D is calculated by using:

$$\%D = (\text{larger SR} - \text{smaller SR} \times 100) / \text{smaller SR}$$

where SR = sample result

The RPD is calculated by using:

$$\text{RPD} = (\text{OSR} - \text{DSR} \times 100) / ((\text{OSR} + \text{DSR}) / 2)$$

where OSR = original sample result and DSR = duplicate sample result.

- Average – The average or arithmetic mean (X) of a set of n values (Xi) is calculated by summing the individual values and dividing by n.

$$X = (\sum_{i=1 \text{ to } n} X_i) / n$$

- Range – The range (R_i) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X₂, X₁), the range (R_i) of the duplicates and the average range (R) of the n sets are calculated by the following equations.

$$R_i = X_2 - X_1$$

$$R = \sum_{i=1 \text{ to } n} R_i / n$$

- Standard Deviation and Variance – The standard deviation (S) of a sample of n results is the most widely used measure to describe the variability of a data set. It is calculated by using the following equation.

$$S = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}} \quad n \text{ to } i-1$$

where X = average of the n results and i = value of result

Normally, $X \pm S$ will include 68% and $X \pm 2S$ will include approximately 95% of normally distributed data.

The variance is equal to S^2 . The percent relative standard deviation (%RSD) or coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100 as follows.

$$\text{CV} = 100S/X$$

The Laboratory Project Manager, with individual laboratory group leaders, will identify any data that should be rated as "unacceptable" based on the assessment of the QA/QC criteria and will notify the QAO.

11. FIELD QA/QC PROCEDURES

A brief description of field QA/QC samples is presented in the following sections.

11.1 FIELD DUPLICATE SAMPLES

Collection of field duplicate samples provides for the evaluation of the laboratory's precision performance by comparing analytical results of two samples from the same location. They are also collected to evaluate field sample collection precision procedures. Samples are collected from one location and sent to the laboratory blind (with two different sample identifications). Duplicates of aqueous samples are obtained by alternately filling samples containers from the same sampling device for each parameter. Duplicates of aqueous samples submitted for VOC analysis from monitoring wells are filled from the same bailer full of water whenever possible and are the first set of containers filled. Duplicates of solid samples submitted for VOC analysis are obtained from discrete locations without mixing. Duplicates for the remaining analyses require homogenization by filling a decontaminated stainless steel tray or bowl with the sample and mixing it with a decontaminated stainless steel instrument. The mixed sample is divided in half and scooped alternatively from each half to fill the sample container. One field duplicate sample will be collected for every 20 samples of similar matrix for each analysis type. If less than 20 samples are collected during a sampling event, one field duplicate sample will be collected for that sample matrix.

11.2 MS/MSD AND DUPLICATE SAMPLES

The MS/MSD samples are duplicate samples that have spiking solutions added at the laboratory during sample preparation and are considered identical to the original sample. The %R of the spiked amount indicates the accuracy of the extraction as well as interferences caused by the matrix. The RPDs between spike sample recoveries will indicate the precision of the data. Duplicates of aqueous samples are obtained by alternately filling samples containers from the same sampling device for each parameter. One MS/MSD sample set will be collected for every 20 of similar matrix for each analysis type. If less than 20 samples are collected during a sampling event, one MS/MSD sample set will be collected for that sample matrix.

Duplicate samples may be prepared for inorganic analyses as an alternative to MSD samples. Duplicate samples are analyzed within the same batch as the environmental samples and to determine precision of the analytical method with respect to sample matrices. For inorganic analyses, duplicate analyses may be performed on samples at a frequency of one for every 20 samples of similar matrix for each analysis type. If less than 20 samples are collected during a sampling event, one inorganic duplicate sample may be collected for that sample matrix.

11.3 FIELD/EQUIPMENT BLANKS

Field/equipment blanks will consist of samples of analyte-free water that are passed through and/or over decontaminated sampling equipment. These blanks will not be required if dedicated sampling equipment is utilized. The field/equipment blank samples will be subject to the same analyses as the environmental samples. One field/equipment blank will be collected for every 20 samples or one per matrix for less than 20 samples for each analysis type.

11.4 TRIP BLANKS

Trip blanks will be prepared following the same procedure used for the other VOC preservation containers and will contain analyte-free solvent, where applicable. The trip blank will undergo shipment from the sampling location to the laboratory in coolers with the environmental samples to be analyzed for VOCs. Trip blanks will be analyzed for VOCs to determine if contamination has taken place during sample handling and/or shipment. Trip blanks will be utilized for samples at a frequency of one each per shipment sent to the laboratory for VOCs.

11.5 TEMPERATURE BLANKS

Temperature blanks will consist of vials of water that have undergone shipment from the sampling location to the laboratory in coolers with the environmental samples to be analyzed for the sampling program. The temperature of these blanks will be measured at the laboratory upon receipt of the sample cooler to verify compliance with the cooler temperature requirement.

12. INSTRUMENT/EQUIPMENT TESTING AND MAINTENANCE

Preventative maintenance procedures will be carried out on field equipment by personnel in accordance with the procedures outlined in the manufacturers' specifications and/or equipment manuals. Maintenance activities involving field equipment will be recorded in the field logbook. Field equipment will be checked by qualified field representatives prior to being used in the field. Problems encountered while operating the instrument will be documented in the field logbook. If problems with operation of equipment are detected or should the equipment require service, the equipment will be returned and a qualified technician will perform the maintenance required. Use of the equipment will not be resumed until the problem is resolved.

Analytical laboratory instrumentation that will be used on this project has been documented and is on file with the laboratory. An equipment form will be prepared for each new purchase, and old forms will be removed from the instrument area and filed when an instrument is replaced.

The laboratory will be required to maintain an equipment form detailing both preventative maintenance activities and the required QA testing and monitoring. In the event an instrument does not perform within the limits specified on the monitoring form, the Laboratory Project Manager will be notified and a decision will be made as to the corrective action necessary. The corrective action procedure will be documented in the instrument log. If repair is necessary, the instrument will not be used for analyses until repairs are completed and the instrument tested. Repairs made to the instrument will be documented in the instrument logbook. Required QA/QC testing and monitoring will be completed prior to the resumption of sample analysis.

Routine maintenance is performed to keep laboratory instruments running under optimum conditions and to reduce instrument malfunction. Specific preventative maintenance programs outlining required maintenance procedures and their application frequencies are incorporated in laboratory SOPs for each methodology.

Minimally, field and laboratory instruments will undergo maintenance on an annual basis and when calibration, blanks, or QC analyses, indicate that maintenance is necessary to correct or improve system performance. Maintenance, whether performed by laboratory personnel or manufacturer, is documented as an entry in the appropriate log. Log entries will include the reason for maintenance, maintenance performed, date, and initials of person in charge during maintenance.

The operating temperatures for refrigerators, coolers, ovens, and water baths will be monitored by the laboratory daily. The analyst will record the following information in either a bound logbook, or in electronic format: equipment identification, temperature reading, date and time of reading, and analyst initials.

13. CALIBRATION AND FREQUENCY

13.1 FIELD EQUIPMENT CALIBRATION

Field equipment used during the Brownfield Area Remedial Investigation activities will be calibrated in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment to be used for the field sampling will be examined to confirm that it is in good operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to confirm that the maintenance requirements are being observed.

In general, instruments will be calibrated daily prior to use and will be recalibrated as required. All calibration procedures performed will be documented in the field logbook. Calibration will be performed at the intervals specified by the manufacturer. If an internally calibrated field instrument fails to meet calibration procedures, it will be returned to the manufacturer for service.

13.2 LABORATORY EQUIPMENT CALIBRATION

Proper calibration of laboratory analytical instrumentation is essential for the generation of reliable data that meet the project's DQOs. Analytical instrument calibration is monitored through the use of control limits that are established for individual analytical methods. Calibration procedures to be followed are specified, in detail, in the analytical methods. These procedures specify the type of calibration, calibration materials to be used, range of calibration, and frequency of calibration. The calibration requirements listed in the QC requirements and corrective actions in **Tables 3-1 through 3-8**, which augment the method requirements, are to be followed by the laboratory.

The laboratory will be responsible for proper calibration and maintenance of laboratory analytical equipment. The following subsections present general calibration procedures outlined in the analytical methods.

13.2.1 Organics

Before the GC/MS is calibrated for organics analysis, the mass calibration and resolution of the instruments are verified using 4-bromofluorobenzene (BFB) for VOCs and decafluorotriphenylphosphine (DFTPP) for SVOCs. The performance check analysis must meet the criteria referenced in the analytical method and the QAPP. The system must be verified every 12 hours of analysis and when the instrument performance check solution fails to meet criteria. Samples are not analyzed until performance check analysis criteria are met.

For organics analysis, an initial five-point calibration is performed for the target compounds prior to start-up and whenever system specifications change or if the continuing calibration acceptance criteria have not been met. The lowest calibration standard establishes the QL concentration. The method criteria, including relative response factors (RRFs) and %RSD of specific compounds, must meet established criteria as specified in the method and the QAPP. If these parameters fail to meet criteria, corrective actions must be implemented and the initial calibration must be repeated.

13.2.2 Metals and Inorganics

Instrument calibration for metal analyses is performed daily. At a minimum, a two-point calibration for inductively coupled plasma (ICP) analyses is performed. Five point calibrations are performed for cold vapor atomic absorption instruments. For non-ICP analyses, the lowest calibration standard establishes the QL concentration. The calibration curves must have correlation coefficients greater than or equal to 0.995. Calibration verification is monitored by analyzing calibration verification standards and calibration blanks following calibration and meet established criteria as specified in the method and the QAPP. To verify inter-element and background corrective factors for ICP analysis, interference check samples (ICSA and ICSAB) must be analyzed and meet established criteria as specified in the method and the QAPP.

13.2.3 Thermometers

On an annual basis, thermometers are calibrated using a certified thermometer with a traceable calibration certificate. General purpose thermometers are calibrated at three temperatures encompassing the entire operating range of the thermometer and labeled with correction factors. Thermometers are calibrated at room temperature, at ice point, at the boiling point, or above the boiling point. The maximum allowable deviation from the certified thermometer is 2°C. Any thermometer exceeding this tolerance is to be discarded.

13.3 STANDARDS AND SOLUTIONS

The use of standard materials of a known purity and quality is necessary for the generation of reproducible data. The laboratory will monitor the use of laboratory materials including solutions, standards, and reagents. Reagent solutions used for quantitation purposes must be American Chemical Society (ACS)-grade or better. Standards prepared or purchased must be traceable to National Standards of Measurement. Standards should be traceable by lot number to a certificate of analysis, which is on file at the laboratory. Standards and standard solutions are verified prior to use. This verification may be in the form of a certification of analysis from the supplier or by comparison to a standard curve or another standard from a separate source. Standards are routinely checked for signs of deterioration, including unusual volume changes, discoloration, formation of precipitates, or changes in analyte response.

Solvent materials are also verified prior to use. Each new lot of solvent is analyzed to verify the absence of interfering constituents. Reagent and method blanks are routinely analyzed to evaluate possible laboratory-based contamination of samples.

A records book will be kept for standards and will include the following information:

- Material name;
- Control or lot number;
- Purity and/or concentration;
- Supplier/manufacturer;
- Receipt/preparation date;
- Recipient/preparer name; and
- Expiration date.

These records will be checked periodically as part of the laboratory's internal laboratory controls review.

13.4. CALIBRATION RECORDS

Calibration data will be kept for each instrument that requires calibration. The data will contain a record of activities associated with QA monitoring and instrument repairs. These records will be checked during periodic equipment review and internal and external QA/QC audits.

14. INSPECTION REQUIREMENTS FOR SUPPLIES

The use of standard materials of a known purity and quality is necessary for the generation of reproducible data. The laboratory will monitor the use of laboratory consumable materials including solutions, standards, and reagents as described in **Section 13**.

Solvent materials are also verified prior to use. Each new lot of solvent is analyzed to verify the absence of interfering constituents. Reagent and method blanks are routinely analyzed to evaluate possible laboratory-based contamination of samples.

The sample containers used for this project will be supplied by the laboratory. The containers will be pre-cleaned sample containers that will be purchased from a USEPA-certified manufacturer (I-Chem 200 or equivalent container) or are cleaned using USEPA protocols. The soil vapor canisters will be individually or batch certified-clean by the laboratory, and documentation will be provided in the data package.

15. DATA ACQUISITION REQUIREMENTS

Non-direct measurement data, in the form of historical data from previous investigations, may be utilized for this Investigation.

16. DATA DELIVERABLES

For data to be scientifically valid, legally defensible, and comparable, valid procedures must be used to prepare this data. The laboratory will provide the data in an EDD format that complies with the NYSDEC's requirements. The data packages will be reported by the laboratory in NYSDEC Category B deliverables format. The laboratory will also provide the complete data packages in electronic format.

NYSDEC requires that analytical data be submitted in electronic format that can be uploaded to the NYSDEC's EQuIS database. Therefore, all data submittals from the laboratory will be submitted as an Electronic Data Deliverable (EDD) in the EQuIS 4-file format, as well as in the NYSDEC export format. It is also expected that the laboratory will use the EQuIS Data Processor checking device prior to submittal of the EDD and provide a copy of the EDP error report with the analytical results. More information regarding the NYSDEC electronic data submittals can be found at <http://www.dec.ny.ny.gov/chemical/62440.html>. A quick-start guide for data providers can be found on the NYSDEC website.

17. ASSESSMENT AND RESPONSE ACTIONS

17.1 PERFORMANCE AND SYSTEMS AUDITS

17.1.1 Performance Audits

At the discretion of the Project Manager, field and laboratory performance audits consisting of on-site performance evaluations may be performed during the field program and during the laboratory analysis program. These audits will evaluate the adherence of the field and laboratory programs to the QA program outlined in this QAPP. The protocols used to conduct the audits may be found in the following sections. Acceptance criteria used in determining the need for corrective action will be those criteria defined in this QAPP. The laboratory's SOPs and QAM will be consulted where acceptance criteria are not defined for laboratory procedures and analytical methods. The results of the field and laboratory audits will be documented and submitted to the Project Manager. These reports and any corrective actions that are implemented as a result of the audits will be included in the project report.

17.1.2 Laboratory Audit Protocol

The laboratory audit will investigate factors that may affect the quality of the analytical results.

The QA/QC criteria specified in this QAPP and the analytical methods must be adhered to. An on-site evaluation will be performed by the QAO or her designee. The areas of concern of the laboratory audit will include:

- Implementation of a scientifically sound QA/QC program addressing precision, accuracy, reproducibility, comparability, completeness, and blank contamination;
- Sufficient documentation and recordkeeping for technical personnel external to the laboratory to recreate each analytical event; and
- Compliance with the project requirements for laboratory analysis.

The specific parameters to be evaluated include:

- Data comparability;
- Calibration and quantitation;
- QC execution;
- Out-of-control events;
- SOPs;
- Sample management;
- Record keeping;
- Instrument calibration records;
- Other analytical records;
- QC records;
- Corrective action reports;
- Maintenance logs;
- Data review;
- MDLs and QLs;
- QC limits; and
- Analytical methods

17.1.3 Field Audit Protocol

The purpose of a field audit is to identify whether the systems and procedures described in the QAPP are operational in the field and contributing to the production of accurate and defensible analytical results. An on-

site evaluation will be performed by the Field Team Leader or a designee. The areas of concern in a field audit include:

- Sampling procedures
- Decontamination of sampling equipment, if applicable
- COC procedures
- SOPs
- Proper documentation of field methods

17.2 SYSTEM AUDITS

Routine laboratory and field performance will be monitored through the analysis of field and laboratory blanks, spiked samples, laboratory control samples, laboratory and field duplicates, and performance evaluation samples. The Laboratory Project Manager, in conjunction with the QAO and Project Manager, will formulate corrective actions in the event that QC limits specified in this document are exceeded. The results of the system audits will be documented in the project report.

17.3 CORRECTIVE ACTIONS

Corrective action procedures will be implemented based on unacceptable audit results or on detection of unacceptable data during data review performed by the laboratory and the Project Manager.

Two types of audits may be performed during the Brownfield Area Remedial Investigation activities. The data generation process will be audited by assessing adherence to control limits and by performing a laboratory audit, if requested by the Project Manager. The field program will be audited by assessing adherence to the procedures outlined in this document via analysis of field QC samples and performing an on-site field audit, if requested by the Project Manager. If required, corrective action procedures will be developed on a case-by-case basis. The enacted corrective actions will be documented in the appropriate notebook, log, or case file. File and laboratory personnel are encouraged to discuss specific issues and proposed corrective actions with the QAO.

The Field Team Leaders will be responsible for field QA. Field sampling excursions discovered during field sampling will be documented in the field logbook, and immediate corrective action will be taken. For problems or situations that cannot be solved through immediate corrective action, the Field Team Leaders will immediately notify the Project Manager, who will investigate the situation and determine who will be responsible for implementing the corrective action. Corrective action will be implemented upon approval by the Project Manager. The Project Manager will verify that the corrective action has been taken, appears effective, and at a later date, verify that the problem has been resolved. The successfully implemented corrective action will be documented in the field logbook by the Field Team Leaders. Deviations from the QA protocol in this QAPP must be justified, approved by the Project Manager, and properly documented.

The corrective actions that will be taken by the laboratory were described previously in **Section 10.9** of this QAPP.

18. QA REPORTS TO MANAGEMENT

Following completion of the Brownfield Area Remedial Investigations, the Project Manager will prepare a Remedial Investigation Report. This report will present and discuss the field and analytical data collected during the investigation. The data validation report will be submitted as an appendix to the Remedial Investigation Report.

The data validation report will be prepared under the direction of the QAO and Project Manager. The report will include data usability, and the results of any laboratory and field audits.

19. DATA REVIEW AND MANAGEMENT

19.1 DATA PRODUCTION, HANDLING, AND REPORTING

19.1.1 Laboratory Documents

Specific laboratory procedures and instrumentation can be found in the SOPs and QAM for the laboratories, which are available upon request. The general data production and reporting procedures described below will be employed at the laboratory.

19.1.2 Data Reduction

Data reduction consists of manual and computer data reduction procedures and calculations. Computer data reduction procedures and calculations will be checked manually by the laboratory to verify that compound identification and quantitation adhere to method requirements. The laboratory will be responsible for maintaining a listing of computer-based data reduction programs and SOPs for data reduction. Sample preparation and extraction records will be used to document sample preparation information (*e.g.* preparation weights, volumes, and reagents). Instrument analytical sequence records will also be maintained for each instrument. Qualitative identification and quantitation of organic and inorganic analytes will be performed by experienced analysts in accordance with analytical method requirements.

19.1.3 Laboratory Data Review

Analytical results are generally entered into the laboratory computer system by the analyst, independently reviewed by another analyst or supervisor experienced in the method, and approved by the Laboratory Project Manager. The following are requirements that are generally examined as part of this review:

- Initial calibration criteria were met. Standards in the calibration curve covered the expected concentration ranges of the samples, including the QL;
- Initial and continuing calibrations met the acceptance criteria defined in the method standard procedure;
- Sample results fell within the range of the standard curve;
- For GC/MS methods requiring internal standards, retention times and area responses were evaluated against limits established by the daily calibration;
- Method blanks were processed with each analytical batch, and no detectable levels of contamination were identified;
- The MS/MSDs were performed at the required frequency, and recoveries were within acceptable control limits;
- Duplicate analyses were performed at the required frequency, and results were within the control limits;
- The LCS analyses were performed with each analytical batch, and the results obtained were within control limits;
- For organic compound analyses, surrogate spike recoveries were within control limits;
- Compounds identified by GC/MS were manually rechecked by comparison with the data system library for both target compounds and tentatively identified compounds. Retention times and ratios of fragmentation were verified;
- Calculations have been accurately performed;
- Reporting units are correct;
- Data for the analysis provide a complete audit trail; and
- The QLs comply with data quality requirements.

The analyst's supervisor will check a minimum of 10% of the data back to raw data in the secondary review. A data package will be generated when required analyses on the samples in a project are complete, entered, and

reviewed. The data package will be forwarded to the assigned Laboratory Project Supervisor or designee for review. The data package will then be reviewed for the following items (at a minimum):

- The QC data will be reviewed to identify whether or not internal specification and contract requirements have been met; and
- Non-conformance reports, if any, will be reviewed for completion of corrective actions and their impact of results. The QC requirements and corrective actions listed in **Tables 3-1 through 3-8** in this QAPP will be referenced in the laboratory review process. Non-compliance and corrective action procedures will be documented in the case narrative.

The data package requires the signature of the Laboratory Project Supervisor or designee. Electronic data are copied onto storage media, inventoried, and stored off-site in a secure facility, or within locked cabinets on-site. This data archive system is maintained for a minimum of five years.

Following final review, two hardcopies and one electronic version of the data package will be transmitted to the Project Manager. The full deliverable data packages will document sample preparation, extraction, and analysis and include raw data and logs associated with the analyses performed for the Brownfield Area Remedial Investigation. All data deliverables from each laboratory must be paginated in ascending order. The data packages will be provided within four weeks of receipt of the last sample at the laboratory for each sampling event.

19.1.4 Data Management

Definitive data will be generated in the laboratory, and screening data will be generated in the field as described in **Section 3**. The laboratory-generated data will be entered into the laboratory database management system and presented in data packages. The laboratory will perform the data review process described in **Section 10**.

Analytical and field data will be managed in a relational DBMS. Laboratory analytical data will be provided in EDD format for direct upload into the DBMS; associated field data will be entered into the DBMS using the appropriate electronic upload format. Data validation qualifiers will be entered into the DBMS manually and checked independently. The DBMS will be used to provide custom data queries and tables to support data analysis and report preparation; data tables containing the validated sample data will be included in their corresponding investigation report.

Records will be incorporated into the final project files. Field logs, data packages, and records will be included in the project file that will be archived for a period of ten years.

20. DATA VALIDATION AND USABILITY

20.1 SCOPE OF VALIDATION

Data validation will be performed on the data collected during the Brownfield Area Remedial Investigation utilizing USEPA Region II validation guidance and NYSDEC DUSR guidance (NYSDEC, 2010) as described in the following section. Upon request by the data validator, the laboratory will provide additional or supplemental information within three working days of the request.

20.2 VALIDATION PROCEDURES

Data Validation is a process of determining the suitability of a measurement system for providing useful analytical data. Data validation is essentially a three-step process in which the analytical data's QA/QC information is first compared to a series of QA/QC criteria. Based on the results of this comparison, the analytical data are then assigned qualifiers, which provide an indication of the data's usability. Finally, an overall evaluation of the data's usability is performed.

Full validation will be performed for 100% of the samples for each matrix and each analysis type, consisting of a review of data summary forms and supportive raw analytical data provided in the data packages.

Utilizing the DUSR process as guidance, the following questions will be considered during the validation:

1. Is the data package complete as defined under the requirements for the most current DEC ASP Category B or USEPA Contract Laboratory Program (CLP) deliverables?
2. Have the holding times been met?
3. Do all the QC data: blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, duplicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
4. Have the data been generated using established and agreed upon analytical protocols?
5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
6. Have the correct data qualifiers been used?
7. Have any exceedances been specifically noted in the report?

The analytical data generated for this investigation will be evaluated using the analytical methods utilized by the laboratories (as presented in this QAPP), the QA/QC requirements listed in **Tables 3-1 to 3-8** (where applicable for each method), and professional judgment.

Data affected by excursions from the QA/QC criteria will be qualified using the following USEPA Region II data validation guidance documents or the most current documents and professional judgment.

- USEPA. 2006c. Reviewed 2009. *USEPA Region II Evaluation of Metals Data for the CLP Program, SOP HW-2 Revision 13*. New York, NY.
- USEPA. 2006d. Reviewed 2009. *USEPA Region II Validating Volatile Organic Compounds by SW-846 Method 8260B, SOP HW-24 Revision 2*. New York, NY.
- USEPA. 2006e. Reviewed 2009. *USEPA Region II Data Validation SOP of Organochlorine Pesticides by Gas Chromatography SW-846 Method 8081B, SOP HW-44 Revision 1*. New York, NY.
- USEPA. 2006f. Reviewed 2009. *USEPA Region II Data Validation SOP of PCBs by Gas Chromatography SW-846 Method 8082A, SOP HW-45 Revision 1*. New York, NY.
- USEPA. 2006g. Reviewed 2009. *Validating Volatile Organic Analysis of Ambient Air in Canister by Method TO-15. SOP HW-31, Revision 4*. Albany, NY.

- USEPA. 2009a. Reviewed 2009. *USEPA Region II Validating Semivolatile Organic Compounds by SW-846 Method 8270, SOP HW-22 Revision 4*. New York, NY.

These validation guidelines will be modified to reflect the QA/QC criteria established in this QAPP and the analytical methods utilized by the laboratories.

Data validators will be responsible for reviewing the QC parameters as listed below. For full validation, data validators will recalculate approximately 10% of the sample results using raw data and review approximately 10% of the raw data to verify that target analyte identification was performed correctly and transcription errors are not present.

Data quality will be evaluated using current laboratory control limits as provided in the data packages and data will be qualified based on excursions. Data validators will check corrective action reports and results of reanalysis if available. Corrective actions implemented by the laboratory will be evaluated during the validation process.

In accordance with the USEPA guidance and utilizing professional judgment, the following qualifiers will be used in the data validation:

- "R" Indicates that the QL or sample result is determined to be unusable due to a major deficiency in the data generation process. The data should not be used for any qualitative or quantitative purposes.
- "U" Indicates that the analyte was analyzed for, but a concentration was not detected. The sample QL is reported. This qualifier is also used in the validation process to signify that the detection limit of an analyte was revised due to blank contamination.
- "J" Indicates that the concentration should be considered approximate. This qualifier is used when the data validation process identifies a deficiency in the data generation process. This qualifier is also applied by the laboratory when the analyte concentration is greater than the MDL but less than the QL. In the latter case, the identification of the analyte is not in question but the quantitation of the analyte concentration may be uncertain.
- "UJ" Indicates that the analyte was analyzed for, but a concentration was not detected. The sample QL is reported and should be considered approximate. This qualifier is used when the data validation process identifies a deficiency in the data generation process.
- "JN" Indicates that there is presumptive evidence that the analyte is present, but it has not been confirmed due to confirmation excursions.

The following guidelines will be used regarding the assignment of qualifiers and the evaluation of data. The data quality evaluation results in only one type of qualifier ("U", "J", "UJ," or "R") for each analyte. In a case when several qualifiers are applicable for the same analyte, the cumulative effect of the various QA/QC excursions is employed in assigning the final data qualifiers. For example, the final data qualifier is the "R" qualifier if a sample result is affected by low surrogate recoveries, for which the "UJ" qualifier is applied, but low MS/MSD recoveries result in the rejection of the sample result (application of the "R" qualifier).

The following parameters will be included in the full validation for organic and inorganic analyses, where applicable for each analysis method, unless otherwise noted:

- QAPP compliance;
- COC records;
- Sample collection and sample preservation;
- Canister evaluations;
- Percent solids;
- Holding times;
- GC/MS tuning criteria;

- Instrument performance;
- Calibration;
- Analytical sequence;
- Blank analysis;
- Surrogate recovery;
- Recovery standard analysis;
- MS/MSD analysis;
- Laboratory duplicate analysis;
- Field duplicate analysis;
- LCS or MSB analysis;
- ICP interference check sample analysis;
- ICP serial dilution analysis;
- Internal standards performance;
- Target analyte identification, quantitation, and QLs;
- Confirmation analysis; and
- Deliverables and documentation completeness.

Unless requested, TICs for VOC and SVOC analyses will not be evaluated as part of the validation process.

20.3 DATA USABILITY EVALUATION

Based on the QA/QC information review and the qualifiers assigned to the analytical data, an overall evaluation of the data's usability will be performed. Data usability is defined as the percentage of data that remains unqualified or is qualified as approximate or non-detected due to blank contamination, divided by the data reported by the laboratory times 100. The percentage usability excludes the data qualified as rejected due to major QA/QC excursions. The non-usable data are defined as the percentage of the data qualified as rejected divided by the data reported by the laboratory times 100. The data usability will be provided for each the complete data set for this project.

The data usability evaluation considers the data parameters of precision, sensitivity, accuracy, representativeness, comparability, and completeness, which are described as follows:

- Precision is evaluated through the review of field duplicate samples, laboratory duplicates, and MS/MSD samples;
- Sensitivity is evaluated through the review of QLs;
- Accuracy is evaluated through the review of MS/MSD recoveries, MSB recoveries, internal standards, surrogate recoveries, LCS recoveries, calibration, instruction performance check, ICP interference check analysis, and ICP serial dilutions;
- Representativeness is evaluated through the review of holding times, sample preservation and preparation, blank analysis, and target compound identification and quantification;
- Comparability is evaluated through the review of the analytical methods and reporting procedures for consistency; and
- Completeness is defined as the overall percentage of sample results that are determined to be usable.

20.4 DATA USABILITY SUMMARY REPORT

The DUSR will contain separate QA sections in which data quality information collected during the investigation is summarized. The DUSR will include the following:

- Guidelines used to evaluate the data;
- Data qualifiers applied to sample results;
- Summary of samples collected and analyses performed;
- Narrative that identifies major and minor analysis excursions detected for each parameter evaluated for each analysis;
- Additional issues and information that may be beneficial to the data user are discussed;
- Data summary forms; and
- Data usability.

The DUSR will be prepared by the QAO, or his or her designee. The QAO or designee will be independent of the laboratory performing the analyses, and independent from any direct involvement with the project (e.g. Project Manager or property owner).

21. RECONCILIATION WITH USER REQUIREMENTS

Sample results from the Brownfield Area Remedial Investigation will be reviewed by the Project Manager. Data usability with respect to the DQOs and data uses will be compared to the project requirements. Samples will be recollected at the discretion of the Project Manager in the event that the completeness objective of 95% is not achieved due to major QC deviations in the sample analysis process.

REFERENCES

AWWA, APHA, and WEF. 1998. *Standard Methods for the Examination of Water and Wastewater, 20th Edition*. Washington, D.C.

NYSDEC. 2010. *DER-10 Technical Guidance for Site Investigation and Remediation*. Albany, NY.

USEPA. 1988. *Determination of Total Organic Carbon in Sediment*, Region II, Environmental Services Division, Monitoring Management Branch, Edison, New Jersey.

USEPA. 1999. *Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*. Cincinnati, OH.

USEPA. 2004. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, 3rd Edition, Update IIIB*. Washington D.C.

USEPA, 2006a. *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5)*. Washington, D.C.

USEPA, 2006b. *Guidance for the Data Quality Objectives Process (EPA QA/G-4)*. Washington, D.C.

USEPA. 2006c. *USEPA Region II Evaluation of Metals Data for the CLP Program, SOP HW-2 Revision 13*. New York, NY.

USEPA. 2006d. *USEPA Region II Validating Volatile Organic Compounds by SW-846 Method 8260B, SOP HW-24 Revision 2*. New York, NY.

USEPA. 2006e. *USEPA Region II Data Validation SOP of Organochlorine Pesticides by Gas Chromatography SW-846 Method 8081B, SOP HW-44 Revision 1*. New York, NY.

USEPA. 2006f. *USEPA Region II Data Validation SOP of PCBs by Gas Chromatography SW-846 Method 8082A, SOP HW-45 Revision 1*. New York, NY.

USEPA. 2006g. *Validating Volatile Organic Analysis of Ambient Air in canister by Method TO-15, SOP HW-31, Revision 4*. Albany, NY.

USEPA. 2007. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, 3rd Edition, Update IV*. Washington D.C.

USEPA. 2009a. *USEPA Region II Validating Semivolatile Organic Compounds by SW-846 Method 8270, SOP HW-22 Revision 4*. New York, NY.

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Volatile Organic Compounds by USEPA Methods 5030B/5035A/8000C/8260B/8260C^{1,2}	Groundwater	3- 40-milliliter glass vials with Teflon® lined septum caps	4°C HCL to pH≤2 FC Sealed and Headspace Free	Analysis within 14 days from collection for preserved samples. Analysis within 7 days from collection for samples not acid preserved.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	1 each in cooler with VOC samples	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Vinyl chloride and styrene by USEPA Methods 5030B/5035A/8000C/8260B/8260C^{1,2}	Groundwater	3 - 40-milliliter glass vials with Teflon® lined septum caps	4°C Unpreserved	Analysis within 7 days from collection for unpreserved samples.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	1 each in cooler with VOC samples	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Volatile Organic Compounds Low Level by USEPA Methods 5035A/8000C/8260B/8260C^{1,2}	Soil, Sediment	125 mm wide mouth glass container sealed with Teflon® lined lid; or 3- Encore™ samplers used to collect and transport sample in accordance with USEPA Method 5035A.	4°C Sealed and Headspace Free	Analysis within 14 days of collection. For Encore™ sampler: extrude sample to a sealed vial and freeze to - 7°C within 48 hours from collection. Analysis must be performed within 14 days from collection. Otherwise, 48 hours from collection to analysis.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	1 each in cooler with VOC samples	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Volatile Organic Compounds Medium Level by USEPA Methods 5035A/8000C/8260B/8260C^{1,2}	Soil, Sediment	125 mm wide mouth glass container sealed with Teflon® lined lid; or 3-Encore™ samplers in accordance with USEPA Method 5035A.	4°C Sealed and Headspace Free	Analysis within 14 days of collection. For Encore™ sampler: within 48 hours of collection: For Encore sampler: extrude sample to a sealed vial. Add methanol solution to 5 grams of sample in accordance with USEPA Method 5035A. 14 days from collection to analysis.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	One ea. per cooler with VOC samples. Methanol preservation trip blank.	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Volatile Organic Compounds by USEPA Method 624⁸	Groundwater	4-40 milliliter glass vials with Teflon® lined septum caps	4°C HCL to pH≤2 RC	Analysis within 14 days from collection for preserved samples	TBD	One per 20 samples or one per matrix (for less than 20 samples)	1 each in cooler with VOC samples	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Volatile Organic Compounds by USEPA Method TO15³	Soil Vapor	6.0 Liter SUMMA® vacuum canisters	None	Analysis within 30 days from collection to analysis. Used and un-used canisters must be returned to the laboratory within 15 days of shipment of the canisters to the sampling location.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	NA	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Glycols and alcohols by USEPA Methods 8000C/8015B¹	Groundwater	1-one liter amber glass container with Teflon® lined screw caps	4°C	14 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	1 each in cooler with VOC samples ¹⁰	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Glycols and alcohols by USEPA Methods 8000C/8015B¹	Soil, Sediment	1- 250 milliliter wide mouth glass container with Teflon® lined lid. 100 grams sample volume required	4°C	14 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	1 each in cooler with VOC samples ¹⁰	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Semivolatile Organic Compounds by USEPA Methods 3510C/3520C/8000C/8270C/8270D^{1,2}	Groundwater	1-one liter amber glass container with Teflon® lined screw caps	4°C	7 days from collection to extraction; 40 days from extraction to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Semivolatile Organic Compounds (USEPA Methods 3541/3550B/8000C/8270C/8270D)^{1,2}	Soil, Sediment	1- 250 milliliter wide mouth glass container with Teflon® lined lid. 100 grams sample volume required	4°C	14 days from collection to extraction; 40 days from extraction to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Organochlorine Pesticides by USEPA Methods 3510C/3520C/8081A/8081B¹	Groundwater	1-one liter amber glass container with Teflon® lined screw caps	4°C	7 days from collection to extraction; 40 days from extraction to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Organochlorine Pesticides by USEPA Methods 3541/3550B/8081A/8081B¹	Soil, Sediment	1- 250 milliliter wide mouth glass container with Teflon® lined lid. 100 grams sample volume required	4°C	14 days from collection to extraction; 40 days from extraction to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Polychlorinated Biphenyls by USEPA Method 3510C/3520C/8000C/8082/8082A^{1,2}	Groundwater	1-one liter amber glass container with Teflon® lined screw caps	4°C	None Recommended Holding Time: 7 days from collection to extraction; 40 days from extraction to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Polychlorinated Biphenyls by USEPA Method 3541/3550B/8000C/8082/8082A^{1,2}	Soil, Sediment	1- 250 milliliter wide mouth glass container with Teflon® lined lid. 100 grams sample volume required.	4°C	None Recommended Holding Time: 14 days from collection to extraction; 40 days from extraction to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Metals by USEPA Methods 3005A/6010B/6010C/6020/6020A^{1,2}	Groundwater	1- 1000 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 100 milliliters sample volume required.	4°C HNO ₃ to pH<2	180 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Metals by USEPA Methods 3050B/6010B/6010C/6020/6020A^{1,2}	Soil, Sediment	4 ounce wide mouth polyethylene or fluorocarbon (TFE or PFA) container. 50 grams sample volume required.	4°C	180 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Mercury by USEPA Method 7470A¹	Groundwater	1-250 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 200 milliliters sample volume required.	4°C HNO ₃ to pH<2	28 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Mercury by USEPA Method 7471A/7471B¹	Soil, Sediment	4 ounce wide mouth polyethylene or fluorocarbon (TFE or PFA) container. 50 grams sample volume required.	4°C	28 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Total Cyanide by USEPA Method 9012A/9012B/9014¹	Groundwater	1-1000 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 500 milliliters sample volume required.	4°C NaOH to pH≥12 OA	14 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Total Cyanide by USEPA Method 9012A/9012B/9014¹	Soil, Sediment	4 ounce wide mouth glass container with Teflon® lined lid. 100 grams sample volume required.	4°C	14 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Hexavalent Chromium by USEPA Methods 3060A/7199¹	Soil, Sediment	4 ounce wide mouth glass container with Teflon® lined lid. 100 grams sample volume required.	4°C	30 days from collection to extraction. Analysis within 7 days from extraction.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Hexavalent Chromium by USEPA Method 7196A¹	Groundwater	1-250 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 200 milliliters sample volume required.	4°C	24 hours from collection to analysis.	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Ammonia by USEPA Method 350.1⁶	Soil, Sediment	4 ounce wide mouth glass container with Teflon® lined lid. 50 grams sample volume required.	4°C	28 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Ammonia by USEPA Method 350.1⁶	Groundwater	One -1000 milliliter polyethylene bottle 500 milliliters sample volume required	4°C H ₂ SO ₄ to pH<2	28 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Nitrate by USEPA Method 353.2⁶	Groundwater	One-250 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 50 milliliters sample volume required.	4°C	48 hours from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Nitrate by USEPA Method 353.2⁶	Soil, Sediment	4 ounce wide mouth glass container with Teflon® lined lid. 50 grams sample volume required.	4°C	48 hours from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Nitrite by USEPA Method 353.2⁶	Groundwater	One-250 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 50 milliliters sample volume required.	4°C	48 hours from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Nitrite by USEPA Method 353.2⁶	Soil, Sediment	4 ounce wide mouth glass container with Teflon® lined lid. 50 grams sample volume required.	4°C	48 hours from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Sulfate by USEPA Method 300.0⁷	Groundwater	1-500 milliliter polyethylene or fluorocarbon (TFE or PFA) container. 50 milliliters sample volume required.	4°C	28 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Sulfate by USEPA Method 300.0⁷	Soil, Sediment	4 ounce wide mouth glass container with Teflon® lined lid. 50 grams sample volume required.	4°C	28 days from collection to analysis	TBD	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
Percent Solids by SM20 2540B⁴	Soil, Sediment	8 ounce wide mouth glass container with Teflon® lined lid. 50 grams sample volume required.	4°C	NA	78	NA	NA	NA	NA
TOC by USEPA Lloyd Kahn Method⁵	Sediment	14-ounce wide mouth glass container with Teflon® lined lid	4°C	28 days from collection to analysis	See Work Plan	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
pH by SM 4500H+B⁴	Groundwater	1-100 milliliter plastic bottle. 50 milliliters sample volume required.	4°C	48 hours from collection to analysis	See Work Plan	One per 20 samples or one per matrix (for less than 20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix

NOTES:

MS/MSD indicates matrix spike/matrix spike duplicate sample for organic analyses. Spike duplicate may be performed for inorganic analyses.

Field blank is required at a frequency of one per 20 samples or one per sampling event if less than 20 samples are collected, for each matrix type. Field blank is not required if disposable equipment is used.

FC indicates that if free chlorine is present in samples, it must be removed by the appropriate addition of sodium thiosulfate or ascorbic acid.

RC indicates that if residual chlorine is present in samples, add sodium thiosulfate to the sample container before filling.

TABLE 1 – FIELD SAMPLING SUMMARY

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation ⁹	Holding Times	Number of Samples	QC Sample Frequency		
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate
HCL indicates hydrochloric acid.								
HN03 indicates nitric acid.								
NaOH indicates sodium hydroxide.								
Method References:								
1. USEPA. 2004. <i>Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846</i> , 3rd Edition, Update IIIB. Washington D.C.								
2. USEPA. 2007. <i>Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846</i> , 3rd Edition, Update IV. Washington D.C.								
3. USEPA. 1999. <i>Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)</i> . Cincinnati, Ohio.								
4. AWWA, APHA, and WEF. 1998. <i>Standard Methods for the Examination of Water and Wastewater</i> , 20th Edition. Washington, D.C								
5. USEPA. 1988. <i>Determination of Total Organic Carbon in Sediment</i> , Region II, Environmental Services Division, Monitoring Management Branch, Edison, New Jersey.								
6. USEPA. 1983. <i>Methods for Chemical Analysis of Water and Wastes</i> , EPA-600/4-79-020. Cincinnati, Ohio.								
7. USEPA. 1993. <i>Methods for the Determination of Inorganic Substances in Environmental Samples</i> , EPA-600/R-93/100. Washington, D.C.								
8. USEPA. 2001. <i>40 CFR Part 136, Appendix A</i> . Washington, D.C.								
9- Comment 113.								
10- Comment 123.								
Source: O’Brien & Gere								

Table 2-1A. LABORATORY DETECTION LIMITS AND REGULATORY CRITERIA FOR VOCs

Target Analytes	CAS Number	USEPA Method	Laboratory QL Aqueous (µg/L)	Laboratory MDL Aqueous (µg/L)	Laboratory QL Low Level Solid (µg/Kg)	Laboratory MDL - Low Level Solid (µg/Kg)	Laboratory QL Medium Level Solid (µg/Kg)	Laboratory MDL Medium Level Solid (µg/Kg)	Class GA Groundwater (µg/L)	Part 375 Commercial SCOs (µg/Kg)	Part 375 Industrial SCOs (µg/Kg)	Part 375 Protect. Of Groundwater (µg/Kg)
VOCs - TCL - SOMO1.2												
1,1,1-Trichloroethane	71-55-6	8260B (1)	1	0.82	5	0.363	100	27.7	5	500,000	1,000,000	680
1,1,2,2-Tetrachloroethane	79-34-5	8260B (1)	1	0.21	5	0.811	100	16.24	5	NA	NA	600
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	8260B (1)	1	0.31	5	1.14	100	50	5	NA	NA	6,000
1,1,2-Trichloroethane	79-00-5	8260B (1)	1	0.23	5	0.65	100	21	1	NA	NA	NA
1,1-Dichloroethane	75-34-3	8260B (1)	1	0.38	5	0.61	100	30.9	5	240,000	480,000	270
1,1-Dichloroethene	75-35-4	8260B (1)	1	0.29	5	0.612	100	34.6	5	500,000	1,000,000	330
1,2,3-Trichlorobenzene	87-61-6	8260B (1)	1	0.41	5	0.531	100	46	5	NA	NA	NA
1,2,4-Trichlorobenzene	120-82-1	8260B (1)	1	0.41	5	0.304	100	37.9	5	NA	NA	3,400
1,2,4-Trimethylbenzene	95-63-6	8260B (1)	1	0.75	5	0.96	100	27.9	5	190,000	380,000	3,600
1,2-Dibromo-3-chloropropane	96-12-8	8260B (1)	1	0.39	5	2.5	100	50	0.04	NA	NA	NA
1,2-Dibromoethane	106-93-4	8260B (1)	1	0.73	5	0.642	100	3.8	0.0006	NA	NA	NA
1,2-Dichlorobenzene	95-50-1	8260B (1)	1	0.79	5	0.391	100	25.5	3	500,000	1,000,000	1,100
1,2-Dichloroethane	107-06-2	8260B (1)	1	0.21	5	0.251	100	40.9	0.6	30,000	60,000	20
1,2-Dichloropropane	78-87-5	8260B (1)	1	0.72	5	2.5	100	16.2	1	NA	NA	NA
1,3-Dichlorobenzene	541-73-1	8260B (1)	1	0.78	5	0.257	100	26.7	3	280,000	560,000	2,400
1,3,5-Trimethylbenzene	108-67-8	8260B (1)	1	0.77	5	0.322	100	30.2	5	190,000	380,000	8,400
1,4-Dichlorobenzene	106-46-7	8260B (1)	1	0.84	5	0.7	100	14	3	130,000	250,000	1,800
1,4-Dioxane	123-91-1	8260B (1)	40	9.32	200	24.1	4000	2310	NA	130,000	250,000	100
2-Butanone (Methylethyl ketone)	78-93-3	8260B (1)	10	1.32	25	1.83	500	297	50*	500,000	1,000,000	120
2-Hexanone	591-78-6	8260B (1)	5	1.24	25	2.5	500	205	50*	NA	NA	NA
2-Nitropropane	79-46-9	8260B (1)	5	2.2	25	6.8	500	54	NA	NA	NA	NA
4-Methyl-2-pentanone (methyl isobutyl ketone MIBK)	108-10-1	8260B (1)	5	2.1	25	1.64	500	32	NA	NA	NA	1,000
Acetone	67-64-1	8260B (1)	10	3	25	4.21	500	411	50*	500,000	1,000,000	50
Acetonitrile	75-05-8	8260B (1)	40	26	200	30.8	4000	2609	NA	NA	NA	NA
Benzene	71-43-2	8260B (1)	1	0.41	5	0.245	100	4.8	1	44,000	89,000	60
Bromochloromethane	74-97-5	8260B (1)	1	0.87	5	0.361	100	36.1	5	NA	NA	NA
Bromodichloromethane	75-27-4	8260B (1)	1	0.39	5	0.67	100	20	50*	NA	NA	NA
Bromoform	75-25-2	8260B (1)	1	0.26	5	2.5	100	50	50*	NA	NA	NA
Bromomethane	74-83-9	8260B (1)	1	0.69	5	0.45	100	22	5	NA	NA	NA
n-Butanol (n-butyl alcohol)	71-36-3	8260B (1)	40	8.85	200	94	4000	1510	50*	NA	NA	NA
tert - butanol	75-65-0	8260B (1)	20	14	100	63	2000	1230	NA	NA	NA	NA
Butylbenzene	104-51-8	8260B (1)	1	0.64	5	0.435	100	29.2	5	500,000	1,000,000	12,000
sec-Butylbenzene	135-98-8	8260B (1)	1	0.75	5	0.435	100	36.8	5	500,000	1,000,000	11,000
tert-Butylbenzene	98-06-6	8260B (1)	1	0.81	5	0.52	100	27.8	5	500,000	1,000,000	5,900
Carbon disulfide	75-15-0	8260B (1)	1	0.19	5	2.5	100	45.5	60*	NA	NA	2,700
Carbon tetrachloride	56-23-5	8260B (1)	1	0.27	5	0.484	100	25.5	5	22,000	44,000	760
Chlorobenzene	108-90-7	8260B (1)	1	0.75	5	0.66	100	13.2	5	500,000	1,000,000	1,100
Chlorodifluoromethane	75-45-6	8260B (1)	1	0.26	5	2.6	100	31.8	NA	NA	NA	NA
Chloroethane	75-00-3	8260B (1)	1	0.32	5	1.13	100	20.8	5	NA	NA	1,900
Chloroform	67-66-3	8260B (1)	1	0.34	5	0.309	100	68.6	7	350,000	700,000	370
Chloromethane	74-87-3	8260B (1)	1	0.35	5	0.302	100	23.8	5	NA	NA	NA
cis-1,2-Dichloroethene	156-59-2	8260B (1)	1	0.81	5	0.64	100	27.6	5	500,000	1,000,000	250
cis-1,3-Dichloropropene	10061-01-5	8260B (1)	1	0.36	5	0.72	100	23.9	0.4	NA	NA	NA
Cyclohexane	110-82-7	8260B (1)	1	0.18	5	0.7	100	22.2	NA	NA	NA	NA
Cyclohexanone	108-94-1	8260B (1)	10	5.2	50	18	1000	884	NA	NA	NA	NA
Dibromochloromethane	124-48-1	8260B (1)	1	0.32	5	0.64	100	48.4	50*	NA	NA	NA
Dichlorodifluoromethane	75-71-8	8260B (1)	1	0.68	5	0.413	100	43.6	5	NA	NA	NA
Diethyl ether	60-29-7	8260B (1)	1	0.72	25	2.1	500	58.1	NA	NA	NA	NA
Ethyl Acetate	141-78-6	8260B (1)	1	0.66	5	0.348	100	52.2	NA	NA	NA	NA
Ethylbenzene	100-41-4	8260B (1)	1	0.74	5	0.345	100	29.1	5	390,000	780,000	1,000
Heptane	142-82-5	8260B (1)	20	0.42	100	2.7	100	12	NA	NA	NA	NA
Hexane	110-54-3	8260B (1)	10	0.4	50	2.9	1000	25.4	NA	NA	NA	NA
Isobutanol	78-83-1	8260B (1)	40	20	200	50.6	4000	2690	NA	NA	NA	NA
Isopropylbenzene	98-82-8	8260B (1)	1	0.79	5	0.754	100	15	5	NA	NA	2,300
p-Isopropyl toluene	99-87-6	8260B (1)	1	0.31	5	0.401	100	33.7	5	NA	NA	10,000
Methyl acetate	79-20-9	8260B (1)	1	0.5	5	0.93	100	47.6	NA	NA	NA	NA

Table 2-1A. LABORATORY DETECTION LIMITS AND REGULATORY CRITERIA FOR VOCs

			Laboratory QL Aqueous	Laboratory MDL Aqueous	Laboratory QL Low Level Solid	Laboratory MDL - Low Level Solid	Laboratory QL Medium Level Solid	Laboratory MDL Medium Level Solid	Class GA Groundwater	Part 375 Commercial SCOs	Part 375 Industrial SCOs	Part 375 Protect. Of Groundwater
Target Analytes	CAS Number	USEPA Method	(µg/L)	(µg/L)	(µg/Kg)	(µg/Kg)	(µg/Kg)	(µg/Kg)	(µg/L)	(µg/Kg)	(µg/Kg)	(µg/Kg)
Methyl tert-butyl ether	1634-04-4	8260B (1)	1	0.16	5	0.491	100	37.8	10*	500,000	1,000,000	930
Methylcyclohexane	108-87-2	8260B (1)	1	0.16	5	0.76	100	46.8	NA	NA	NA	NA
Methylene chloride	75-09-2	8260B (1)	1	0.44	5	2.3	100	19.8	5	500,000	1,000,000	50
Naphthalene	91-20-3	8260B (1)	1	0.43	5	0.67	100	33.7	10*	500,000	1,000,000	12,000
Styrene	100-42-5	8260B (1)	1	0.73	5	0.25	100	24.1	5	NA	NA	NA
Tetrachloroethene	127-18-4	8260B (1)	1	0.36	5	0.671	100	13.44	5	150,000	300,000	1,300
Tetrahydrofuran	109-99-9	8260B (1)	5	1.25	25	4.6	500	258	50*	NA	NA	NA
Toluene	108-88-3	8260B (1)	1	0.51	5	0.378	100	26.8	5	500,000	1,000,000	700
trans-1,2-Dichloroethene	156-60-5	8260B (1)	1	0.9	5	0.516	100	23.6	5	500,000	1,000,000	190
trans-1,3-Dichloropropene	10061-02-6	8260B (1)	1	0.37	5	2.2	100	4.8	0.4	NA	NA	NA
Trichloroethene	79-01-6	8260B (1)	1	0.46	5	1.1	100	27.8	5	200,000	400,000	470
Trichlorofluoromethane	75-69-4	8260B (1)	1	0.88	5	0.473	100	46.9	5	NA	NA	NA
Vinyl chloride	75-01-4	8260B (1)	1	0.9	5	0.61	100	33.5	2	13,000	27,000	20
m,p-Xylene	108-38-3/ 106-42-3	8260B (1)	2	0.66	10	0.84	200	55.4	5**	NA	NA	NA
o-Xylene	95-47-6	8260B (1)	1	0.76	5	0.653	100	13	5**	NA	NA	NA
Xylenes (total)	1330-20-7	8260B (1)	2	0.66	10	0.84	200	16.8	5	500,000	1,000,000	1,600
Other Analytes												
Isopropyl Alcohol	67-63-0	8015B (1)	1000	120	1000	242	NA	NA	NA	NA	NA	NA
Ethanol	64-17-5	8015B (1)	1000	140	1000	150	NA	NA	NA	NA	NA	NA
Ethylene Glycol	107-21-1	8015B (1)	10000	760	5000	1100	NA	NA	50*	NA	NA	NA
Methanol (methyl alcohol)	67-56-1	8015B (1)	1000	409	1000	298	NA	NA	NA	NA	NA	NA
Propylene Glycol	57-55-6	8015B (1)	10000	760	5000	1000	NA	NA	1000*	NA	NA	NA
Amyl Acetate	628-63-7	624 (2)	5	0.36	NA	NA	NA	NA	NA	NA	NA	NA
n-Butyl Acetate	123-86-4	624 (2)	5	0.49	NA	NA	NA	NA	NA	NA	NA	NA
Targeted Tentatively Identified Compounds (TICs) for Method 8260B												
Acetyl Bromide	506-96-7	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Amyl Acetate	628-63-7	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloropentafluoroethane	76-15-3	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorotrifluoromethane	75-72-9	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	140-88-5	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Oxide	75-21-8	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Acetate	110-19-0	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Butyl Acetate	123-86-4	8260B (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Notes:												
QL indicates quantitation limit.												
MDL indicate method detection limit.												
QLs and MDLs will be provided by the laboratory selected.												
Target compound list (TCL) resource - USEPA Method SOMO1.2												
ug/L indicates micrograms per Liter.												
ug/Kg indicates micrograms per kilogram.												
Method reference:												
1. United States Environmental Protection Agency (USEPA). 2004. <i>Test Methods for Evaluating Solid Waste: Physical/Chemical Methods</i> , SW-846, 3rd Edition, Update IIIB. Washington D.C.												
2. USEPA. 2001. <i>40 CFR Part 136, Appendix A</i> . Washington, D.C.												
Regulatory criteria and notes:												
Soil Criteria from GNYCRR Part 375 <i>Environmental Remediation Programs</i> ; Effective December 14, 2006, Current as of August 2012.												
Class GA Groundwater Standards and Guidance values as listed in T.O.G.S 1.1.1; <i>Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations</i> ; June 1998, current as of August 2012.												
*-Guidance values not standards.												
** 5 ug/L is the criteria for total Xylenes												
NA- actions limits are not available.												

Table 2-1B LABORATORY DETECTION LIMITS FOR VOCs IN SOIL VAPOR					
Target Analyte	USEPA Method	CAS #	M.W.	Soil Vapor and Subslab Soil	Soil Vapor and Subslab Soil
				Laboratory QL Air	Laboratory QL Air
				ppbv	ug/m3
Acetone	TO-15 (1)	67-64-1	58.08	5	12
Benzene	TO-15 (1)	71-43-2	78.11	0.2	0.64
Bromodichloromethane	TO-15 (1)	75-27-4	163.83	0.2	1.3
Bromoethene	TO-15 (1)	593-60-2	106.90	0.2	0.87
Bromoform	TO-15 (1)	75-25-2	252.75	0.2	2.1
Bromomethane	TO-15 (1)	74-83-9	94.94	0.2	0.78
1,3-Butadiene	TO-15 (1)	106-99-0	54.09	0.01	0.44
2-Butanone (methyl ethyl ketone) (MEK)	TO-15 (1)	78-93-3	72.11	0.5	1.5
Chlorobenzene	TO-15 (1)	108-90-7	112.55	0.2	0.92
Chloroethane	TO-15 (1)	75-00-3	64.52	0.5	1.3
Chloroform	TO-15 (1)	67-66-3	119.38	0.2	0.98
Chloromethane	TO-15 (1)	74-87-3	50.49	0.5	1
3-Chloropropene	TO-15 (1)	107-05-1	76.53	0.5	1.6
2-Chlorotoluene (o-chlorotoluene)	TO-15 (1)	95-49-8	126.60	0.2	1
Carbon disulfide	TO-15 (1)	75-15-0	76.14	0.5	1.6
Carbon tetrachloride	TO-15 (1)	56-23-5	153.81	0.04	0.25
Cyclohexane	TO-15 (1)	110-82-7	84.16	0.2	0.69
Dibromochloromethane	TO-15 (1)	124-48-1	208.29	0.2	1.7
1,2-Dibromoethane (ethylene dibromide)	TO-15 (1)	106-93-4	187.90	0.2	1.5
1,2-Dichlorobenzene (ortho)	TO-15 (1)	95-50-1	147.00	0.2	1.2
1,3-Dichlorobenzene (meta)	TO-15 (1)	541-73-1	147.00	0.2	1.2
1,4-Dichlorobenzene (para)	TO-15 (1)	106-46-7	147.00	0.2	1.2
Dichlorodifluoromethane (Freon 12)	TO-15 (1)	75-71-8	120.92	0.5	2.5
1,1-Dichloroethane	TO-15 (1)	75-34-3	98.96	0.2	0.81
1,2-Dichloroethane	TO-15 (1)	107-06-2	98.96	0.2	0.81
1,1-Dichloroethene	TO-15 (1)	75-35-4	96.94	0.2	0.79
1,2-Dichloroethene (cis)	TO-15 (1)	156-59-2	96.94	0.2	0.79
1,2-Dichloroethene (trans)	TO-15 (1)	156-60-5	96.94	0.2	0.79
1,2-Dichloroethene (total)**	TO-15 (1)	—	—	0.2	0.79
1,2-Dichloropropane	TO-15 (1)	78-87-5	112.99	0.2	0.92
1,2-Dichlorotetrafluoroethane (Freon 114)	TO-15 (1)	76-14-2	170.93	0.2	1.4
Ethylbenzene	TO-15 (1)	100-41-4	106.17	0.2	0.87
4-Ethyltoluene (p-Ethyltoluene)	TO-15 (1)	622-96-8	120.19	0.2	0.98
n-heptane	TO-15 (1)	142-82-5	100.20	0.2	0.82
Hexachlorobutadiene	TO-15 (1)	87-68-3	260.80	0.2	2.1
n-Hexane (hexane)	TO-15 (1)	110-54-3	86.17	0.20	0.70
Methylene Chloride	TO-15 (1)	75-09-2	84.93	0.5	1.7
4-Methyl-2-pentanone (MIBK)	TO-15 (1)	108-10-1	100.16	0.5	2
MTBE (methyl tert butyl ether)	TO-15 (1)	1634-04-4	88.15	0.20	0.70
Styrene	TO-15 (1)	100-42-5	104.15	0.2	0.85
Tertiary butyl alcohol (TBA)	TO-15 (1)	75-65-0	74.12	5	15
1,1,2,2-Tetrachloroethane	TO-15 (1)	79-34-5	167.85	0.2	1.4
Tetrachloroethene	TO-15 (1)	127-18-4	165.83	0.2	1.4
Toluene	TO-15 (1)	108-88-3	92.14	0.2	0.75
1,2,4-Trichlorobenzene	TO-15 (1)	120-82-1	181.50	0.5	3.7
1,1,1-Trichloroethane	TO-15 (1)	71-55-6	133.41	0.2	1.1
1,1,2-Trichloroethane	TO-15 (1)	79-00-5	133.41	0.2	1.1
Trichlorofluoromethane (Freon 11)	TO-15 (1)	75-69-4	137.40	0.2	1.1
1,1,2-Trichloro-1,2,2-trifluoroethane	TO-15 (1)	76-13-1	187.40	0.2	1.5
Trichloroethene	TO-15 (1)	79-01-6	131.39	0.04	0.25
1,2,4-Trimethylbenzene	TO-15 (1)	95-63-6	120.19	0.2	0.98
1,3,5-Trimethylbenzene	TO-15 (1)	108-67-8	120.19	0.2	0.98
2,2,4-Trimethylpentane	TO-15 (1)	540-84-1	132.38	0.2	0.93
Vinyl chloride	TO-15 (1)	75-01-4	62.50	0.04	0.25
Xylenes (m&p)	TO-15 (1)	1330-20-7	106.17	0.5	2.2
Xylenes (o)	TO-15 (1)	95-47-6	106.17	0.2	0.87
Xylenes (total)***	TO-15 (1)	—	—	0.2	0.87
1,4-Dioxane	TO-15 (1)	123-91-1	88.11	5	18
Isopropyl Alcohol	TO-15 (1)	67-63-0	60.10	5	12
Methyl Butyl Ketone	TO-15 (1)	591-78-6	100.20	0.5	2
Methyl methacrylate	TO-15 (1)	80-62-6	100.12	0.5	2
Naphthalene	TO-15 (1)	91-20-3	126.18	0.5	2.6
Tetrahydrofuran	TO-15 (1)	109-99-9	72.10	5	15

Notes:

QL indicates quantitation limit.

Target list resource - Project Target list

µg/m³ indicates microgram per cubic meter.

ppbv indicates parts per billion by volume.

* indicates Indicates that the laboratory will report the results to the QL level only.

** indicates the concentrations of each isomer are added if multiple isomers are present and the results compared to the total screening level.

QLs will be provided by the laboratory selected.

Method reference:

1. United States Environmental Protection Agency (USEPA). 1999. *Compendium Method TO-15: Determination of Volatile Organic Compounds(VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*. Cincinnati, Ohio.

Regulatory criteria and notes:

NYSDOH Sub-slab and Indoor Air matrix from "Guidance for Evaluating Vapor Intrusion in the State of New York," NYSDOH, October 2006, Current as of October 2011.

NA- action limits are not available.

Table 2-2. LABORATORY DETECTION LIMITS AND REGULATORY CRITERIA FOR SVOCs

Target Analytes	CAS Number	USEPA Method	Laboratory QL Aqueous (µg/L)	Laboratory MDL Aqueous (µg/L)	Laboratory QL Solid (µg/Kg)	Laboratory MDL - Solid (µg/Kg)	Class GA Groundwater (µg/L)	Part 375 Commercial SCOs (µg/Kg)	Part 375 Industrial SCOs (µg/Kg)	Groundwater Protection SCOs (µg/Kg)
TCL - SOMO1.2										
1,1'-Biphenyl	92-52-4	8270C	5	0.653	170	10.51	5	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	8270C	5	0.58	170	15.42	5	NA	NA	NA
2,3,4,6-Tetrachlorophenol	58-90-2	8270C	5	0.32	170	170.00	1**	NA	NA	NA
2,4,5-Trichlorophenol	95-95-4	8270C	5	0.48	170	36.81	1**	NA	NA	100
2,4,6-Trichlorophenol	88-06-2	8270C	5	0.61	170	11.14	1**	NA	NA	NA
2,4-Dichlorophenol	120-83-2	8270C	5	0.51	170	8.85	1**	NA	NA	400
2,4-Dimethylphenol	105-67-9	8270C	5	0.5	170	45.60	1**	NA	NA	NA
2,4-Dinitrophenol	51-28-5	8270C	10	2.22	330	59.06	1**	NA	NA	200
2,4-Dinitrotoluene	121-14-2	8270C	5	0.447	170	26.13	5	NA	NA	NA
2,6-Dinitrotoluene	606-20-2	8270C	5	0.4	170	41.30	5	NA	NA	170
2-Chloronaphthalene	91-58-7	8270C	5	0.46	170	11.33	10*	NA	NA	NA
2-Chlorophenol	95-57-8	8270C	5	0.53	170	8.59	1**	NA	NA	NA
2-Methylnaphthalene	91-57-6	8270C	5	0.6	170	2.04	NA	NA	NA	36,400
2-Methylphenol	95-48-7	8270C	5	0.4	170	5.19	1**	500,000	1,000,000	330
2-Nitroaniline	88-74-4	8270C	10	0.42	330	54.15	5	NA	NA	400
2-Nitrophenol	88-75-5	8270C	5	0.48	170	7.72	1**	NA	NA	300
3,3'-Dichlorobenzidine	91-94-1	8270C	5	0.4	170	148.00	5	NA	NA	NA
3 & 4 -Methylphenol	NA	8270C	10	0.36	330	9.40	1**	500,000	1,000,000	330
3-Nitroaniline	99-09-2	8270C	10	0.48	330	38.81	5	NA	NA	500
4,6-Dinitro-2-methylphenol	534-52-1	8270C	10	2.2	330	58.29	1**	NA	NA	NA
4-Bromophenyl phenyl ether	101-55-3	8270C	5	0.45	170	53.71	NA	NA	NA	NA
4-Chloro-3-methylphenol	59-50-7	8270C	5	0.45	170	6.94	1**	NA	NA	NA
4-Chloroaniline	106-47-8	8270C	5	0.59	170	49.55	5	NA	NA	220
4-Chlorophenyl phenyl ether	7005-72-3	8270C	5	0.35	170	3.60	NA	NA	NA	NA
4-Nitroaniline	100-01-6	8270C	10	0.25	330	18.86	5	NA	NA	NA
4-Nitrophenol	100-02-7	8270C	10	1.52	330	40.92	1**	NA	NA	100
Acenaphthene	83-32-9	8270C	5	0.41	170	1.98	20*	500,000	1,000,000	98,000
Acenaphthylene	208-96-8	8270C	5	0.38	170	1.38	NA	500,000	1,000,000	107,000
Acetophenone	98-86-2	8270C	5	0.54	170	8.66	NA	NA	NA	NA
Aniline	62-53-3	8270C	10	0.61	330	92.44	5	500,000	1,000,000	330
Anthracene	120-12-7	8270C	5	0.28	170	4.32	50*	500,000	1,000,000	1,000,000
Atrazine	1912-24-9	8270C	5	0.46	170	7.51	7.5	NA	NA	NA
Benzaldehyde	100-52-7	8270C	5	0.267	170	18.51	NA	NA	NA	NA
Benzo[a]anthracene	56-55-3	8270C	5	0.36	170	2.91	0.002*	5,600	11,000	1,000
Benzo[a]pyrene	50-32-8	8270C	5	0.47	170	4.07	ND	1,000	1,100	22,000
Benzo[b]fluoranthene	205-99-2	8270C	5	0.34	170	3.28	0.002*	5,600	11,000	1,700
Benzo[g,h,i]perylene	191-24-2	8270C	5	0.35	170	2.03	NA	500,000	1,000,000	1,000,000
Benzo[k]fluoranthene	207-08-9	8270C	5	0.73	170	1.86	0.002*	56,000	110,000	17,000
Benzyl alcohol	100-51-6	8270C	20	0.44	330	8.07	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	111-91-1	8270C	5	0.35	170	9.18	5	NA	NA	NA
bis(2-chloroethyl)ether	111-44-4	8270C	5	0.4	170	14.57	1	NA	NA	NA
bis(2-chloroisopropyl)ether	108-60-1	8270C	5	0.52	170	17.64	5	NA	NA	NA
bis(2-Ethylhexyl)phthalate	117-81-7	8270C	5	1.8	170	54.39	5	NA	NA	435,000
Butyl benzyl phthalate	85-86-7	8270C	5	0.42	170	45.33	50*	NA	NA	122,000
Caprolactam	105-60-2	8270C	5	2.2	170	73.02	NA	NA	NA	NA
Carbazole	86-74-8	8270C	5	0.3	170	1.95	NA	NA	NA	NA
Chrysene	218-01-9	8270C	5	0.33	170	1.69	0.002*	56,000	110,000	1,000
Dibenz[a,h]anthracene	53-70-3	8270C	5	0.42	170	1.99	NA	560	1,100	1,000,000
Dibenzofuran	132-64-9	8270C	10	0.51	170	1.76	NA	350,000	1,000,000	6,200
Dicyclohexylamine (DCHA)	101-83-7	8270C	10	1.4	NA	NA	NA	NA	NA	NA
Diethyl phthalate	84-66-2	8270C	5	0.22	170	5.10	50*	NA	NA	7,100
n,n Dimethylaniline (DMA)	121-69-7	8270C	NA	NA	NA	NA	1	NA	NA	NA

Table 2-2. LABORATORY DETECTION LIMITS AND REGULATORY CRITERIA FOR SVOCs

Target Analytes	CAS Number	USEPA Method	Laboratory QL Aqueous (µg/L)	Laboratory MDL Aqueous (µg/L)	Laboratory QL Solid (µg/Kg)	Laboratory MDL - Solid (µg/Kg)	Class GA Groundwater (µg/L)	Part 375 Commercial SCOs (µg/Kg)	Part 375 Industrial SCOs (µg/Kg)	Groundwater Protection SCOs (µg/Kg)
TCL - SOMO1.2										
Dimethyl phthalate	131-11-3	8270C	5	0.36	170	4.40	50*	NA	NA	27,000
Di-n-butyl phthalate	84-74-2	8270C	5	0.31	170	58.35	50	NA	NA	8,100
Di-n-octyl phthalate	117-84-0	8270C	5	0.47	170	3.95	50*	NA	NA	120,000
Fluoranthene	206-44-0	8270C	5	0.51	170	2.45	50*	500,000	1,000,000	1,000,000
Fluorene	86-73-7	8270C	5	0.68	170	3.89	50*	500,000	1,000,000	386,000
Hexachlorobenzene	118-74-1	8270C	5	0.51	170	8.39	0.04	6,000	12,000	1,400
Hexachlorobutadiene	87-68-3	8270C	5	0.68	170	8.64	0.5	NA	NA	NA
Hexachlorocyclopentadiene	77-47-4	8270C	5	0.59	170	51.04	5	NA	NA	NA
Hexachloroethane	67-72-1	8270C	5	0.59	170	13.06	5	NA	NA	NA
Indeno[1,2,3-cd]pyrene	193-39-5	8270C	5	0.47	170	4.67	0.002*	5,600	11,000	8,200
Isophorone	78-59-1	8270C	5	0.43	170	8.44	50*	NA	NA	4,400
Naphthalene	91-20-3	8270C	5	0.76	170	2.81	10*	500,000	1,000,000	12,000
Nitrobenzene	98-95-3	8270C	5	0.29	170	7.48	0.4	69,000	140,000	170
N-Nitroso-di-n-propylamine	621-64-7	8270C	5	0.54	170	13.37	na	NA	NA	NA
N-Nitrosodiphenylamine	86-30-6	8270C	5	0.51	170	9.23	50*	NA	NA	NA
Pentachlorophenol	87-86-5	8270C	10	2.2	330	57.90	1**	6,700	55,000	800
Phenanthrene	85-01-8	8270C	5	0.44	170	3.54	50	500,000	1,000,000	1,000,000
Phenol	108-95-2	8270C	5	0.39	170	17.77	1**	500,000	1,000,000	330
Pyridine	110-86-1	8270C	25	0.41	330	94.99	50*	NA	NA	NA
Pyrene	129-00-0	8270C	5	0.34	170	1.09	50*	500,000	1,000,000	1,000,000
Triethylamine	121-44-8	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Targeted Tentatively Identified Compounds (TICs)										
Cyclohexylamine	108-91-8	8270C	NA	NA	NA	NA	NA	NA	NA	NA
N,N-Dimethylformamide	68-12-2	8270C	NA	NA	NA	NA	50*	NA	NA	NA
Potassium Acetate	127-08-2	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene diamine tetra acetic acid	60-00-4	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethyldisilane (HMDS)	1450-14-2	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethyldisiloxane (HMDSO)	107-46-0	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylchlorosilane	75-77-4	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Syltherm XLT (Dimethylpolysiloxane)	63148-62-9	8270C	NA	NA	NA	NA	NA	NA	NA	NA
Notes: QL indicates quantitation limit. MDL indicate method detection limit. QLs and MDLs will be provided by the laboratory selected. Target compound list (TCL) resource - USEPA Method SOMO1.2 ug/L indicates micrograms per Liter. ug/Kg indicates micrograms per kilogram. Method reference: United States Environmental Protection Agency (USEPA). 2004. <i>Test Methods for Evaluating Solid Waste: Physical/Chemical Methods</i> , SW-846, 3rd Edition, Update IIIB. Washington D.C. Regulatory criteria and notes: Soil Criteria from 6NYCRR Part 375 <i>Environmental Remediation Programs</i> ; Effective December 14, 2006, Current as of August 2012. Class GA Groundwater Standards and Guidance values as listed in T.O.G.S 1.1.1; <i>Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations</i> ; June 1998, current as of August 2012. ** - included in Phenolic Compounds which is sum of substances. * - Guidance Criteria not standard. NA- actions limits are not available.										

Table 2-3. LABORATORY DETECTION LIMITS AND REGULATORY CRITERIA FOR PCBs AND ORGANOCHLORINE PESTICIDES

TCL Target Analyte	CAS Number	USEPA Method	Laboratory QL Aqueous (µg/L)	Laboratory MDL Aqueous (µg/L)	Laboratory QL Solid (µg/Kg)	Laboratory Solid MDL (µg/Kg)	Class GA Groundwater (µg/L)	Part 375 Commercial SCOs (µg/Kg)	Part 375 Industrial SCOs (µg/Kg)	Groundwater Protection SCOs (µg/Kg)
TCL Polychlorinated biphenyls										
Aroclor 1016	12674-11-2	8082 (1)	0.5	0.176	250	48.9	0.09**	1,000	25,000	3,200
Aroclor 1221	11104-28-2	8082 (1)	0.5	0.176	250	48.9	0.09**	1,000	25,000	3,200
Aroclor 1232	11141-16-5	8082 (1)	0.5	0.176	250	48.9	0.09**	1,000	25,000	3,200
Aroclor 1242	53469-21-9	8082 (1)	0.5	0.176	250	48.9	0.09**	1,000	25,000	3,200
Aroclor 1248	12672-29-6	8082 (1)	0.5	0.176	250	48.9	0.09**	1,000	25,000	3,200
Aroclor 1254	11097-69-1	8082 (1)	0.5	0.25	250	117	0.09**	1,000	25,000	3,200
Aroclor 1260	11096-82-5	8082 (1)	0.5	0.25	250	117	0.09**	1,000	25,000	3,200
Aroclor 1262	37324-23-5	8082 (1)	0.5	0.25	250	117	0.09**	1,000	25,000	3,200
Aroclor 1268	11100-14-4	8082 (1)	0.5	0.25	250	117	0.09**	1,000	25,000	3,200
TCL Organochlorine Pesticides										
4,4'-DDE	72-55-9	8081A (1)	0.05	0.0116	1.67	0.25	0.2	62,000	120,000	17,000
4,4'-DDT	50-29-3	8081A (1)	0.05	0.011	1.67	0.17	0.2	47,000	94,000	136,000
4,4'-DDD	72-54-8	8081A (1)	0.05	0.0092	1.67	0.324	0.3	92,000	180,000	14,000
Aldrin	309-00-2	8081A (1)	0.05	0.0066	1.67	0.41	ND	680	1,400	190
Alpha BHC	319-84-6	8081A (1)	0.05	0.0066	1.67	0.3	0.01	3,400	6,800	20
Beta BHC	319-85-7	8081A (1)	0.05	0.0248	1.67	0.18	0.04	3,000	14,000	90
Alpha Chlordane	5103-71-9	8081A (1)	0.05	0.0148	1.67	0.83	0.05	24,000	47,000	2,900
Gamma Chlordane	5103-74-2	8081A (1)	0.05	0.011	1.67	0.53	0.05	NA	NA	14,000
Delta BHC	319-86-8	8081A (1)	0.05	0.01	1.67	0.22	0.04	500,000	1,000,000	250
Dieldrin	60-57-1	8081A (1)	0.05	0.0098	1.67	0.4	0.004	1,400	2,800	100
Endosulfan I	959-98-8	8081A (1)	0.05	0.011	1.67	0.21	NA	200,000	920,000	102,000
Endosulfan II	33213-65-9	8081A (1)	0.05	0.012	1.67	0.3	NA	200,000	920,000	102,000
Endosulfan Sulfate	1031-07-8	8081A (1)	0.05	0.0157	1.67	0.311	NA	200,000	920,000	1,000,000
Endrin	72-20-8	8081A (1)	0.05	0.0138	1.67	0.23	ND	89,000	410,000	60
Endrin Aldehyde	7421-93-4	8081A (1)	0.05	0.0163	1.67	0.426	5	NA	NA	NA
Endrin Ketone	53494-70-5	8081A (1)	0.05	0.012	1.67	0.41	5	NA	NA	NA
Gamma BHC (Lindane)	58-89-9	8081A (1)	0.05	0.006	1.67	1.206	0.05	9,200	23,000	100
Heptachlor	76-44-8	8081A (1)	0.05	0.0085	1.67	0.261	0.04	15,000	29,000	380
Heptachlor Epoxide	1024-57-3	8081A (1)	0.05	0.0053	1.67	0.43	0.03	NA	NA	20
Methoxychlor	72-43-5	8081A (1)	0.05	0.0141	1.67	0.23	35	NA	NA	900,000
Toxaphene	8001-35-2	8081A (1)	0.5	0.12	16.7	9.7	0.06	NA	NA	NA

Notes:

QL indicates quantitation limit.

MDL indicate method detection limit.

QLs and MDLs will be provided by the laboratory selected.

Target compound list (TCL) resources for PCBs and pesticides - USEPA Method SOMO1.2

ug/L indicates micrograms per Liter.

ug/Kg indicates micrograms per kilogram.

Method reference:1- USEPA. 2004. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846, 3rd Edition, Update IIIB. Washington D.C.**Regulatory criteria and notes:**Soil Criteria from 6NYCRR Part 375 *Environmental Remediation Programs* ; Effective December 14, 2006, Current as of August 2012.Class GA Groundwater Standards and Guidance values as listed in T.O.G.S 1.1.1; *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* ; June 1998, Current as of August 2012.

*-Guidance values not standards.

** 0.09 is the criteria for the sum of the Aroclors

NA- actions limits are not available.

Table 2-4. LABORATORY DETECTION LIMITS AND REGULATORY CRITERIA FOR METALS AND INORGANICS										
Target Analytes	CAS Number	Method (Reference)	Laboratory QL Aqueous µg/L	Laboratory MDL - Aqueous µg/L	Laboratory QL Solid mg/Kg	Laboratory MDL - Solid mg/Kg	Class GA Groundwater µg/L	Part 375 Commercial Use SCOs mg/Kg	Part 375 Industrial Use SCOs mg/Kg	Protection of Groundwater SCOs mg/Kg
TAL Metals										
Aluminum	7429-90-5	6010B/6020 (1)	200	600	10	4.4	NA	NA	NA	NA
Antimony	7440-36-0	6010B/6020 (1)	20	67.9	15	0.54	3	NA	NA	NA
Arsenic	7440-38-2	6010B/6020 (1)	10	55.5	2	0.4	25	16	16	16
Barium	7440-39-3	6010B/6020 (1)	2	7	0.5	0.11	1,000	400	10,000	820
Beryllium	7440-41-7	6010B/6020 (1)	2	3	0.2	0.028	3*	590	2,700	47
Cadmium	7440-43-9	6010B/6020 (1)	1	3.3	0.2	0.03	5	9.3	60	7.5
Calcium	7440-70-2	6010B/6020 (1)	500	1000	50	3.3	NA	NA	NA	NA
Total Chromium	7440-47-3	6010B/6020 (1)	4	8.7	0.5	0.2	50	NA	NA	NA
Hexavalent Chromium	18540-29-9	7196A (1)	2.7	10	NA	NA	50	400	800	19
Hexavalent Chromium	18540-29-9	3060A/7199 (1)	NA	NA	0.145	0.2	50	400	800	19
Trivalent Chromium	16065-83-1	NA	NA	NA	NA	NA	NA	1,500	6,800	NA
Cobalt	7440-48-4	6010B/6020 (1)	4	6.3	0.5	0.05	NA	NA	NA	NA
Copper	7440-50-8	6010B/6020 (1)	10	15	1	0.21	200	270	10,000	1,720
Iron	7439-89-6	6010B/6020 (1)	50	193	10	1.1	300	NA	NA	NA
Lead	7439-92-1	6010B/6020 (1)	5	30	1	0.24	25	1,000	3,900	450
Magnesium	7439-95-4	6010B/6020 (1)	200	434	20	0.927	35,000*	NA	NA	NA
Manganese	7439-96-5	6010B/6020 (1)	3	4	0.2	0.032	300	10,000	10,000	2,000
Mercury	7439-97-6	7470A/7471A (1)	0.2	0.12	0.02	0.0081	0.7	2.8	5.7	0.73
Molybdenum	7439-98-7	6010B/6020 (1)	10	35.6	1	0.13	NA	NA	NA	NA
Nickel	7440-02-0	6010B/6020 (1)	10	12.6	5	0.23	100	310	10,000	130
Potassium	7440-09-7	6010B/6020 (1)	500	2000	30	20	NA	NA	NA	NA
Selenium	7782-49-2	6010B/6020 (1)	15	87	4	0.57	10	1,500	6,800	4
Silver	7440-22-4	6010B/6020 (1)	3	12.3	0.5	0.2	50	1,500	6,800	8.3
Sodium	7440-23-5	6010B/6020 (1)	1000	3240	140	13	20,000	NA	NA	NA
Thallium	7440-28-0	6010B/6020 (1)	20	102.4	6	0.3	0.5*	NA	NA	NA
Vanadium	7440-62-2	6010B/6020 (1)	5	10.8	0.5	0.11	NA	NA	NA	NA
Zinc	7440-66-6	6010B/6020 (1)	10	17	2	0.153	2,000*	10,000	10,000	2,480
Total Cyanide	57-12-5	9012A/9012B/9014 (1)	10000	3	10	0.003	200	27	10,000	40
Other Analytes										
Ammonia	7664-41-7	350.1 (2)	0.02 mg/L	0.009 mg/L	4 mg/Kg	2 mg/Kg	2,000	NA	NA	NA
Nitrate	-	353.2 (2)	0.05 mg/L	0.011 mg/L	1 mg/Kg	0.02 mg/Kg	10,000	NA	NA	NA
Nitrite	-	353.2 (2)	0.05 mg/L	0.02 mg/L	1 mg/Kg	0.006 mg/Kg	1,000	NA	NA	NA
Sulfate	-	300.0 (3)	2 mg/L	0.35 mg/L	20 mg/Kg	3.5 mg/Kg	250,000	NA	NA	NA
Notes: MDLs indicate method detection limits. QLs indicates quantitation limits. mg/kg indicates milligrams per kilogram. µg/L indicates micrograms per Liter. QLs and MDLs will be provided by laboratory selected. Target Analyte List (TAL) resource for metals - USEPA Method ILM05.4.										
Method references: 1. USEPA. 2004. <i>Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846</i> , 3rd Edition, Update IIIB. Washington D.C. 2. USEPA. 1983. <i>Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020</i> . Cincinnati, Ohio. 3. USEPA. 1993. <i>Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100</i> . Washington, D.C.										
Regulatory criteria and notes: Soil Criteria from 6NYCRR Part 375 <i>Environmental Remediation Programs</i> ; Effective December 14, 2006, Current as of August 2012. Class GA Groundwater Standards and Guidance values as listed in T.O.G.S 1.1.1; <i>Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations</i> , June 1998, Current as of August 2012. *- Guidance value not standard. NA- actions limits are not available.										

TABLE 3-1A. VOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Applies to: USEPA Methods 8000C/8260B/8260C			
Holding times	Samples must be analyzed within holding time.	Analyze within 14 days from collection for preserved aqueous samples and solids. Analyze within 7 days from collection for unpreserved aqueous.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions. 2. Notify QAO since re-sampling may be required. 3. Document any observations and corrective action in the case narrative corrective action in the case narrative.
Solid sample collection	Samples must be prepared using USEPA Method 5035. The collection and preparation methods for each sample will be identified in the case narrative.	NA	NA
MS Tuning	Once every 12 hours prior to initial calibration and calibration verifications. Analytical sequence must be completed within 12 hours of the GC/MS Instrument Performance Check	1. Bromofluorobenzene (BFB) key ions and abundance criteria listed in the method must be met for all 9 ions and analyses must be performed within 12 hours of injection of the BFB. 2. Part of the BFB peak will not be background subtracted to meet tune criteria. 3. Documentation of all bromofluorobenzene analyses and evaluation must be included in the data packages.	1. Tune the mass spectrometer. 2. Document any observations and corrective action in the case narrative. 3. Samples cannot be analyzed until control limit criteria have been met.

TABLE 3-1A. VOCs QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Initial Calibration	Prior to sample analysis and when calibration verifications criteria are not met. Initial calibration will contain all target analytes in each standard. Quantitation of analyses will utilize the initial calibration results. Sequence must be completed within 12 hours of the GC/MS Instrument Performance Check	- Five concentrations bracketing expected concentration range for all compounds of interest. One standard must be at or less than the QL. - One second-source standard must be analyzed immediately following the initial calibration at the mid-calibration concentration. This standard must be within 30% recovery or within laboratory control limits. - It is also recommended that a separate standard at the MDL level be analyzed after calibration is complete to check sensitivity. - Response factor (RF) as listed in Method 8260B, with remaining RFs factor ≥ 0.050 except for ketones with response factor ≥ 0.010 <i>8260C- RFs must meet criteria in Method Table 4. The remaining RFs factor ≥ 0.050 except for ketones with response factor ≥ 0.010</i> - For compound with %RSD >15, quantitation must be performed using a separate calibration curve and the Coefficient of Determination (COD) must be ≥ 0.990. <i>8260C - For compound with %RSD >20, quantitation must be performed using a separate calibration curve and the COD must be ≥ 0.990.</i> <i>If linear regression is used for the calibration curve, the low calibration standard should be evaluated for accuracy using %D of 30% from true value.</i> <i>Relative retention for each target analyte in each calibration standard must agree within ± 0.06 units.</i>	- Identify and correct problem. - If criteria are still not met, recalibrate. - Document any observations and corrective action in the case narrative. - Samples should not be analyzed until calibration control limit criteria are met.

TABLE 3-1A. VOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Calibration Verification	Every 12 hours, following BFB. The calibration verification will contain all target analytes in each standard at a concentration that is representative of the midpoint of the initial calibration.	1. Within percent drift or percent difference (%D) of ≤ 20 for target analytes. RF requirements are the same as listed in the initial calibration. 2. The internal standards areas and retention times must meet the method criteria.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document any observations and corrective action in the case narrative; samples should not be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Every 12 hours, following calibration verification	1. Methylene chloride less than 3 times QL, 2-butanone and acetone less than 5 times QL. Remaining analytes less than QL. 2. QLs and MDLs will be provided along with the preparation blank results.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in blank. 3. Document any observations and corrective action in the case narrative - samples cannot be analyzed until blank criteria have been met.
Field/Equipment Blank Analysis	Field collected - One per sampling event, or one per 20 samples or one per matrix (for less than 20 samples)	Methylene chloride less than 3 times QL, 2-butanone and acetone less than 5 times QL. Remaining analytes less than QL. QLs and MDLs will be provided along with the preparation blank results.	1. Investigate problem. 2. Document any observations and in the case narrative.
Trip Blank	Field provided – One for each cooler containing VOC samples.	Methylene chloride less than 3 times QL, 2-butanone and acetone less than 5 times QL. Remaining analytes less than QL. QLs and MDLs will be provided along with the preparation blank results.	1. Investigate problem. 2. Document any observations and in the case narrative.
Laboratory Control Sample Analysis	Each analytical batch (every 12 hours). Prepared independently from calibration standards. Spike must contain all target analytes and should be at a concentration, which is in the lower 1/2 of the calibration curve.	Recovery within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. If recovery failures are above control limits and these target analytes are not detected in the associated samples, corrective action is not required. 2. If recovery failures are below control limits, reanalyze LCS. 3. If re-analysis fails, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document any observations and corrective action in the case narrative.

TABLE 3-1A. VOCs QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Internal Standards	All samples and blanks (including MS/MSD)	- Response -50% - +200% of internal standards from continuing calibration of the day. - RT must be ± 30 sec. from associated calibration verification standard of that sequence.	- Reanalyze. - If still outside of the limits, report both analyses. - Document any observations and corrective action in the case narrative.
Surrogate Spike	All samples and blanks (including MS/MSD)	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%.	- Reanalyze any environmental or QC sample with surrogates that exceed control limits. - If still outside of the limits, report both analyses. - Document any observations and corrective action in the case narrative
Matrix Spike/ Matrix Spike Duplicate (MS/MSD) Analysis	Collected one per 20 samples or one per matrix (for less than 20 samples) Samples from the investigation must be used for MS/MSD analysis. Spike must contain complete list of target analytes.	Recovery and RPD within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	- Reanalyze if <10%. - If reanalysis is still <10%, report both analyses and document in the case narrative. - If >10%, document in case narrative; no additional corrective action required. - Document corrective action in the case narrative
Field Duplicate Analysis	Field collected - One for each 20 samples or one per matrix (for less than 20 samples) Field duplicate will not be identified to the laboratory.	Validation criteria: 50% RPD for waters, 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.

TABLE 3-1A. VOCs QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Target Analyte Identification	As required for identification of target analytes	1. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion. 2. The relative retention time (RRT) of the sample component is within ± 0.06 RRT units of the RRT of the standard component. 3. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.) 4. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times 5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important.	Not applicable

TABLE 3-1A. VOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Target Analyte Identification	As required for identification of target analytes	Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes co-elute (i.e., only one chromatographic peak is apparent), the identification criteria may be met, but each analyte spectrum will contain extraneous ions contributed by the co-eluting compound.	Not applicable
Target Analyte Quantitation	Apply USEPA Method 8000C for medium level extraction technique	Moisture correction in accordance with USEPA Method 8000C will be applied to the complete set of solid samples, regardless of the percent moisture content..	Not applicable
Tentatively Identified Compound	If required, perform for each sample and blank analysis. Non-target compounds will be reported using a Mass Spectral Library search.	Not applicable	Not applicable
Dilutions	- When target analyte concentration exceeds upper limit of calibration curve. - When matrix interference is demonstrated by the lab and documented in the case narrative (highly viscous samples or a large number of nontarget peaks on the chromatogram). - It is recommended that a reagent blank be analyzed if an analyte saturates the detector or if highly concentrated analytes are detected. Otherwise data impacted from carryover cannot be used. - Laboratory will note in the data deliverables which analytical runs were reported.	The reagent blank will meet the method blank criteria.	- Reanalyze reagent blank until method blank criteria are met. - Document corrective action in the case narrative.
Percent solids	For soil samples, the percent solids will be determined and sample results will be corrected for percent solids.	Not applicable	Not applicable
pH Determination	Once sample aliquot is taken from the VOC vial, the pH of water samples must be determined.	Record pH and report in the case narrative.	Not applicable
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable

TABLE 3-1A. VOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8260B/8260C)	Corrective Action
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Deliverables	1. Full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures and any observations of bubbles in sample containers will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.
Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Notes: Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods that are currently used by the laboratory. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with the QAO will be documented and included in the data packages. Source: O'Brien & Gere			

TABLE 3-1B. VOCs SOIL VAPOR QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Applies to USEPA Method TO-15			
Holding Times	Samples must be analyzed within holding time. Used and un-used canisters must be returned to the laboratory within 15 days of shipment of the canisters to the sampling location.	Analyze within 30 days of sample collection. Preservation of sample containers is not required.	If holding times are exceeded for initial or re-analyses required, notify QAO since re-sampling may be required. Document communications, any observations and corrective action in the case narrative
SUMMA® Canister Preparation	1. Canisters are equipped with a laboratory preset regulator, pressure gauge, critical orifice, stainless steel frit dust filter over the orifice, and specially prepared interior surfaces. 2. The flow controller (regulator) is preset at the laboratory for sample collection periods and the collection period is identified for each canister. 3. Canisters are shipped to the site at sub-atmospheric pressure approximating negative 30 inches of mercury. 4. The laboratory evacuates the canister to approximately – 30 inches of Hg prior to shipping.		
Sample collection using SUMMA® canisters	1. Samples will be collected for sample duration of 8 hours. 2. The backpressure is primarily a factor of the length of the tubing from the sampling point to the canister, the interior diameter of the tubing, the construction of the sampling probe, and the soil type. 3. If the backpressure constraint is greater than the vacuum in the canister, sample collection will not occur. 4. When possible, the system backpressure should be evaluated prior to sampling. 5. The method by which the ambient pressure and temperature will be obtained must be either weather station or portable instrument for exterior samples.		
SUMMA® Canister Leak Test Evaluation Prior to Collection	All canisters are leak tested prior to each sampling. Canister pressure must be recorded by lab prior to shipment to the client (approximately -30 inches of mercury), and by field after sample collection. The pressure must be recorded by lab upon receipt.	The difference between the initial canister pressure recorded at the laboratory and the subsequent pressure reading prior to sample collection at the field location must not be greater than 10 in Hg.	1. If canister pressure is exceeded notify QAO since re-sampling may be required. 2. Document communications, any observations and corrective action in the case narrative.
SUMMA® Canister Leak Test Evaluation After Collection	Canister pressure should be recorded by the field after sample collection, and by the lab upon receipt at the lab.	The difference between the pressure recorded in the field after sample collection and the pressure recorded by the lab upon sample receipt must not be greater than 10 in Hg. If pressure difference is exceeded, documentation instructing the lab to analyze the sample must be provided.	1. If canister pressure is exceeded notify QAO since re-sampling may be required. 2. Document communications, any observations and corrective action in the case narrative.
SUMMA® Canister Filling	The canisters must be filled to a minimum of -15 in Hg, but should be filled to between -5 in Hg and -2 in Hg when collection of sample is completed.	Canisters used for sample collection should be filled properly.	1. If canister filling requirement is exceeded notify QAO since re-sampling may be required. 2. Document communications, any observations and corrective action in the case narrative.
SUMMA® Canister Cleaning	Canisters must be clean and free of any contaminants before sample collection. Canisters will be batch certified. It is recommended that canisters are individually certified for low level samples (<0.5 ug/m3). The same laboratory that certifies the canisters as clean must analyze the sample canisters. Certification should be provided in the data package. The laboratory must document which canisters are associated with each batch certification.	Canisters are cleaned using either humid zero nitrogen cleaning procedures as described in USEPA Method TO-15 or the canisters are heated in an isothermal oven or by use of heating bands. Batch certified: 1 of the canisters per batch of 12 (8.3%) are analyzed by TO-15. Clean canisters do not contain analytes above or equal to the quantitation limit (QL). Any canister that has not tested clean will not be used.	1. If canister cleaning requirement is exceeded notify QAO since re-sampling may be required. 2. Document communications, any observations and corrective action in the case narrative.

TABLE 3-1B. VOCs SOIL VAPOR QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
GC/MS tuning	Once every 24 hours prior to initial calibration and calibration verification.	1. Tune key ions and abundance criteria listed in USEPA Method TO-15 must be met for all ions and analyses must be performed within 24 hours of injection of the tune. 2. Part of the tune peak will not be background subtracted to meet tune criteria. 3. Documentation of all tune analyses and evaluations must be included in the data packages.	1. Tune the mass spectrometer. 2. Document communications, any observations and corrective action in the case narrative - samples must not be analyzed until control limit criteria have been met.
Analytical Sequence	Analytical sequence is defined as analyses performed within a 24-hour period.	Not applicable	Not applicable
Initial Calibration (IC)	Prior to sample analysis and when calibration verification criteria are not met. Initial calibration will contain all target analytes in each standard.	1. Minimally five concentrations of standards bracketing the expected concentration range for all compounds of interest. One standard must be at or below the QL. 2. The %RSD must be less than or equal to 30 for all target analytes or calibration coefficient of greater than 0.990 for calibration curves 3. Minimum relative response factor (RRF) of ≥ 0.05. 4. If used, tracer gas must be included in calibration. 5. Quantitation of analyses will utilize the initial calibration results.	1. Identify and correct problem. 2. Recalibrate instrument. Samples must not be analyzed until initial calibration criteria are met.
Calibration Verification (CCV)	Every 24 hours, following tune. Calibration verification will contain all target analytes in each standard at a concentration that is representative of the midpoint of the initial calibration.	1. The percent difference must be less than or equal to 30 for all target analytes 2. Minimum RRF of ≥ 0.05.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem and recalibrate. Samples must not be analyzed until continuing calibration criteria are met.
Method Blank Analysis	Prepared with each analytical sequence of 24-hour period. The method blank is an unused, certified canister that has not left the laboratory. The blank canister is pressurized with humidified, ultra-pure zero air and carried through the same analytical procedure as a field sample. The injected aliquot of the blank must contain the same amount of internal standards that are added to each sample.	1. The laboratory method blank must be analyzed after the calibration standard and before any samples are analyzed. 2. The blank can not contain any target analyte at a concentration greater than the QL or analytes with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.	1. Reanalyze blank. 2. If limits are still exceeded, investigate and correct problem. Otherwise, flag data indicating blank contamination was detected. 3. Document communications, any observations and corrective action in the case narrative.
Field/ Equipment Blank Analysis (when requested)	Laboratory-supplied clean SUMMA canister for each batch of canisters. Collected one per sampling day and/or one after every 20 samples, if required. Canister blank may not be required for a project.	The blank can not contain any target analyte at a concentration greater than the QL or analytes with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.	1. Investigate problem. 2. Document communications, any observations and corrective action in the case narrative.

TABLE 3-1B. VOCs SOIL VAPOR QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Internal Standards	Samples, blanks, LCSs must be spiked with method specified internal standards. Add sufficient internal standard equivalent to 10 ppbv in the sample.	1. The area response for each internal standard must be within ± 40 percent of the mean area response of the internal standard in the most recent valid calibration verification. 2. The retention time for each of the internal standards in the blanks must be within ± 0.33 minutes between the analysis and the most recent valid calibration verification.	1. Reanalyze. 2. If recovery is still outside criteria, report both analyses. 3. Document communications, any observations and corrective action in the case narrative.
Laboratory Control Sample (LCS) /Laboratory Control Sample Duplicate (LCSD)	Every 20 samples, one per analysis sequence. LCS will contain all target analytes in each calibration standard, using a second source, at a concentration that is near a midpoint calibration standard. LCSD should also be analyzed for precision if laboratory duplicate analyses are not performed.	Recovery within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	If recovery failures are above control limits and these compounds are not detected in the associated samples above the MDL or QL, corrective action is not required. If recovery failures are below control limits, reanalyze LCS. If reanalysis fails, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. Document communications, any observations and corrective action in the case narrative
Field Duplicate Analysis	One per 20 samples.	Within 25 relative percent difference (RPD) for soil vapor samples. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Sample Analysis	All SUMMA Canister samples should be at temperature equilibrium in the laboratory.	Not applicable	Not applicable
Sample Dilution	Automatic dilution of samples is permitted to obtain an aliquot of sample from the canister. Samples must be diluted and re-analyzed when concentrations exceed the highest calibration standard.	Makeup air should only be humidified ultra pure air. Air source must be same as that used for method blank preparation. Dilution will keep the concentration in the upper half of the initial calibration range.	Not applicable
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable

TABLE 3-1B. VOCs SOIL VAPOR QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Deliverables	Full data deliverables must be provided to document each audit item for easy reference and inspection. An example calculation will be provided for each type of analysis, for each type of matrix in the data package using samples from the project. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. Final spiking concentrations will be presented in summary form. Run logs will be provided in the data packages. Canister pressures prior to shipment and upon receipt, canister certification documentation and leak check evaluation documentation must be included in the data package.	Not applicable	Provide missing or additional deliverables for validation purposes.
Method requirements	The laboratory will perform the method as presented in this table and will adhere to the requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the table in the data package case narrative.	Not applicable	Not applicable

Notes:

Data validation will be performed in accordance with QA/QC criteria established in this table and the analytical methods that are currently used by the laboratory. Excursions from QAPP criteria will be qualified based on guidance provided in this table.

Communications with O'Brien & Gere will be documented and referenced in the data packages.

Source: O'Brien & Gere

TABLE 3-1C. VOCs USING USEPA METHOD 624 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Holding times	Samples must be analyzed within holding time.	Analyze within 14 days from collection; samples preserved to pH less than or equal to 2. If residual chlorine is present in samples, add sodium thiosulfate to the sample container before shipping to the site.	1. If holding times are exceeded for initial or any re-analyses required due to quality control excursions. 2. Notify Quality Assurance Officer (QAO) since re-sampling may be required. 3. Document corrective action in the case narrative.
GC/MS Instrument Performance Check	Once every 12 or 24 hours prior to initial calibration and calibration verifications. Analytical sequence must be completed within 12 or 24 hours of the GC/MS Instrument Performance Check	Bromofluorobenzene (BFB) key ions and abundance criteria listed in Table 2 of Method 624 must be met for all 9 ions and analyses must be performed within 12 or 24 hours of injection of the BFB. Part of the BFB peak will not be background subtracted to meet tune criteria. Documentation of all check analyses and evaluation must be included in the data packages.	1. Tune the mass spectrometer. 2. Document corrective action in the case narrative. 3. Samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis and when calibration verification criteria are not met.	A minimum of three concentrations for each target analyte bracketing expected concentration range for all target compounds. One standard must be at the QL concentration. If RSDs are less than 35%, the average response factor is used for quantitation. If RSD greater than or equal to 35%, the laboratory must generate and use a calibration curve for quantitation. Apply a linear calibration with least squares regression. Use r for un-weighted least squares regression, Coefficient of Determination (COD) or r^2; r, COD or r^2 must be greater than 0.990. Or apply non-linear calibration using no more than third order with seven standards. COD or r^2 must be greater than 0.990. Response factors <i>should be</i> greater than or equal to 0.05 for the target analytes.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action in the case narrative. 4. Samples should not be analyzed until calibration criteria are met. 5. Document corrective action in the case narrative; samples should not be analyzed until calibration criteria are met.
Continuing Calibration Verification (CCV)	Every day of analysis, following Instrument Performance Check at a concentration of 20 ug/L or at the lower end of the calibration curve.	The recoveries for the CCV target analytes must meet criteria listed in Table 5 of Method 624. Response factors <i>should be</i> greater than or equal to 0.05 for target analytes.	1. Reanalyze CCV for the failing target analyte. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action in the case narrative; samples should not be analyzed until calibration criteria are met.
Laboratory Method Blank Analysis	Every day of analysis, following CCV.	Common laboratory contaminants (acetone, methylene chloride) less than 5 X QL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in

TABLE 3-1C. VOCs USING USEPA METHOD 624 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
		Remaining target analytes less than QL.	blank. 3. Document corrective action. 4. Samples cannot be analyzed until blank criteria have been met.
Laboratory Control Sample (LCS) Analysis	Each analytical batch (every 12 or 24 hours). Prepared independently from calibration standards. Spike must contain all target analytes and should be at a concentration, which is in the lower 1/2 of the calibration curve.	Recovery within Method Table 5 or laboratory control limits. For compounds without established control limits, 70 to 130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. If recovery failures are above control limits and these target analytes are not detected in the associated samples, corrective action is not required. 2. If recovery failures are below control limits, reanalyze LCS and examine results of other QC analyses. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action in the case narrative.
Internal Standards	All samples and blanks and quality control samples.	Response -50% to +100% of internal standards from the midpoint of the CCV. RT must be within 30 sec of the mean retention time in the associated calibration verification standard.	1. Reanalyze. 2. Document corrective action.
Matrix Spike/ Matrix Spike Duplicate Analysis	Collected per project requirements. Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact O'Brien & Gere Project Manager upon receipt of samples at the laboratory. Spike must contain complete list of target analytes.	Recovery within Method Table 5 or laboratory control limits. For compounds without established control limits, 70 to 130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze if less than 10% recovery. 2. If greater than 10% and LCS criteria are met, document in case narrative; no additional corrective action required. 3. If LCS criteria are exceeded also, examine other QC data for source of problem; i.e., surrogate recoveries for calibration data for instrument performance issues. 4. Take corrective action as required, re-extract, or reanalyze samples and associated MS/MSD and LCSs as required.
Equipment and Field Blank Analysis	Collected per project requirements. Equipment blank is not required if dedicated sampling equipment used.	Common laboratory contaminants (acetone, methylene chloride) less than 5 X QL. Remaining target analytes less than QL. QLs and MDLs will be provided along with the blank results.	1. Document in case narrative.
Trip Blank	1 per cooler containing VOC samples.	Common laboratory contaminants (acetone, methylene chloride) less than 5 X QL. Remaining target analytes less than QL. QLs and MDLs will be provided along with the blank results.	1. Document in case narrative.
Field Duplicate Analysis	Collected per project requirements.	50% RPD for aqueous samples. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.

TABLE 3-1C. VOCs USING USEPA METHOD 624 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
		evaluate field duplicates.	
Surrogate Spike	All samples, blanks, and quality control samples.	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze any environmental or QC sample with surrogates that exceed control limits. 2. Document corrective action.
Identification	Samples, blanks, and quality control samples	Retention times must be within 30 seconds of the CCV. The characteristic masses for the primary and two secondary ions must maximize within one scan of each other. The peak heights of the three ions present in standard mass spectrum must be within 20% of the relative intensity of the reference spectrum. The reference spectrum must not contain co-eluting analytes. For isomers, resolution (baseline to valley height between isomers) must be less than 25%.	1. If identification criteria are not met, but in the judgment of the GC/MS operator the target compound is present, proceed with quantitation and document reasoning in data package.
Quantitation	Samples, blanks, and quality control samples	Internal standard method of quantitation must be used by applying the primary characteristic ions specified in the method unless interferences are present. Alternate use of ions must be documented. Concentrations must be within the linear calibration range of the instrument.	1. If concentration is above the linear range, dilute the sample and reanalyze. The dilution should result in concentration being within the upper range of the calibration curve.
Dilutions	1. When target analyte concentration exceeds upper limit of calibration curve. 2. When matrix interference is demonstrated by the lab and documented in the case narrative (highly viscous samples or a large number of nontarget peaks on the chromatogram). 3. A reagent blank will be analyzed if an analyte saturates the detector or if highly concentrated analytes are detected. 4. Laboratory will note in the data deliverables which analytical runs were reported.	1. The reagent blank will meet the method blank criteria.	1. Reanalyze reagent blank until blank criteria are met. 2. Document corrective action in the case narrative.
pH Determination	Once sample aliquot is taken from the VOC vial, the pH of water samples must	Record pH and report in the data package.	Not applicable

TABLE 3-1C. VOCs USING USEPA METHOD 624 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
	be determined.		
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Deliverables	1. When requested, full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures and any observations of bubbles in sample containers will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.

TABLE 3-1C. VOCs USING USEPA METHOD 624 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
	7. Run logs will be provided in the data packages.		
Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Notes: Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with the QAO will be documented and included in the data packages.			

TABLE 3-2. SVOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Applies to: USEPA Methods 8000C/8270C/8270D			
Holding Times	Samples must be extracted and analyzed within holding time.	Extract within 7 days from collection for aqueous samples; 14 days for soil samples. Analyze extracts within 40 days of extraction.	If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the QAO since re-sampling may be required.
MS Tuning	Once every 12 hours prior to initial calibration and calibration verification. Must contain 50ng/uL of 4,4-DDT, pentachlorophenol, and benzidine.	1. DFTPP key ions and abundance criteria listed in the method must be met for all 13 ions and analyses must be performed within 12 hours of injection of the DFTPP. 2. Part of the DFTPP peak will not be background subtracted to meet tune criteria. 3. Documentation of all DFTPP analyses and evaluations must be included in the data packages. 4. Degradation of 4,4-DDT <20%. Peak tailing must not be evident.	1. Tune the mass spectrometer. 2. Document any observations and corrective action in the case narrative - samples cannot be analyzed until control limit criteria have been met.

TABLE 3-2. SVOCs QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Initial Calibration	Prior to sample analysis and when calibration verification criteria are not met. Initial calibration will contain all target analytes in each standard. Quantitation of analyses will utilize the initial calibration results.	- Five concentrations bracketing expected concentration range for all compounds of interest with one standard at or less than the QL - One second-source standard should be analyzed immediately following the initial calibration at the mid-calibration concentration. This standard must be within 30% recovery or within laboratory control limits. - It is also recommended that a separate standard at the MDL level be analyzed after calibration is complete to check sensitivity. - Response factors (RFs) must be >0.050. 8270D- RFs must meet criteria listed in Method 8270D; remaining RFs must be 0.05 with RF of 0.01 for n-nitroso-di-n-propylamine and 2,4-dimethylphenol. - For compounds with %RSD >15, quantification must be performed using a separate calibration curve and the COD must be ≥ 0.990. 8270D - For compounds with %RSD >20, quantification must be performed using a separate calibration curve and the COD must be ≥ 0.990. If linear regression is used for the calibration curve, the low level initial calibration standard should be evaluated for accuracy using criteria of %D < 30% from the true value. - Relative retention for each target analyte in each calibration standard must agree within ± 0.06 units.	- Identify and correct problem. - If criteria are still not met, recalibrate. - Document any observations and corrective action in the case narrative - samples should not be analyzed until calibration control limit criteria are met.

TABLE 3-2. SVOCs QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Calibration Verification	Every 12 hours, following DFTPP. Calibration verification will contain all target analytes in each standard at a concentration that is representative of the midpoint of the initial calibration.	1. Within method specified criteria, percent drift or percent difference (%D) ≤ 20 for target analytes. Response factor requirements as listed in initial calibration. 2. 8270D- %D ≤ 20 for target analytes. 3. The internal standards areas and retention times must meet the method criteria.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document any observations and corrective action in the case narrative - samples should not be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Prepared with each extraction batch of no more than 20 analytical samples.	1. Common laboratory contaminants (phthalate) less than 5 x QL. Remaining analytes less than QL. 2. QLs and MDLS will be provided along with the preparation blank results.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system and re-extract and reanalyze all samples if detected for same compounds as in the blank. 3. Document any observations and corrective action in the case narrative - samples should not be analyzed until blank criteria have been met.
Field/ Equipment Blank Analysis	Collected one per sampling event, or one per 20 samples or one per matrix (for less than 20 samples)	1. Common laboratory contaminants (phthalate) less than 5 x QL. Remaining analytes less than QL. 2. QLs and MDLS will be provided along with the blank results.	1. Investigate problem. 2. Document any observations and corrective actions in the case narrative.
Laboratory Control Sample Analysis	Prepared with each extraction batch, of no more than 20 analytical samples. Prepared independently from calibration standards. Spike must contain all target compounds and should be at a concentration that is approximately in the lower 1/2 of the calibration curve.	Recovery within laboratory control limits. For compounds without established laboratory control limits, 70 to 130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, no corrective action is required. 2. If recovery failures are below the control limits, reanalyze LCS. 3. If re-analysis fails, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document any observations and corrective action in the case narrative.

TABLE 3-2. SVOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Internal Standards	All samples and blanks (including MS/MSD).	Response -50% - +200% of the internal standards from the continuing cal of the day. RT must be $\pm$ 30 sec. from calibration verification of that sequence.	1. Reanalyze. 2. If recovery is still outside criteria, report both analyses. 3. Document any observations and corrective action in the case narrative.
Surrogate Spike	All samples and blanks (including MS/MSD).	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze if more than 1 AE or 1 BN fails, or if any one surrogate recovery is < 10%. 2. If recovery meets criteria, report both analyses. 3. If re-analysis recovery fails and if the recovery is <10%, re-extract sample if within holding time and re-analyze. 4. If re-analysis recovery fails and if the recovery is >10%, report both analyses. 5. Document any observations and corrective action in the case narrative.
Matrix Spike/ Matrix Spike Dup. (MS/MSD) Analysis	Collected one per 20 samples or one per matrix (for less than 20 samples) Samples from the investigation must be used for MS/MSD analysis. Spike must contain complete list of target analytes.	Recovery and RPD within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze if <10%. 2. If reanalysis is < 10%, report both analyses and document in the case narrative. 3. If reanalysis is >10%, document in the case narrative. 4. Document any observations and corrective action in the case narrative.
Field Duplicate Analysis	Field collected - One for every 20 samples or one per matrix (for less than 20 samples) Field duplicate will not be identified to the laboratory.	Validation criteria: 50% RPD for waters, 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.

TABLE 3-2. SVOCs QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Target Analyte Identification	As required for identification of target analytes	1. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion. 2. The relative retention time (RRT) of the sample component is within ± 0.06 RRT units of the RRT of the standard component. 3. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.) 4. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times.	Not applicable

TABLE 3-2. SVOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
		5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important. 6. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes coelute (i.e., only one chromatographic peak is apparent), the identification criteria may be met, but each analyte spectrum will contain extraneous ions contributed by the co-eluting compound.	
Cleanup	Gel permeation chromatography (GPC) should be performed for water should extracts with high molecular weight contaminants.	Calibrate according to method. Criteria must be met as listed in method for calibration and blank analysis.	Clean GPC column or replace.
Tentatively Identified Compounds	If required, prepare for each sample and blank analysis. Non-target compounds will be reported using a Mass Spectral Library search.	Not applicable	Not applicable
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Percent solids	For soil/ samples, the percent solids will be determined and sample results will be corrected for percent solids.	Not applicable	Not applicable

TABLE 3-2. SVOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Dilutions	1. When target analyte concentration exceed upper limit of calibration curve. 2. When matrix interference demonstrated by lab and documented in the case narrative (highly viscous samples or a large number of non-target peaks on the chromatogram). 3. Samples should be cleaned up during sample preparation/extraction procedure using appropriate methods when matrix interference is present. 4. Laboratory will note in the data deliverables which analytical runs were reported.	Not applicable	Not applicable
Laboratory control limits	1. Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Deliverables	1. Full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.

TABLE 3-2. SVOCS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8270C/8270D)	Corrective Action
Method and QCD requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Notes: Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods that are currently used by the laboratory. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with the QAO will be documented and included in the data packages. Source: O'Brien & Gere			

TABLE 3-3. PCBS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns) (Criteria for 8000C/8082/ 8082A)	Corrective Action (Applies to both primary and confirmation columns)
Applies to: USEPA Method 8000C/8082/8082A			
Holding Times	Samples must be extracted and analyzed within holding time.	Extract within 7 days from collection for aqueous samples and 14 days from collection for solid samples. Analyze extracts within 40 days of extraction.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the QAO immediately since re-sampling may be required. 2. Document any observations and corrective action in the case narrative.
Initial Calibration	Prior to start up and when criteria are exceeded for continuing calibration. Calibrations must contain all target analytes. Quantitation of analyses will utilize the initial calibration results.	1. Minimally five concentrations for Aroclor 1016/1260 (one point calibration for the remaining Aroclors), one calibration standard must be at concentration less than or equal to the QL. 2. Recommended that if results are reported below the QL, a separate standard at the MDL level analyzed after calibration is complete to check sensitivity. 3. If $RSD \leq 20\%$, the average relative response factor (internal calibration) or average calibration factor (external calibration) is used for quantitation. If $RSD > 20\%$, a linear regression calibration that does not pass through the origin with a correlation coefficient (r) ≥ 0.990 is used for quantitation; or a nonlinear first or second order calibration curve with a coefficient of determination (COD) of ≥ 0.990 is used for quantitation.	1. Identify and correct problem. 2. Recalibrate instrument; samples should not be analyzed until initial calibration criteria are met. 3. Document any observations and corrective action in the case narrative.
Calibration Verification	Calibration standards must contain Aroclor 1016/1260 at the mid-range concentration. Calibration verification standards must be analyzed every 20 samples and must bracket each end of the sample sequence. In the case that Aroclors are detected above the MDL concentration in the associated samples, the identified Aroclor must be analyzed within the same 48 hour period as the sample in a valid analytical sequence.	Calibration verification response (% difference) or concentration (% drift) $\leq 15\%$. 8282A - Calibration verification response $\%D \leq 20\%$. RT for each target analyte must be within established RT windows.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. Samples must be bracketed by compliant calibration standards. 3. Document any observations and corrective action in the case narrative.
Retention Time Windows	Retention time windows (absolute retention time) must be established in accordance with USEPA Method 8000B/8000C or relative retention times must be used if internal standards are employed.	Compounds must be within established retention time windows or within laboratory established relative retention time criteria for the succeeding calibration standards. Retention time windows must be provided for each calibration verification. Retention times for each surrogate analyzed for samples and QC samples must be provided on a summary form.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. 3. Document any observations and corrective action in the case narrative.

TABLE 3-3. PCBS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns) (Criteria for 8000C/8082/ 8082A)	Corrective Action (Applies to both primary and confirmation columns)
Method Blank Analysis	Method Blank : 1 per 20 samples of similar matrix extracted at the same time and undergo same cleanup procedures as samples or a separate cleanup blank must be prepared and analyzed.	Compound concentrations must be <QL.	1. Reanalyze. 2. If limits are still exceeded, re-extract and reanalyze method blank and associated samples. Samples must not be analyzed until method blank criteria are met. 3. Document any observations and corrective action in the case narrative.
Blank Analysis	Instrument blank: Must be analyzed at the beginning of 12 hour sequence, following the initial calibration verification standard.	Compound concentrations must be <QL.	1. Reanalyze. 2. If limits are still exceeded, re-extract and reanalyze method blank and associated samples. Samples must not be analyzed until method blank criteria are met. 3. Document any observations and corrective action in the case narrative.
Laboratory Control Sample Or Matrix Spike Blank Analysis	1 per 20 samples of similar matrix extracted at the same times. LCS must be spiked with the Aroclor suspected to be at the site at concentrations near the low end of the calibration curve. Otherwise, Aroclor 1016/1260 or other Aroclors may be used in the LCS analysis.	Percent recoveries must be within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze and examine results of other QC analyses. 2. If the percent recovery is above laboratory control limits and the affected compound is not detected in the associated samples, corrective action is not required; document in case narrative. 3. If percent recovery is below laboratory control limits or <10%, reanalyze LCS. 4. If re-analysis fails, locate and correct problem, recalibrate instrument and re-extract and/or re-analyze samples since last satisfactory LCS. 5. Document any observations and corrective action in the case narrative.
MS/MSD Analysis	1 per 20 samples of similar matrix extracted at the same times. MS/MSDs must be spiked with the Aroclor suspected to be at the site at concentrations near the low end of the calibration curve. Otherwise, Aroclor 1016/1260 or other Aroclors may be used. Samples from the investigation must be used for MS/MSD analysis.	Recovery and RPD within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze if <10%. 2. If reanalysis is still <10%, report both analyses and document in the case narrative. 3. If re-analysis is >10%, no additional corrective action required. 4. Document any observations and corrective action in the case narrative.

TABLE 3-3. PCBS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns) (Criteria for 8000C/8082/ 8082A)	Corrective Action (Applies to both primary and confirmation columns)
Surrogate Spike	Samples, blanks, MS/MSDs, and LCSs must be spiked with method specified surrogate compounds on each column used in the analysis.	Recovery within laboratory control limits. Corrective action is not required if one of the four surrogates (for two columns) has recovery outside of control limits if the recovery is >10% and the remaining three surrogates are within control limits. Surrogate recoveries for each surrogate on each column must be provided in a summary form. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze. 2. If reanalysis recovery fails criteria but is >10%, report both analyses and document in case narrative report. 3. If reanalysis recovery is <10%, re-extract and reanalyze the sample. Special Circumstances. If matrix interference is present (as documented in the case narrative): 1. Reanalyze sample; may be at a higher dilution. 2. Report both analyses. Document any observations and corrective action in the case narrative.
Identification	Samples, blanks, and QC data.	Retention times must be within established retention time windows or must meet relative retention time criteria. Confirmation analysis is required. Retention time windows must be provided for each calibration verification.	1. Investigate problem; reanalyze calibration standards to check for retention time shift. 2. Document any observations and corrective action in the case narrative.

TABLE 3-3. PCBS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns) (Criteria for 8000C/8082/ 8082A)	Corrective Action (Applies to both primary and confirmation columns)
Quantitation	Samples, blanks, and QC data.	Confirmation analysis is required. USEPA CLP Form 10 Summary (or equivalent) form, providing the percent difference and retention times for all detected analytes in samples and QC samples, will be provided. Percent difference must be less than 25%: Difference between Primary column concentration and the Confirmation column divided by the Primary column times 100. Internal or external standard method may be used. Verify concentration is within linear calibration range of standards. Aroclor concentration is determined using response factor for each of the characteristic peaks and then averaging the five concentrations. Peak areas from a minimum of three Aroclor peaks unique to the target Aroclor will be used to quantitate the Aroclor concentration. Every effort must be made to meet specified QL requirements. Lab must state the technique used for quantitation of results for the samples.	1. If concentration is above linear calibration range, dilute sample and reanalyze. Dilution should result in concentration in the upper calibration range of the instrument. 2. Document any observations and corrective action in the case narrative.
Field/ Equipment Blank Analysis	Collected one per sampling equipment and after every 20 samples.	Compounds concentrations must be <QL.	1. Investigate problem; reanalyze to verify laboratory cross contamination is not a factor. 2. Document in the case narrative.
Field Duplicate Analysis	Collected 1 per matrix type; every 20 samples of similar matrix.	Validation criteria: 50% RPD for waters and 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis during the validation process.

TABLE 3-3. PCBS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns) (Criteria for 8000C/8082/ 8082A)	Corrective Action (Applies to both primary and confirmation columns)
Chromatography Presentation	For each standard, sample and QC sample analysis.	Copies of chromatograms provided in the data package must be large enough to view during validation; detail of each peak involved in the Aroclor identification, including peak shape and associated baseline. In the case that matrix interference is detected or manual integration is performed, enlarged copies of those manipulations will be included in the data package for review.	1. Provide requested information.
Cleanup	Acid wash clean-up is used for PCB extracts.	Calibrate according to method. Criteria must be met as listed in method.	Not applicable
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages. USEPA Form 8 Summary form, providing the date, time of analysis of samples and QC samples, surrogate retention times and surrogate retention time window, will be provided.	Not applicable	Not applicable
Confirmation Analysis	Dual column quantitation and qualitative confirmation will be performed. The information presented in CLP Form 10 will be provided in the data package for evaluation.	Not Applicable	Not Applicable
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Percent solids	For solids samples, the percent solids will be determined and sample results will be corrected for percent solids.	Not applicable	Not applicable
Dilutions	- When target analyte concentration exceed upper limit of calibration curve. - When matrix interference demonstrated by lab and documented in the case narrative (highly viscous samples or a large number of non-target peaks on the chromatogram).. - Samples should be cleaned up during sample preparation/extraction procedure using appropriate methods when matrix interference is present. - Laboratory will note in the data deliverables which analytical runs were reported.	The reagent blank will meet the method blank criteria.	Reanalyze reagent blank until method blank criteria are met.

TABLE 3-3. PCBS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns) (Criteria for 8000C/8082/ 8082A)	Corrective Action (Applies to both primary and confirmation columns)
Deliverables	1. Full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.
Method and QCD requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable

Notes:

Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods that are currently used by the laboratory. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP.

Communications with the QAO will be documented and included in the data packages

Source: O'Brien & Gere

TABLE 3-4. ORGANOCHLORINE PESTICIDES QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns)	Corrective Action (Applies to both primary and confirmation columns)
Applies to: USEPA Method 8000C, USEPA Method 8081A/8081B (Organochlorine Pesticides)			
Holding Times	Samples must be extracted and analyzed within holding time.	Extract within 7 days from collection for aqueous samples and 14 days from collection for solid samples. Analyze extracts within 40 days of extraction.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the Project Manager immediately since re-sampling may be required. 2. Document any observations and corrective action in the case narrative.
Initial Calibration	Prior to start up and when criteria are exceeded for continuing calibration. Calibrations must contain all target analytes. Quantitation of analyses will utilize the initial calibration results.	1. Minimally five concentrations for each single component analyte. One calibration standard must be at concentration less than or equal to the QL. 2. It is recommended that if results are reported below the QL, a separate standard at the MDL level analyzed after calibration is complete to check sensitivity. 3. Toxaphene requires a single point calibration. If detected in samples, the samples are re-analyzed behind a five-point calibration for each detected analyte. 4. If $RSD \leq 20\%$ the average relative response factor (internal calibration) or average calibration factor (external calibration) is used for quantitation. If $RSD > 20\%$ a linear regression calibration that does not pass through the origin with a correlation coefficient (r) ≥ 0.990 is used for quantitation; or a nonlinear first or second order calibration curve with a coefficient of determination (COD) of ≥ 0.990 is used for quantitation. 5. 8081B- Degradation of 4,4'-DDT/ endrin to 4,4'-DDE, 4,4'-DDD/ endrin ketone, endrin breakdown must be less than 15%.	1. Identify and correct problem. 2. Recalibrate instrument; samples should not be analyzed until initial calibration criteria are met. 3. Document any observations and corrective action in the case narrative.

TABLE 3-4. ORGANOCHLORINE PESTICIDES QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns)	Corrective Action (Applies to both primary and confirmation columns)
Calibration Verification	Single component analyte calibration standards must contain each target analyte at mid-range concentration. Calibration verification standards must be analyzed at the beginning of 12 hour sequence and every 20 samples (every 10 samples is recommended), and at the close of the sequence. Pesticides- A standard containing 4,4-DDT and endrin must be analyzed at the beginning of each 12 hour sequence. Calibration verification standards must be analyzed every 20 samples and must bracket each end of the sample sequence. In the case that Aroclors are detected above the MDL concentration in the associated samples, the identified Aroclor must be analyzed within the same 48 hour period as the sample in a valid analytical sequence.	Calibration verification response (% difference) or concentration (% drift) $\leq$ 20%. Pesticides- Degradation for 4,4-DDT and endrin must be $<15\%$. Method 8081B- Degradation of 4,4'-DDT/ endrin to 4,4'-DDE, 4,4'-DDD/ endrin ketone, endrin breakdown must be less than 15%.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. Samples must be bracketed by compliant calibration standards. 3. Document any observations and corrective action in the case narrative.
Retention Time Windows	Retention time windows (absolute retention time) must be established in accordance with USEPA Method 8000B/8000C or relative retention times must be used if internal standards are employed.	Compounds must be within established retention time windows or within laboratory established relative retention time criteria for the succeeding calibration standards. Retention time windows must be provided for each calibration verification. Retention times for each surrogate analyzed for samples and QC samples must be provided on a summary form.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. 3. Document any observations and corrective action in the case narrative.
Blank Analysis	Method Blank : 1 per 20 samples of similar matrix extracted at the same time and undergo same cleanup procedures as samples or a separate cleanup blank must be prepared and analyzed. Instrument blank: Must be analyzed at the beginning of 12 hour sequence, following the initial calibration verification standard.	Compound concentrations must be $<QL$.	1. Reanalyze. 2. If limits are still exceeded, re-extract and reanalyze method blank and associated samples. Samples must not be analyzed until method blank criteria are met. 3. Document any observations and corrective action in the case narrative.
Laboratory Control Sample Or Matrix Spike Blank Analysis	1 per 20 samples of similar matrix extracted at the same times. LCSs must be spiked with each of the single component analyte at concentrations near the low end of the calibration curve.	Percent recoveries must be within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. If the percent recovery is above laboratory control limits and the affected compound is not detected in the associated samples, corrective action is not required; document in case narrative. 2. If percent recovery is below laboratory control limits or $<10\%$, reanalyze LCS. 3. If re-analysis fails, locate and correct problem, recalibrate instrument and re-extract and/or re-analyze samples since last satisfactory LCS. 4. Document any observations and corrective action in the case narrative.

TABLE 3-4. ORGANOCHLORINE PESTICIDES QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns)	Corrective Action (Applies to both primary and confirmation columns)
MS/MSD Analysis	1 per 20 samples of similar matrix extracted at the same times. MS/MSDs must be spiked with each of the single component analyte at concentrations near the low end of the calibration curve. Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact QAO upon receipt of samples at the laboratory.	Recovery and RPD within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze if <10%. 2. If reanalysis is still <10%, report both analyses and document in the case narrative. 3. If re-analysis is >10% no additional corrective action required. 4. Document any observations and corrective action in the case narrative.
Surrogate Spike	Samples, blanks, MS/MSDs, and LCSs must be spiked with method specified surrogate compounds on each column used in the analysis.	Recovery within laboratory control limits. Corrective action is not required if one of the four surrogates (for two columns) has recovery outside of control limits if the recovery is >10% and the remaining three surrogates are within control limits. Surrogate recoveries for each surrogate on each column must be provided in a summary form. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze. 2. If reanalysis recovery fails criteria but is >10%, report both analyses and document in case narrative report. 3. If reanalysis recovery is <10%, re-extract and reanalyze the sample. Special Circumstances. If matrix interference is present (as documented in the case narrative): 1. Reanalyze sample; may be at a higher dilution. 2. Report both analyses. Document any observations and corrective action in the case narrative.
Internal Standards	Where applicable: All samples and blanks (including MS/MSD)	Response -50% - +50% of internal standards from continuing calibration of the day. RT must be $\pm$ 30 sec. from associated calibration verification standard of that sequence.	1. Reanalyze. 2. If still outside of the limits, report both analyses. 3. Document any observations and corrective action in the case narrative.

TABLE 3-4. ORGANOCHLORINE PESTICIDES QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns)	Corrective Action (Applies to both primary and confirmation columns)
Identification	Samples, blanks, and QC data.	Retention times must be within established retention time windows or must meet relative retention time criteria. Duel column confirmation (quantitative and qualitative) analysis is required. Retention time windows must be provided for each calibration verification. USEPA CLP Form 10 Summary form, providing the percent difference and retention times for all detected analytes in samples and QC samples, will be provided. Percent difference must be less than 25 %D. %D calculation: Difference between Higher concentration of sample and Lower concentration of sample divided by the Lower concentration of sample times 100.	- Investigate problem; reanalyze calibration standards to check for retention time shift. - Document any observations and corrective action in the case narrative.
Quantitation	Samples, blanks, and QC data.	Confirmation analysis is required. Internal or external standard method may be used. Verify concentration is within linear calibration range of standards. Every effort must be made to meet specified QL requirements. Lab must state the technique used for quantitation of results for the samples.	- If concentration is above linear calibration range, dilute sample and reanalyze. Dilution should result in concentration in the upper calibration range of the instrument. - Document any observations and corrective action in the case narrative.
Field Blank Analysis	Field collected - One per sampling equipment and after every 20 samples.	Compounds concentrations must be <QL.	- Investigate problem; reanalyze to verify laboratory cross contamination is not a factor. - Document any observations and in the case narrative.
Field Duplicate Analysis	Field collected – One for each matrix type, every 20 samples of similar matrix.	Validation criteria: 50% RPD for waters and 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis during the validation process.

TABLE 3-4. ORGANOCHLORINE PESTICIDES QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns)	Corrective Action (Applies to both primary and confirmation columns)
Chromatography Presentation	For each standard, sample and QC sample analysis.	Copies of chromatograms provided in the data package must be large enough to view during validation; detail of each peak involved in the Aroclor identification, including peak shape and associated baseline. In the case that matrix interference is detected or manual integration is performed, enlarged copies of those manipulations will be included in the data package for review.	1. Provide requested information.
Cleanup	GPC must be performed for all pesticide solids or water extracts with high molecular weight contaminants. Sulfur must be performed for all sample extracts contaminated with sulfur. Florisil cartridge cleanups are mandatory for all pesticide extracts.	Calibrate according to method. Criteria must be met as listed in method.	For GPC, perform column maintenance, recalibrate. For florisil, obtain a new lot of cartridges.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages. USEPA Form 8 Summary form, providing the date, time of analysis of samples and QC samples, surrogate retention times and surrogate retention time window, will be provided.	Not applicable	Not applicable
Confirmation Analysis	Dual column quantitation and qualitative confirmation will be performed. The information presented in CLP Form 10 will be provided in the data package for evaluation.	Not Applicable	Not Applicable
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Percent solids	For solids samples, the percent solids will be determined and sample results will be corrected for percent solids.	Not applicable	Not applicable

TABLE 3-4. ORGANOCHLORINE PESTICIDES QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency (Applies to both primary and confirmation columns)	Control Limits (Applies to both primary and confirmation columns)	Corrective Action (Applies to both primary and confirmation columns)
Dilutions	- When target analyte concentration exceed upper limit of calibration curve. - When matrix interference demonstrated by lab and documented in the case narrative (highly viscous samples or a large number of non-target peaks on the chromatogram). - Samples should be cleaned up during sample preparation/extraction procedure using appropriate methods when matrix interference is present. - Laboratory will note in the data deliverables which analytical runs were reported.	The reagent blank will meet the method blank criteria.	Reanalyze reagent blank until method blank criteria are met.
Deliverables	- Full deliverables must be provided to document each audit item for easy reference and inspection. - An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. - Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. - Final spiking concentrations will be presented in summary form. - Standard tracing information will be provided. - Cooler temperatures will be provided in the data packages. - Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.
Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable

Notes:

Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods that are currently used by the laboratory. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP.

Communications with the QAO will be documented and included in the data packages.

Source: O'Brien & Gere

TABLE 3-5. METALS, MERCURY AND TOTAL CYANIDE QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 6010C ,6020 ,6020A, 7471B, and 9012B)	Corrective Action
Applies to: metals by USEPA Methods 6010B/6010C/6020/6020A, mercury by USEPA Methods 7470A/7471A/7471B and total cyanide by USEPA Methods 9012A/9012B/9014			
Holding Times	Samples must be digested and analyzed within holding time.	Metals: 180 days from collection to analysis. Mercury: 28 days from collection to analysis. Cyanide: 14 days from collection to analysis.	1. If holding times are exceeded for initial or any reanalysis required due to QC excursions, notify the QAO since re-sampling may be required. 2. Document any observation or corrective action in the case narrative.
Mass Tuning	<i>A solution containing elements representing mass regions of interest (Li, Co, In, and Tl for example) must be analyzed prior to sample analysis.</i>	<i>Mass calibrations must be within 0.1amu from the true value. The resolution must be <0.9amu full width at 10 percent peak height.</i>	1. <i>Adjust the mass calibration until criteria are met.</i>
Initial Calibration Verification and Continuous Calibration Verification (Metals, mercury, cyanide) (ICV, CCV)	A minimum of two-point calibration for ICP consisting of one at least one standard and one blank. Is required. <i>An appropriate internal standard is required for each analyte. Recommended internal standards are 6Li, 45Sc, 74Ge, 89Y, 103Rh, 115In, 159Tb, 169Ho, and 209Bi.</i> Five point calibration for remaining methods, with one standard at the QL level. Calibrate each time instrument is set up. After calibration, Initial calibration verification (ICV) is performed. The ICV is from a source independent of the calibration standards. For cyanide, the ICV must be distilled. A continuing calibration verification (CCV) is analyzed at the beginning of the run, at 10% or every 2 hours. Also verify at the end of each run. <i>It is also recommended that low level initial calibration standard (LLICV) and a low level calibration verification (LLCCV) standard be analyzed at the beginning and end of the run.</i>	ICV, CCV - 90% to 110% of expected value for ICP, AA, colorimeter, and spectrophotometer. ICV for Mercury – 90% to 110% of expected true value. CCV for Mercury - 80% to 120% of expected true value. Correlation coefficient for first or second order curve must be ≥ 0.995 . For cyanide the ICV and CCV must meet 85 to 115% recovery. <i>Percent recoveries for LLICV/LLCCV must be within 70-130%.</i>	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document any observation or corrective action in the case narrative - samples should not be analyzed until calibration control limit criteria have been met.

TABLE 3-5. METALS, MERCURY AND TOTAL CYANIDE QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 6010C ,6020 ,6020A, 7471B, and 9012B)	Corrective Action
Lower Limit of Quantitation Check (LLQC)	1. For ICP, AA, and cyanide, LLQC is a standard at the QL concentration analyzed at the beginning of each run for all elements at the QL level	The percent recovery of the LLQC must meet the control limits of 70-130%.	1. The LLQC shall be re-analyzed immediately for those analytes; if the results of the re-analysis for those analytes fall within the control limits, no further corrective action is required. 2. If the results of the re-analysis for those analytes do not fall within the control limits, the analysis shall be terminated, the problem corrected, the instrument recalibrated, the LLQC analyzed, and the samples associated with the LLQC re-analyzed. 3. Document any observation or corrective action in the case narrative.
Initial and Continuing Calibration Blank (ICB/CCB) (Metals, mercury, cyanide)	After ICV, CCV, at beginning and end of run and at a rate of 10% or every 2 hours during run.	The absolute value of the ICB and CCB must not exceed the QL.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate and reanalyze affected samples. 3. Document any observation or corrective action in the case narrative- samples cannot be analyzed until blank control limit criteria have been met.
<i>Rinse Blank</i>	<i>Rinse blank must be analyzed following every sample and standard to flush the instrument..</i>	<i>The absolute value of the rinse blank must not exceed the QL.</i>	1. Identify and correct problem. 2. If criteria are still not met, recalibrate and reanalyze affected samples. 3. Document any observation or corrective action in the case narrative - samples cannot be analyzed until blank control limit criteria have been met.
Preparation Blank Analysis	One for each batch of samples prepared/ digested, or 1 in 20 samples, whichever is greater. PB shall be carried through the complete procedure and contain the same acid concentration in the final solution as the sample solution used for analysis.	The absolute value of the method blank must not exceed the QL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and re-preparation and reanalyze affected samples if detected. 3. Document any observation or corrective action in the case narrative - samples cannot be analyzed until blank criteria are met.
Field/Equipment Blank Analysis	Field collected - One per sampling event, or one per 20 samples or one per matrix (for less than 20 samples)	Less than QL	1. Investigate problem. 2. Document any observation or in the case narrative.

TABLE 3-5. METALS, MERCURY AND TOTAL CYANIDE QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 6010C ,6020 ,6020A, 7471B, and 9012B)	Corrective Action
Laboratory Control Sample Analysis	Every 20 samples or each digestion batch. Prepared independently from calibration standards.	Recovery within 80 to 120%	1. Reanalyze LCS and examine results of other QC analyses. 2. If recovery is still outside limits, report both runs. 3. Document corrective action in the case narrative.
Serial Dilution Analysis for ICP (Metals)	Required once per analytical batch when analyte concentration is >10 times the instrument detection limit (IDL) (or MDL if applicable). Samples from the investigation must be used for Serial dilution analysis.	An analysis of a 1:5 dilution of the sample should provide a result with 90% to 110% of the original determination (for concentrations 10x the lower limit of quantitation after dilution)	1. Report results. 2. Document corrective action in the case narrative.
Interference Check Sample Analysis for ICP (Metals)	Beginning and end of each analytical run or twice during every 8 hours, whichever is more frequent for ICP. Solution A consists of the interferences, and Solution AB consists of the analytes mixed with the interferences.	Results for the ICS Solution AB (ICSAB) during the analytical runs shall fall within the control limit of ± 2 times the QL of the true value or $\pm 20\%$ of the true value, whichever is greater, for the analytes included in the ICSAB	1. Reanalyze. 2. If limits are still exceeded, adjust instrument. 3. Restart analytical run and reanalyze samples analyzed since last satisfactory ICS. 4. Document any observation or corrective action in the case narrative.
Matrix Spike Analysis (Metals, mercury, cyanide)	Collected one per 20 samples or one per matrix (for less than 20 samples) Samples from the investigation must be used for MS/MSD analysis.	Recovery within laboratory control limits or 75-125%, or in-house laboratory limits. Recovery does not apply if sample concentration > 4 X spike concentration. Spike must contain all analytes. The lowest acceptable laboratory control limits for recovery will be 10%.	1. Analyze post-digestion/post-distillation spike at two times the QL or two times the indigenous level, whichever is greater. 2. Document any observation or corrective action in the case narrative.
Post-Digestion Spike (Recommended for Metals, mercury, cyanide)	Spike must contain all target elements. Performed every 20 samples as necessary.	Recovery within 80-120% of true value.	1. Dilute sample and reanalyze. 2. Recovery of the reanalysis must be 90-110% of the original analysis. 3. If recovery is outside limits, document in the case narrative. 4. Standard additions may be used to compensate for matrix effects.
Internal standard	Monitored for all samples, blanks, standards, and QC samples analyzed.	Internal Standard counts must be within 30% of Internal Standard counts of the calibration standard for all samples and standards.	1. If internal standard area is not within 30%, review the internal areas of the closest calibration blanks for compliance. If the calibration blanks meet criteria; dilute the sample five fold and reanalyze. 2. If the internal standard area of the calibration blank is also outside of 30%, stop sample analysis and recalibrate.

TABLE 3-5. METALS, MERCURY AND TOTAL CYANIDE QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 6010C ,6020 ,6020A, 7471B, and 9012B)	Corrective Action
Laboratory Duplicate or Matrix Spike Duplicate Analysis	Collected one per 20 samples or one per matrix (for less than 20 samples) Samples from the investigation must be used for Laboratory Duplicate and MSD analysis	Laboratory control limit or 20% for RPD shall be used for original and duplicate sample values greater than or equal to five times the QL. A control limit of the QL value shall be used if either the sample or duplicate value is less than five times the CRQL.	1. Investigate problem and reanalyze. 2. Document any observation or corrective action in the case narrative.
Field Duplicate Analysis	Field collected – One for each matrix; every 20 samples of similar matrix. The field duplicate identification will not be provided to the laboratory.	Validation criteria: 50% RPD for waters and 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Percent solids	For solid samples, the percent solids will be determined and sample results will be corrected for percent solids.	Not applicable	Not applicable
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
IDL Determination for ICP	Recommended within 30 days of the start of analysis and semiannually.	Not applicable	Not applicable
MDL Determination	Before any field samples are analyzed, the MDLs shall be determined for non-prepared analyses, each digestion procedure and instrument used, prior to the start of analyses, and annually thereafter.	Not applicable	Not Applicable
Linear Range Analysis for ICP	Every 6 months must be routinely monitored by analysis of high concentration standard.	Results for high point standard must be within 10% of true value.	Not applicable
Interelement Correction For ICP	Within 6 months of the start of analysis and annually. Correction factors for Al, Ca, Fe, and Mg must be reported and for others if they are applied.	Not applicable	Not applicable
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Dilutions	1. When target analyte concentration exceed upper limit of calibration curve. 2. When matrix interference demonstrated by lab and documented in the case narrative. 3. Laboratory will note in the data deliverables which analytical runs were reported.	Not applicable	Not applicable

TABLE 3-5. METALS, MERCURY AND TOTAL CYANIDE QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 6010C ,6020 ,6020A, 7471B, and 9012B)	Corrective Action
Deliverables	1. Full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.
Method and QCD requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable

Notes:

Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods that are currently used by the laboratory. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP.

Communications with the QAO will be documented and included in the data packages.

Source: O'Brien & Gere

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
Holding times	Samples must be analyzed within holding time.	Analyze within 14 days from collection.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions. 2. Notify QAO since re-sampling may be required. 3. Document any observations and corrective action in the case narrative.
Initial Calibration	Prior to sample analysis and when calibration verifications criteria are not met. Initial calibration will contain all target analytes in each standard. Quantitation of analyses will utilize the initial calibration results.	1. A minimum of five concentrations and one calibration standard must be at concentration less than or equal to the QL. 2. If RSD <20% the average RRF (internal calibration) or average calibration factor (external calibration) is used for quantitation. If RSD >20% a linear regression calibration that does not pass through the origin with a correlation coefficient (r) >0.990 is used for quantitation; or a nonlinear first or second order calibration curve with a coefficient of determination (COD) or $r^2 \geq 0.990$ is used for quantitation.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action in the case narrative. 4. Samples should not be analyzed until calibration control limit criteria are met.
Calibration Verification	Calibration standards must contain all target analytes at mid-range concentration. Minimally, analyze calibration standards daily and every 12 hours during sequence. Calibration verification standards should be analyzed every 20 samples.	1. Response (% difference) or concentration (% drift) < 15%.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document any observations and corrective action in the case narrative; samples should not be analyzed until calibration control limit criteria are met.

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
MS/MSD Analysis	1 per 20 samples of similar matrix may be prepared at the same times. For MS/MSDs analyzed, must be spiked with all target analytes. Samples from the investigation must be used for MS/MSD analysis.	Recovery and RPD within laboratory control limits. For compounds without established laboratory control limits, 70-130% recovery will be used. The lowest acceptable control limits for recovery will be 10%.	1. Reanalyze if <10%. 2. If reanalysis is still <10%, report both analyses and document in the case narrative. 3. If re-analysis is >10%, document in case narrative; no additional corrective action required. 4. Document any observations and corrective action in the case narrative.
Surrogate Spike	Samples, blanks, MS/MSDs, and LCSs may be spiked with surrogate compounds.	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%. Corrective action is not required if one of the four surrogates (for two columns) has recovery outside of control limits if the recovery is >10% and the remaining three surrogates are within control limits. Surrogate recoveries for each surrogate on each column must be provided in a summary form.	1. Reanalyze. 2. If reanalysis recovery fails criteria but is >10%, report both analyses and document in case narrative report. 3. If reanalysis recovery is <10%, re-extract and reanalyze the sample. 4. Document any observations and corrective action in the case narrative.
Retention Time Windows	Retention time windows must be established for each target analyte.	Compounds must be within established retention time windows or within laboratory established relative retention time criteria for the associated calibration standards. Retention time windows must be provided for each calibration verification.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate; reanalyze samples back to last compliant calibration standard. 3. Document any observations and corrective action in the case narrative.

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
Preparation Blank Analysis	One for every 20 samples of similar matrix extracted at the same time.	Target analyte concentrations must be <QL. QLs will be provided with preparation blank results.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples if detected for same compounds as in blank. 3. Document any observations and corrective action in the case narrative - samples cannot be analyzed until blank criteria have been met.
Trip Blank	One per cooler containing glycol/alcohol samples	Target analyte concentrations must be <QL. QLs will be provided with preparation blank results.	Document in case narrative.
Laboratory Control Sample Analysis	1 per 20 samples of similar matrix extracted at the same times. Prepared independently from calibration standards. Spike must contain all target analytes and should be at a concentration, which is in the lower 1/2 of the calibration curve.	Recovery within laboratory control limits. The lowest acceptable control limits for recovery will be 10%.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, corrective action is not required. 2. If recovery failures are below control limits, reanalyze LCS. 3. If re-analysis fails, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document any observations and corrective action in the case narrative.

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
Identification	Samples, blanks, and QC data.	Retention times must be within established retention time windows or must meet relative retention time criteria. Confirmation analysis is required. Retention time windows must be provided for each calibration verification. USEPA Form 10 Summary or equivalent form, providing the percent difference and retention times for all detected target analytes in samples and QC samples, will be provided. Percent difference calculation: Difference between Higher concentration of sample and Lower concentration of sample divided by the Lower concentration of sample times 100.	- Investigate problem; reanalyze calibration standards to check for retention time shift. - Document any observations and corrective action in the case narrative.
Quantitation	Samples, blanks, and QC data.	Verify concentration is within linear calibration range of standards. Every effort must be made to meet specified QL requirements. Soil samples concentrations must be corrected to dry weight. Lab must state the technique used to quantitate results for the samples.	- If concentration is above linear calibration range, dilute sample and reanalyze. Dilution should result in concentration in the upper calibration range of the instrument. - Document any observations and corrective action in the case narrative.
Equipment Blank Analysis	Field collected - One for each piece of sampling equipment and after every 20 samples.	Compounds concentrations must be <QL.	- Investigate problem; reanalyze to verify laboratory cross contamination is not a factor. - Document any observations and in the case narrative.

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
Field Duplicate Analysis	Field collected - One for every 20 samples or one per matrix (for less than 20 samples) Field duplicate will not be identified to the laboratory.	Validation criteria: 50% RPD for waters, 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.
Chromatography Presentation	For each standard, sample and QC sample analysis.	Copies of chromatograms provided in the data package must be large enough to view during validation; detail of each peak involved in the identification, including peak shape and associated baseline. In the case that matrix interference is detected or manual integration is performed, enlarged copies of those manipulations will be included in the data package for review.	1. Provide requested information.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages. USEPA Form 8 Summary form, providing the date, time of analysis of samples and QC samples will be provided.	Not applicable	Not applicable
Laboratory control limits	1. Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
Dilutions	2. When target analyte concentration exceed upper limit of calibration curve. 3. When matrix interference demonstrated by lab and documented in the case narrative (highly viscous samples or a large number of non-target peaks on the chromatogram). 4. Laboratory will note in the data deliverables which analytical runs were reported.	1. The reagent blank will meet the method blank criteria.	1. Reanalyze reagent blank until method blank criteria are met.

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits (Criteria for 8000C/8015B)	Corrective Action
Applies to: USEPA Methods 8000C/8015B			
Deliverables	1. Full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided for one of the first data packages provided for the project or other arrangements will be made to evaluate standard tracing. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.

TABLE 3-6. GLYCOLS QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Note Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods that are currently used by the laboratory. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with the QA Officer will be documented and included in the data packages. Source: O'Brien & Gere			

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be digested and analyzed within holding time.	Aqueous samples: Analyze within 24 hours from collection.	1. If holding times are exceeded for initial or any re-analyses required, notify the QAO immediately since re-sampling may be required. 2. Document corrective action in the case narrative.
Calibration	1. To compensate for possible slight losses of chromium during digestion or other operations of the analysis, treat the chromium standards by the same procedure as the sample. Accordingly, pipet a chromium standard solution in measured volumes into 250-mL beakers or conical flasks to generate standard concentrations ranging from 0.5 to 5 mg/L Cr(VI) when diluted to the appropriate volume. 2. Develop the color of the standards as for the samples. 3. Transfer a suitable portion of each colored solution to a 1-cm absorption cell and measure the absorbance at 540 nm.	Correlation coefficient for first or second order curve must be greater than or equal to 0.995.	1. Identify and correct problem, recalibrate and reanalyze affected samples. 2. Document corrective action – samples cannot be analyzed until calibration control limit criteria have been met.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Calibration	4. As reference, use reagent water. Correct the absorbance readings of the standards by subtracting the absorbance of a reagent blank carried through the method. 5. Construct a calibration curve by plotting corrected absorbance values against mg/L of Cr(VI).	Correlation coefficient for first or second order curve must be greater than or equal to 0.995.	3. Identify and correct problem, recalibrate and reanalyze affected samples. 4. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.
Calibration Verification	Verify calibration with an independently prepared check standard every 15 samples.	80% to 120% of expected true value	1. Identify and correct problem, recalibrate and reanalyze affected samples. 2. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Matrix Interference Verification	For every sample matrix analyzed, verification is required to ensure that neither a reducing condition nor chemical interference is affecting color development. This must be accomplished by analyzing a second 10-mL aliquot of the pH-adjusted filtrate that has been spiked with Cr(VI). The amount of spike added should double the concentration found in the original aliquot. Under no circumstances should the increase be less than 30 µg Cr(VI)/liter.	To verify the absence of an interference, the spike recovery must be between 85% and 115%.	1. If the result of verification indicates a suppressive interference, the sample should be diluted and reanalyzed. 2. If the interference persists after sample dilution, contact Project QAO. Project QAO will evaluate if an alternative method (Method 7195, Co-precipitation, or Method 7197, Chelation/Extraction) should be used. (This decision may require use of an alternate laboratory to evaluate the other sample preparation methods). 3. Acidic extracts that yield recoveries of less than 85% should be retested to determine if the low spike recovery is due to the presence of residual reducing agent. This determination shall be performed by first making an aliquot of the extract alkaline (pH 8.0-8.5) using 1 N sodium hydroxide and then re-spiking and analyzing. If a spike recovery of 85-115% is obtained in the alkaline aliquot of an acidic extract that initially was found to contain less than 5 mg/L Cr(VI), it can be concluded that the analytical method has been verified.
Preparation Blank Analysis	One for each batch of samples digested.	A preparation blank must be prepared and analyzed with each digestion batch, and detected Cr(VI) concentrations must be less than the method detection limit or one-tenth the regulatory limit or action level, whichever is greater.	1. Identify and correct problem, re-digest the entire batch and reanalyze. 2. Document corrective action - samples cannot be analyzed until blank control limit criteria have been met.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Field/ Equipment Blank Analysis	Collected one per sampling equipment and after every 20 samples.	Detected Cr(VI) concentrations must be less than the method detection limit or one-tenth the regulatory limit or action level, whichever is greater.	1. Investigate problem. 2. Document in case narrative.
LCS Analysis	Every 20 samples. Prepared independently from calibration standards.	Recovery must be within the certified recovery range or a recovery range of 80% to 120% (whichever applies) or the sample batch must be reanalyzed.	1. Correct problem. 2. Reanalyze samples since last satisfactory LCS. 3. Document corrective action.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Pre-digestion MS Analysis	Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact QAO upon receipt of samples at the laboratory. Both soluble and insoluble pre-digestion matrix spikes must be analyzed at a frequency of one each per batch of < 20 field samples. The soluble matrix spike sample is spiked with 1.0 mL of the spiking solution (equivalent to 40 mg Cr(VI)/Kg) or at twice the sample concentration, whichever is greater. The insoluble matrix spike is prepared by adding 10-20 mg of PbCrO to a separate sample aliquot. It is used to evaluate the dissolution during the digestion process. Both matrix spikes are then carried through the digestion process.	An acceptance range for matrix spike recoveries is 75-125%.	1. If MS recoveries are outside of control limits, contact the Project QAO. 2. The entire batch must be reanalyzed if the LCS associated with the batch is outside control limits. 3. If upon reanalysis, the matrix spike is not within the recovery limits, but the LCS is within criteria, consult Figures 1 and 2 and in Section 3.1 of the method. 4. Document corrective action.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Pre-digestion MS Analysis (Method 3060A)	Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact QAO upon receipt of samples at the laboratory.	For Both soluble and insoluble pre-digestion matrix spikes, if the matrix spike recoveries are not within recovery limits, but the LCS is within criteria information such as that specified on Figures 1 and 2 and in Section 3.1 of Method 3060A must be evaluated to interpret ancillary data in conjunction with data on spike recoveries to determine data usability.	See Method 3060A

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Post-digestion MS Analysis	Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact QAO upon receipt of samples at the laboratory. A post-digestion Cr(VI) matrix spike must be analyzed per batch. The post-digestion matrix spike concentration should be equivalent to 40 mg/kg or twice the sample concentration observed in the un-spiked aliquot of the test sample, whichever is greater. Dilute the sample aliquot to a minimum extent, if necessary, so that the absorbance reading for both the un-spiked sample aliquot and spiked aliquot are within the initial calibration curve.	The post-digestion matrix spike recovery is 85-115%.	1. Use the corrective actions/guidance on data use specified in Section 8.5 of the method or the Method of Standard Additions (MSA) as specified in Section 8.0 of Method 7000. 2. If the MSA technique is applied post digestion and no spike is observed from the MSA, these results indicate that the matrix is incompatible with Cr(VI) and no further effort on the part of the laboratory is required. These digestates may contain soluble reducing agents for Cr(VI), such as fulvic acids.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Laboratory Duplicate Analysis	One for each analytical batch.	Duplicate samples must have a Relative Percent Difference (RPD) of < 20%, if both the original and the duplicate are > four times the laboratory QL. A control limit of $\pm$ the laboratory QL is used when either the original or the duplicate sample is < four times the laboratory reporting limit.	1. Investigate problem and reanalyze. 2. Report results. 3. Document corrective action.
Field Dup. Analysis	Collected 1 per matrix; every 20 samples of similar matrix	50% RPD for aqueous samples. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis during the validation process.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Dilutions	Dilute samples if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.	Not applicable	Not applicable

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Deliverables	1. When requested, full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes within 5 calendar days of the request.

TABLE 3-7A. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7196A QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Notes: Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with the QAO will be documented and included in the data packages.			

TABLE 3-7B. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7199 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be prepared and analyzed within holding time. For aqueous samples, either in the field or soon after sample collection, adjust the pH of the sample to 9-9.5 by drop wise addition of buffer solution periodically checking the pH with the pH meter or narrow pH-range pH paper	Aqueous: Analyze within 24 hours from collection. Soil: 30 days from collection to extraction. Analyze within 7 days of extraction.	1. If holding times are exceeded for initial or any re-analyses required, notify the QAO immediately since re-sampling may be required. 2. Document corrective action in the case narrative.
Calibration	1. Calibrate using a minimum of a calibration blank and three calibration standards bracketing the anticipated concentration range of the samples. 2. The calibration range must cover no more than two orders of magnitude. Calibration standards should be prepared from the hexavalent stock standard by appropriate dilution using the dilution water in volumetric flasks. 3- Construct a calibration curve of analyte response (peak height or area) versus analyte concentration. The coefficient of correlation for the curve must be 0.999 or greater.	Correlation coefficient for first or second order curve must be greater than or equal to 0.999 or greater.	1. Identify and correct problem, recalibrate and reanalyze affected samples. 2. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.
Calibration Verification	Verify calibration with a check standard every 10 samples.	Recovery must be within a recovery range of 90% to 110% of the true value or the sample batch must be reanalyzed.	1. Identify and correct problem, recalibrate and reanalyze affected samples. 2. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.

TABLE 3-7B. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7199 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Matrix Interference Verification	Analyze a pH-adjusted project sample spiked with hexavalent chromium so that the final concentration is at the low to mid-level concentration of the calibration curve.	The spike recovery must be within laboratory control limits or between 80% and 120%.	1. Reanalyze if recovery is <30%. 2. If reanalysis is still <30%, report both analyses and document in the case narrative. 3. If >30% and LCS criteria are met, document in case narrative; no additional corrective action required. 4. If >30% and LCS criteria are exceeded also, examine other QC data for source of problem; <i>i.e.</i> calibration data for instrument performance issues. 5. Document corrective action in the case narrative
Preparation /Method Blank Analysis	One for each batch of samples digested/prepared.	Hexavalent chromium must be less than QL concentration.	1. Identify and correct problem, re-prepare the entire batch and reanalyze. 2. Document corrective action - samples cannot be analyzed until blank control limit criteria have been met.
Field/Equipment Blank Analysis	Field collected - One per sampling event, or one per 20 samples or one per matrix (for less than 20 samples)	Hexavalent chromium must be less than QL concentration.	1. Investigate problem. 2. Document any observation or corrective action in the case narrative.
Laboratory Control Sample Analysis	Every 20 samples or one for each digestion batch. Prepared independently from calibration standards.	Recovery must be within the certified recovery range or a recovery range of 80% to 120% (whichever applies) or the sample batch must be reanalyzed.	1. Stop analysis. 2. Correct problem. 3. Reanalyze samples since last satisfactory LCS. 4. Document any observation or corrective action in the case narrative.
Laboratory Duplicate Analysis	One for each analytical batch.	Duplicate samples must have a Relative Percent Difference (RPD) of < 20%, if both the original and the duplicate are > four times the laboratory QL. A control limit of $\pm$ the QL is used when either the original or the duplicate sample is < four times the laboratory QL.	1. Investigate problem and reanalyze. 2. Report results. 3. Document any observation or corrective action in the case narrative.
Field Duplicate Analysis	Field collected - one per 20 samples or one per matrix (for less than 20 samples) The field duplicate identification will not be provided to the laboratory.	Validation criteria: 50% RPD for waters and 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis during the validation process.

TABLE 3-7B. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7199 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Dilutions	Dilute samples if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.	Not applicable	Not applicable
Deliverables	1. When requested, full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.

TABLE 3-7B. HEXAVALENT CHROMIUM USING USEPA METHODS 3060A/7199 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Notes: Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with the QA Officer will be documented and included in the data packages. Source: O'Brien & Gere			

TABLE 3-8. AMMONIA USING USEPA METHOD 350.1, NITRATE USING USEPA METHOD 353.2, NITRITE USING USEPA METHOD 353.2 AND SULFATE USING USEPA METHOD 300.0 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be prepared and analyzed within holding time.	Nitrite, Nitrate: Analyze 48 hours from collection. Ammonia, Sulfate: Analyze 28 days from collection.	1. If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the Quality Assurance Officer (QAO) since re-sampling may be required.
Initial Calibration and Calibration Verification (ICV, CCV) Applies to methods utilizing calibrations.	At a minimum three to five standards (depending on method requirements) and a blank, prior to sample analysis and when calibration verification criteria are not met.. One standard must be at the QL concentration. ICV accompanies each initial calibration. CCV is analyzed following calibration, after every 10 samples and at the end of the sequence to bracket sample analyses. For total cyanide, the ICV must be distilled.	Linear calibration using response factor with RSD less than or equal to 10%. If RSD <10% the average calibration factor (external calibration) is used for quantitation. For compounds with RSD greater than 10% use linear calibration that does not pass through the origin with least squares regression (r for un-weighted least squares regression, Coefficient of Determination or r ² must be greater than 0.995) or non-linear calibration using no more than third order with seven standards, (COD or r ² must be greater than 0.995). For ICV, CCV - 90% to 110% of expected value.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action in the case narrative - samples cannot be analyzed until calibration criteria have been met.
Calibration Blank Applies to methods utilizing calibrations.	At beginning and end of run and at a rate of 10% during run.	The absolute value of the target analyte must be less than QL.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action in the case narrative 4. Samples cannot be analyzed until blank control limit criteria have been met.
Preparation/Method Blank Analysis	1 per batch of samples prepared in the sample batch.	Target analytes less than QL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and re-preparation and reanalyze affected samples if detected. 3. Document corrective action - samples cannot be analyzed until blank criteria are met.

TABLE 3-8. AMMONIA USING USEPA METHOD 350.1, NITRATE USING USEPA METHOD 353.2, NITRITE USING USEPA METHOD 353.2 AND SULFATE USING USEPA METHOD 300.0 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Laboratory Control Sample Analysis	Every 20 samples or each preparation batch. Prepared independently from calibration standards.	Recovery within laboratory control limits or 80% to 120%. The lowest acceptable control limits for recovery will be 10%.	1. If recovery failures are above control limits and these target analytes are not detected in the associated samples, no corrective action is required. 2. If recovery failures are below the control limits, reanalyze LCS and examine results of other QC analyses. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action in the case narrative.
Matrix Spike Analysis	Collected per project requirements. Samples from the investigation must be used for MS/MSD analysis. If samples were not designated as MS/MSD samples, contact QAO upon receipt of samples at the laboratory.	Recovery within laboratory control limits or 75-125%. Recovery does not apply if sample concentration > 4 X spike concentration. Spike must contain all analytes. The lowest acceptable laboratory control limits for recovery will be 10%.	1. Analyze post-digestion/post-distillation spike at two times the QL or two times the indigenous level, whichever is greater 2. Document corrective action in the case narrative.
Laboratory Duplicate or Matrix Spike Duplicate Analysis	Collected per project requirements. Samples from the investigation must be used for Laboratory Duplicate and MSD analysis. If samples were not designated as QC samples, contact QAO upon receipt of samples at the laboratory.	Laboratory control limit or 20% for RPD shall be used for original and duplicate sample values greater than or equal to five times the QL. A control limit of the QL value shall be used if either the sample or duplicate value is less than five times the QL.	1. Investigate problem and reanalyze. 2. Document corrective action in the case narrative.
Field / Equipment Blank Analysis	Collected per project requirements.	Target analytes less than QL.	1. Investigate problem. 2. Document in the case narrative.
Field Duplicate Analysis	Collected per project requirements.	Validation criteria: 50% RPD for waters, 100% RPD for solids. For sample results that are less than or equal to five times the QL, the criterion of plus or minus two times the QL will be applied to evaluate field duplicates.	No corrective action required of the laboratory since the laboratory will not know the identity of the field duplicate samples. If these criteria are not met, sample results will be evaluated on a case-by-case basis.

TABLE 3-8. AMMONIA USING USEPA METHOD 350.1, NITRATE USING USEPA METHOD 353.2, NITRITE USING USEPA METHOD 353.2 AND SULFATE USING USEPA METHOD 300.0 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Dilutions	Dilute and reanalyze samples with concentrations that are greater than the linear range of the instrument or method technique. The laboratory will note in the data package which analytical runs were used to report the sample results.	Not applicable	Not applicable.
Sample Batching	The laboratory will batch project samples together along with QC samples specified from the project. Non-project information will not be included in the data packages.	Not applicable	Not applicable
Laboratory control limits	Generated with results for an analyte from a minimum of 20 sample analyses. The average of the sample results and the standard deviation are calculated. The internal warning limits are established at 2 times the standard deviation and the control limits are established at 3 times the standard deviation. The control limits are updated annually.	Not applicable	Not applicable
Deliverables	1. When requested, Full deliverables must be provided to document each audit item for easy reference and inspection. 2. An example calculation will be provided for each analysis, for each type of matrix in the data package using samples from the project. 3. Any laboratory abbreviations or notations presented in the raw data or summary information will be explained or referenced in the case narrative. 4. Final spiking concentrations will be presented in summary form. 5. Standard tracing information will be provided. 6. Cooler temperatures will be provided in the data packages. 7. Run logs will be provided in the data packages.	Not applicable	Provide missing or additional deliverables for validation purposes.

TABLE 3-8. AMMONIA USING USEPA METHOD 350.1, NITRATE USING USEPA METHOD 353.2, NITRITE USING USEPA METHOD 353.2 AND SULFATE USING USEPA METHOD 300.0 QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTIONS

Audit	Frequency	Control Limits	Corrective Action
Method and QAPP requirements	The laboratory will perform the method as presented in this QAPP and will adhere to the QAPP requirements presented herein. Otherwise the laboratory will specifically note any procedures that differ from the method or the QAPP in the data package case narrative.	Not applicable	Not applicable
Note Data validation will be performed in accordance with QA/QC criteria established in these tables and the analytical methods. Excursions from QA/QC criteria will be qualified based on guidance provided in this QAPP. Communications with O'Brien & Gere will be documented and included in the data packages. Source: O'Brien & Gere			

QUALITY ASSURANCE PROJECT PLAN (QAPP) ADDENDUM

Select sections of the project Quality Assurance Project Plan (QAPP) (O'Brien and Gere Engineers, 2013) are updated herein to address analytical methods that are proposed in the *Groundwater Remedy Pre-Design Investigation and Supplemental Sampling Work Plan* but not previously included in the QAPP or an addendum. Specifically, the additional analytical methods include aldehydes, low detection level 1,4-dioxane, poly- and perfluoroalkyl substances (PFAS), total petroleum hydrocarbons (TPH), dissolved gases, various geochemical indicator parameters, and the use of Bio-Trap® samplers.

Section 2.2.1: Laboratory Analysis

Currently, the Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (e.g. groundwater) are required, by the Division of Environmental Remediation, to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101 (New York State Department of Environmental Conservation 2018).

Section 7.3.4: Field/Equipment Blank Sampling Procedure

Field/equipment blanks for PFAS samples are described in the attached *Poly- and Perfluorinated alkyl substances (PFAS) Field Sampling Guidance* (Arcadis 2017).

QAPP Tables

See attached for applicable updates.

Table 1 – Field Sampling Summary

Table 2-5 – Laboratory Detection Limits and Regulatory Criteria for New Methods

Table 2-6 – Laboratory Detection Limits and Regulatory Criteria for Full PFAS Target Analyte List

Table 3-2 – SVOC Quality Control Requirements and Corrective Actions

Table 3-9A – General Chemistry QC Samples

Table 3-9B – Analytical Instrument Calibration for General Chemistry Parameters

Table 3-10A – TPH QC Samples

Table 3-10B – Analytical Instrument Calibration for TPH

Table 3-11A – PFAS QC Samples

Table 3-11B – Analytical Instrument Calibration for PFAS

Table 3-12 – Methane, Ethane, Ethene, and Acetylene Quality Control Requirements and Corrective Actions

Table 3-13A – Aldehydes QC Samples

Table 3-13B – Analytical Instrument Calibration for Aldehydes

References

Arcadis U.S., Inc. 2017. Poly- and Perfluorinated alkyl substances (PFAS) Field Sampling Guidance. April 27. Rev 0.

New York State Department of Environmental Conservation. Joshua P. Cook to Michael E. Furlong (Bristol-Myers Squibb). Letter dated 5 April 2018.

O'Brien and Gere Engineers. 2013a. Field Sampling and Analysis Plan: BMS Syracuse North Campus Restoration Area Site No. C734138. March.

O'Brien and Gere Engineers. 2013b. Quality Assurance Project Plan: BMS Syracuse North Campus Restoration Area Site No. C734138. March.

ADDENDUM TO FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

QAPP Tables

Table 1 – Field Sampling Summary

Parameter and Method	Matrix	Sample Container and Volume	Preservation	Holding Times	Number of Samples	QC Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Aldehydes – USEPA Method 8315A	GW	250-mL round glass	4°C	3 d	62	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
1,4-Dioxane (low-level) – USEPA Method 8270 SIM	GW	1-one liter amber glass container with Teflon™ lined screw caps	4°C	7 d from collection to extraction; 40 d from extraction to analysis	62	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for less than 20 samples)	One per 20 samples or one per sampling event as required for each matrix
PFAS – USEPA Modified EPA Method 537	GW	250-mL wide mouth plastic	4 ± 2°C ¹	14 d from collection to extraction; 28 d from extraction to analysis	22	One per sample batch, not to exceed 20 samples	NA	One per sample batch, not to exceed 20 samples	One per sample batch, not to exceed 20 samples. See Section 7.3.4 for further QC detail.
Anions (chloride, fluoride, sulfate) – USEPA Method 300.0	GW	50-mL plastic tube	4°C	28 d	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
Alkalinity – Standard Method 2320B	GW	250-mL wide mouth plastic	4°C	14 d	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix

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Parameter and Method	Matrix	Sample Container and Volume	Preservation	Holding Times	Number of Samples	QC Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Total Organic Carbon – Standard Method 5310C	GW	40-mL amber vial	H ₃ PO ₄ , 4°C	28 d	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
Total phosphorus – Standard Method 4500-PF	GW	250-mL wide mouth plastic	H ₂ SO ₄ , 4°C	28 d	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
Chemical Oxygen Demand (COD) – USEPA Method 410.4	GW	250-mL wide mouth plastic	H ₂ SO ₄ , 4°C	28 d	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
Biological Oxygen Demand (BOD) – Standard Method 5210 B	GW	500-mL round plastic	4°C	48 h	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
TPH-G – USEPA Method 8015D	GW	40-mL glass vial	HCl, 4°C	14 d	6	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
TPH-D/O – USEPA Method 8015D	GW	250-mL round amber glass	HCl, 4°C	7 d	6	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix
Methane, ethane, ethene, acetylene – Pace Analytical internal method AM20GAX	GW	3-40 mL clear glass bottle	Na ₃ PO ₄ , 4°C	14 d	32	One per 20 samples or one per matrix (for <20 samples)	NA	One per 20 samples or one per matrix (for <20 samples)	One per 20 samples or one per sampling event as required for each matrix

ADDENDUM TO FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

Parameter and Method	Matrix	Sample Container and Volume	Preservation	Holding Times	Number of Samples	QC Frequency			
						Field Duplicate	Trip Blank	MS/MSD and Spike Duplicate	Field Blank
Treatability Testing Groundwater Samples	GW	2.5 L per experiment	4°C until microcosms are prepared	1 month	5	NA	NA	NA	NA
Deoxyribonucleic acid (DNA) and messenger ribonucleic acid (mRNA) extraction and quantitative polymerase chain reaction (qPCR)	Microbial cells	Bio-Trap®	Storage on ice	DNA: 48 hours, mRNA: 24 hours	7	NA	NA	NA	NA

Acronyms:

GW = groundwater
NA = not applicable

Note:

1. Do not use blue ice. Store PFAS samples in separate cooler from other types of samples.

ADDENDUM TO FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

Table 2-5 – Laboratory Detection Limits and Regulatory Criteria for New Methods

Target Analyte	CAS Number	Method	Laboratory QL Aqueous	Laboratory MDL Aqueous ¹	Class GA Groundwater ²
Aldehydes: Acetaldehyde	75-07-0	USEPA Method 8315A	60	30	NA
Aldehyde: Formaldehyde	50-00-0	USEPA Method 8315A	50	20	NA
1,4-Dioxane	129-91-1	USEPA Method 8270 SIM	0.3 ug/L	0.1 ug/L	NA
PFAS	See Table 2-6	USEPA Method 537	See Table 2-6	See Table 2-6	NA
Anion: chloride	16887-00-6	USEPA Method 300.0	2,000 ug/L	1,000 ug/L	250,000
Anion: fluoride	16984-48-8	USEPA Method 300.0	500 ug/L	250 ug/L	1,500
Alkalinity	NA	Standard Method 2320B	5,000 ug/L as CaCO ₃	1,700 ug/L as CaCO ₃	NA
Total Organic Carbon	NA	Standard Method 5310C	1,000 ug/L	500 ug/L	NA
Total phosphorus	7723-14-0	Standard Method 4500-PF	100 ug/L	50 ug/L	NA
Chemical Oxygen Demand (COD)	NA	USEPA Method 410.4	50,000 ug/L	12,800 ug/L	NA
Biological Oxygen Demand (BOD)	NA	Standard Method 5210 B	2,000 ug/L	2,000 ug/L	NA
TPH-G by Method 8015D	PHCG	USEPA Method 8015D	50 ug/L	20 ug/L	NA
TPH-D by Method 8015D	PHCDC10C28	USEPA Method 8015D	100 ug/L	45 ug/L	NA
TPH-O by Method 8015D	PHCO>C28C40	USEPA Method 8015D	100 ug/L	45 ug/L	NA
Methane, ethane, ethene, acetylene	74-82-8, 74-84-0, 74-85-1, 74-86-2	Pace Analytical Method AM20GAX	0.50 ug/L ³ , 0.10 ug/L ³ , 0.10 ug/L ³ , 0.50 ug/L ³	To be determined	NA

Acronyms:

MDL = method detection limit

QL = quantitation limit

Notes:

¹ Maximum MDLs allowed per NYSDEC letter are provided.

² Class GA Groundwater Standards and Guidance values as listed in T.O.G.S 1.1.1; Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations; June 1998, current as of May 2018.

³ AM20GAX laboratory reporting limits are provided.

ADDENDUM TO FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

Table 2-6 – Laboratory Detection Limits and Regulatory Criteria for Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number	Laboratory QL Aqueous	Laboratory MDL Aqueous ¹	Class GA Groundwater ²
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5	1.0	0.30	NA
	Perfluorohexanesulfonic acid	PFHxS	355-46-4	2.0	0.40	NA
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8	2.0	0.40	NA
	Perfluorooctanesulfonic acid	PFOS	1763-23-1	2.0	0.40	NA
	Perfluorodecanesulfonic acid	PFDS	335-77-3	2.0	0.60	NA
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4	6.0	2.0	NA
	Perfluoropentanoic acid	PFPeA	2706-90-3	6.0	2.0	NA
	Perfluorohexanoic acid	PFHxA	307-24-4	2.0	0.40	NA
	Perfluoroheptanoic acid	PFHpA	375-85-9	1.0	0.30	NA
	Perfluorooctanoic acid	PFOA	335-67-1	1.0	0.30	NA
	Perfluorononanoic acid	PFNA	375-95-1	2.0	0.40	NA
	Perfluorodecanoic acid	PFDA	335-76-2	2.0	1.0	NA
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8	2.0	0.40	NA
	Perfluorododecanoic acid	PFDoA	307-55-1	1.0	0.30	NA
	Perfluorotridecanoic acid	PFTriA/PFTTrDA	72629-94-8	1.0	0.30	NA
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2	2.0	1.0	NA
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4	6.0	2.0	NA
Perfluorooctane-sulfonamides	Perfluorooctanesulfonamide	FOSA	754-91-6	3.0	1.0	NA
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9	3.0	1.0	NA
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6	3.0	1.0	NA

Reference:

New York State Department of Environmental Conservation. 2018.

Acronyms:

MDL = method detection limit

QL = quantitation limit

Notes:

¹ Maximum MDLs allowed per NYSDEC letter are provided.

² Class GA Groundwater Standards and Guidance values as listed in T.O.G.S 1.1.1; Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations; June 1998, current as of May 2018.

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QAPP Table 3-2 – SVOC Quality Control Requirements and Corrective Actions

The quality control requirements and corrective actions included in the QAPP (O'Brien and Gere Engineers 2013b) for USEPA Methods 8000C/8270C/8270D apply to USEPA Method 8270 SIM, which will be used for 1,4-dioxane analysis.

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QAPP Table 3-9A – General Chemistry QC Samples

Matrix	Water					
Analytical Group	Total Organic Carbon (TOC), Chloride, Fluoride, Total Alkalinity, Total Phosphorus, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD)					
Analytical Method	TOC: SM 5310C; Chloride and Fluoride: EPA 300.0; Total Alkalinity: SM2320B; Total Phosphorus: SM 4500-PF; COD: USEPA 410.4; BOD: SM5210B					
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Duplicate	One per preparatory batch	Per laboratory SOPs	Correct problem, then reanalyze all samples processed with the duplicate	Laboratory analyst	Precision	RPD of $\leq 20\%$ for duplicate results greater than or equal to 5-times the RL
MS/MSD (if applicable)	One per preparatory batch	Per laboratory SOPs	Identify problem, then reanalyze MS/MSD and all associated batch samples	Laboratory analyst	Precision/Accuracy	Within laboratory in-house limits
Method Blank	One per preparatory batch	Per laboratory SOPs	Correct problem, then reanalyze method blank and all samples processed with the contaminated blank	Laboratory analyst	Sensitivity	No target analytes detected greater than one-half QL and 1/10 the amount measured in any sample or 1/10 regulatory limit (whichever is greater)
LCS	One per preparatory batch	Per laboratory SOPs	Identify problem, then reanalyze LCS and all associated batch samples	Laboratory analyst	Accuracy	Within laboratory in-house limits

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QAPP Table 3-9B – Analytical Instrument Calibration for General Chemistry Parameters

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
Autoanalyzer (TOC)	ICAL	Daily prior to sample analysis	$r^2 \geq 0.995$	Recalibrate	Assigned Laboratory Personnel
	ICV	Once after each ICAL, prior to sample analysis	Within $\pm 10\%$ of expected value	Recalibrate	
	CV	After every 10 samples and at the end of the analysis sequence	Within $\pm 10\%$ of expected value	Recalibrate, rerun 10 samples previous to failed CV	
IC (Chloride/ Fluoride)	ICAL	Weekly prior to sample analysis	$r^2 \geq 0.995$	Recalibrate	Assigned Laboratory Personnel
	ICV	Once after each ICAL, prior to sample analysis	Within $\pm 10\%$ of expected value	Recalibrate	
	CV	After every 10 samples and at the end of the analysis sequence	Within $\pm 10\%$ of expected value	Recalibrate, rerun 10 samples previous to failed CV	
Titration (Alkalinity)	CV	Prior to sample analysis	RSD 20%	Recalibrate and rerun samples	Assigned Laboratory Personnel
Spectrophotometer (Phosphorus)	ICAL	Daily prior to sample analysis	$r^2 \geq 0.995$	Recalibrate	Assigned Laboratory Personnel
	ICV	Once after each ICAL, prior to sample analysis	Within $\pm 10\%$ of expected value	Recalibrate	
	CV	After every 10 samples and at the end of the analysis sequence	Within $\pm 10\%$ of expected value	Recalibrate, rerun all samples previous to failed CV	

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QAPP Table 3-10A – TPH QC Samples

Matrix	Soils/Solids					
Analytical Group	TPH-GRO, TPH-DRO					
Analytical Method/SOP Reference	SW-846 8015B Per laboratory SOP					
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	One per preparatory batch	Per laboratory SOP	Identify problem, then reanalyze MS/MSD and all associated batch samples	Laboratory analyst	Precision/ Accuracy	Within laboratory in-house limits
Method Blank	One per preparatory batch	Per laboratory SOP	Correct problem, then reanalyze method blank and all samples processed with the contaminated blank	Laboratory analyst	Sensitivity	No target analytes detected greater than one-half QL and 1/10 the amount measured in any sample or 1/10 regulatory limit (whichever is greater)
LCS	One per preparatory batch	Per laboratory SOP	Identify problem, then reanalyze LCS and all associated batch samples	Laboratory analyst	Accuracy	Within laboratory in-house limits
Surrogate Standards	Added to all samples, blanks, LCS, and MS	Per laboratory SOP	Correct problem, then reanalyze affected samples	Laboratory analyst	Accuracy	Within laboratory in-house limits
Continuing Calibration Verification	Every 12 hours period	Per laboratory SOP	Recalibrate and reanalyze all associated samples	Laboratory analyst	Accuracy	The percent difference for the continuing calibration compounds must be < 15%

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QAPP Table 3-10B – Analytical Instrument Calibration for TPH

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
GC/FID (TPH-DRO)	ICAL – 5 point	Initial calibration prior to sample analysis	%RSD <20%	Correct problem, re-calibrate and re-analyze any affected samples	Assigned Laboratory Personnel
	ICV	Once after each initial calibration	Value of second source within $\pm 20\%$ of expected	Rerun ICV one time, second failure requires recalibration	
	CV	Daily, before sample analysis, every 12 hours of analysis time, and at the end of the analysis sequence	$\pm 20\%$ difference	Re-inject CV; if passes rerun previous 10 samples and continue run; if 2 nd CV fails, recalibrate	
GC/PID (TPH-GRO)	ICAL – 5 point	Initial calibration prior to sample analysis	%RSD <20%	Correct problem, re-calibrate and re-analyze any affected samples	Assigned Laboratory Personnel
	ICV	Once after each initial calibration	Value of second source within $\pm 15\%$ of expected	Rerun ICV one time, second failure requires recalibration	
	CV	Daily, before sample analysis, every 12 hours of analysis time, and at the end of the analysis sequence	$\pm 15\%$ difference	Re-inject CV; if passes rerun previous 10 samples and continue run; if 2 nd CV fails, recalibrate	
	Low-level Calibration Check Standard	Daily	All analytes within $\pm 20\%$ of expected value	Correct problem, then repeat ICAL	
	ICV	Once after each ICAL, prior to sample analysis	Value of second source for all analytes within $\pm 10\%$ of expected value	Recalibrate	
	CV	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 20\%$ of expected value	Recalibrate, rerun 10 samples previous to failed CV	

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QAPP Table 3-11A – PFAS QC Samples

Matrix		Water				
Analytical Group		PFAS				
Analytical Method		EPA Modified 537				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 field samples	Relative percent difference (RPD) $\leq$ 50% for soil; $\leq$ 35% for water	Qualify data as appropriate	Data Validator	Overall precision	RPD $\leq$ 50% for soil; $\leq$ 35% for water
Method blank	1 per analytical batch of no more than 20 samples	No target analyte concentrations $\geq$ $\frac{1}{2}$ LOQ	Correct problem. If required, re-prepare and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	Analyst / Section Supervisor	Contamination/bias	No target analyte concentrations $\geq$ $\frac{1}{2}$ LOQ
Reagent or Equipment blank as appropriate	1 per 20 field samples	No target analyte concentrations $\geq$ $\frac{1}{2}$ LOQ	Qualify data as appropriate	Data Validator	Contamination/bias	No target analyte concentrations $\geq$ $\frac{1}{2}$ LOQ
Laboratory Control Sample (LCS)	1 per analytical batch of no more than 20 samples	Percent recoveries (%R) Lab generated control limits.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	Analyst / Section Supervisor	Accuracy/bias	Percent recoveries (%R) Lab generated control limits.
Extracted Internal standards (1)	Every field sample, standard, blank, and QC sample.	Added to sample prior to extraction. %R 50 to 150% of true value.	If recoveries are acceptable for QC samples, but not field samples, may indicate matrix effect. If QC samples fail, correct problem; rerun all failed samples, report and narrate	Analyst / Section Supervisor	Accuracy/bias	%R 50 to 150% of true value.
Injection Internal Standards	Every field sample, standard, blank, and QC sample.	Added just prior to analysis. Peak areas must be within -50% to +50% of area from ICAL midpoint standard.	If peak areas are unacceptable, analyze a second aliquot of extract if enough remains. If not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Analyst / Section Supervisor	Accuracy/bias	Peak areas must be within -50% to +50% of area from ICAL midpoint standard

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Matrix		Water				
Analytical Group		PFAS				
Analytical Method		EPA Modified 537				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix spike / matrix spike duplicate	1 per analytical batch of no more than 20 samples.	Sample spiked with all analytes at concentration $\geq$ LOQ and $\leq$ mid-level calibration concentration. %R See Lab generated control limits.	If criteria not met, qualify as appropriate.	Analyst / Section Supervisor	Accuracy/ bias	See Lab generated control limits.

Note:

1. The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation.

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QAPP Table 3-11B – Analytical Instrument Calibration for PFAS

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
LC/MS/MS for PFAS	Mass Calibration	Daily, prior to sample analysis and after performing major maintenance, as required to maintain documented instrument sensitivity and stability performance.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer	Retune instrument and peak check tune. Maintenance may be required.	Analyst, Department Manager
	Instrument performance check (tune).	When the masses fall outside of the ± 0.5 amu of the true value.	Mass assignments of the tuning standard within 0.5 amu of true value.	Retune instrument and verify	
	Initial Calibration (ICAL) Standards containing both branched and linear isomers must be used when commercially available. Isotope Dilution or Internal Standard Calibration is required. Minimum five-point initial calibration for linear, or six-point calibration for quadratic.	Initial calibration prior to sample analysis	S/N Ratio: $\geq 10:1$ for all ions used for quantification. For analytes having a promulgated standard, (e.g., HA levels for PFOA and PFOS), the qualitative (confirmation) transition ion must have a S/N Ratio of $\geq 3:1$. Average RF: RSD of the RFs for each analyte $\leq 20\%$ Linear or non-linear Calibration: $r^2 \geq 0.99$. Analytes must be within 70-130% of their true value for each calibration standard.	Verify standard solutions still valid, perform instrument maintenance as needed, then repeat the ICAL	
	Instrument Sensitivity Check (ISC). ISC can serve as initial daily CCV	Prior to analysis and at least once every 12 hours	Analyte concentrations must be at LOQ; concentrations must be within $\pm 30\%$ of true value.	Correct problem, rerun ISC. If problem persists, report ICAL.	
	Initial Calibration Verification (ICV)	Once after each ICAL; analysis of second source standard prior to sample analysis.	Analyte concentrations must be within $\pm 30\%$ of true value.	Correct problem, rerun ICV. If problem persists, report ICAL.	

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Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
	Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at end of analytical sequence.	Analyte concentrations must be within $\pm 30\%$ of true value. Concentration of analytes must range from LOQ to mid-level calibration concentrations.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. Otherwise, perform corrective action, repeat CCV (or ICAL) and reanalyze all associated samples since last successful CCV.	
	Instrument Blanks	Immediately following highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be $\leq \frac{1}{2}$ the LOQ.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower high standard until criteria is met.	
	Continuing calibration – pH standard near the pH of samples	After every 10 samples, and at end of analytical run	pH Check Standard within ± 0.05 su of true value		

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Table 3-12 – Methane, Ethane, Ethene, and Acetylene Quality Control Requirements and Corrective Actions

Matrix	Water		
Analytical Group	Methane, ethane, ethene, and acetylene		
Analytical Method	AM20GAx		
Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	See Table 1.	If holding times are exceeded for initial or any re-analyses required due to QC excursions, notify the QAO since resampling may be required.
Initial Calibration	Initial calibration, immediately followed by initial calibration verification	Initial calibration (ICAL) is accomplished by analyzing multiple standards of appropriate concentration ranges for each detector being readied for sample analysis. A linear fit to an area response versus concentration plot is formed with the origin forced to zero and the calibration is accepted for use if r^2 , the coefficient of determination is ≥ 0.995 . If this criterion cannot be met using a linear fit, a quadratic fit can be used. For the quadratic fit, the acceptance criteria is also $r^2 \geq 0.995$. Initial calibration verification (ICV) is prepared from an alternate source, than that used for the initial calibration standards. The concentration of the ICV is in the middle of the calibration range and is close to that of the ICAL midpoint, but because of the nature of gas standard it is not at exactly that concentration. Acceptance criterion for the ICV is an instrument response within $\pm 15\%$ drift. Since the instrumentation used routinely monitors the percent recoveries and in this instance percent drift is equal to percent recovery less 100%, the control limits are 85-115% recovery.	If the acceptance criteria specified for initial calibration is not met, the instrument is examined for a cause and a new set of calibration standards are analyzed. If the instrument response for ICV standard is outside the acceptance window of 85 – 115%, the analyst will not analyze samples until either the reason is determined and the problem is corrected, or a new multi-point calibration is analyzed and an acceptable ICV is run using that calibration.
Initial Calibration Blank	Following the ICV	An initial calibration blank follows the ICV. The blank is made up of the instrument flush. Target compounds must not be detected above the reporting limits.	If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.
Continuing Calibration Verification (CCV)	CCV is analyzed at the beginning and end of each analytical shift and after every 15 field samples	The CCV is prepared from an alternate source than that used for the ICAL standards. The concentration of the CCV is in the middle of the calibration range and is close to that of the ICAL midpoint, but because of the nature of gas standard it is not at exactly that concentration.	Acceptance criterion for the CCV is an instrument response within $\pm 15\%$ drift. Since the instrumentation used routinely monitors the percent recoveries and in this instance percent drift is equal to percent recovery less 100%, the control limits are 85-115% recovery.

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Matrix	Water		
Analytical Group	Methane, ethane, ethene, and acetylene		
Analytical Method	AM20GAx		
Audit	Frequency	Control Limits	Corrective Action
Continuing Calibration Blank	A CCB follows each CCV.	The blanks are made up of the instrument flush. The acceptance criterion for the blank is the result must be less than the reporting limit for all target compounds.	If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.
Laboratory Method Blank Analysis	A method blank is analyzed with each analytical batch	Water that is free of the principle atmospheric components of nitrogen and oxygen is very difficult to make and similarly difficult to store. Toward that end, the blanks are made up of instrument flush for all of the gases except for blanks for TIC. TIC blanks are made up of deionized water. The acceptance criterion for the blank is the result must be less than the reporting limits for all target compounds.	If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.
Laboratory Control Sample Analysis	Both and LCS and LCSD are to be run with each analytical batch	The LCS and LCSD are prepared at a mid-range concentration. For samples that arrive as waters, DI water is spiked with a gas mixture of target analytes and prepared the same as the samples. Percent recovery is to be between 80 -120 % and RPD is to be less than or equal to 20%.	If the LCS fails, a new LCS is prepared and analyzed. If the new LCS falls within the acceptance criterion, analysis continues. If the new LCS fails, analysis is stopped, and the overall procedural system is checked for errors. Once the cause is determined, analysis continues and if necessary, discussion placed to the case narrative.
Matrix Spike/Matrix Spike Duplicate Analysis	When client requests and sends sufficient number of aliquots to prepare them	The source used for the MS/MSD will be based upon the methane concentration of the original field sample being spiked; depending upon the detector used for the methane determination. Source water is spiked with a gas mixture of target analytes and prepared the same as the field samples. Percent recovery is to be between 70 – 130% and RPD is to be less than or equal to 20%.	If the matrix spike and spike duplicate fail but all the other quality control samples are within the acceptance criteria, matrix interference is noted in the Case Narrative.

ADDENDUM TO FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

Table 3-13A – Aldehydes QC Samples

Matrix	Water				
Analytical Group	Aldehydes				
Analytical Method	EPA 8315A				
Quality Control (QC) Sample	Frequency/ Number¹	SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator
Field duplicate	One per 10 field samples of similar matrix	Per laboratory SOP	Qualify data as needed	Data Validator	Precision – overall
Surrogates	Two per sample	Per laboratory SOP	Reanalysis or re-extraction/ reanalysis of sample	Lab personnel	Accuracy/bias
Method blanks	One per analytical batch	Per laboratory SOP	Qualify data as needed or re-extraction/ reanalysis of batch	Lab personnel and/or Data Validator	Accuracy/bias contamination
Laboratory control sample/laboratory control sample duplicate (LCS/LCSD)	One per analytical batch	Per laboratory SOP	Reanalysis or re-extraction/ reanalysis of batch	Lab personnel and/or Data Validator	Accuracy/bias
Matrix spike/matrix spike duplicate (MS/MSD)	One per batch	Per laboratory SOP	Qualify data as needed	Lab personnel and/or Data Validator	Accuracy/bias
MS/MSD and LCS/LCSD ²	One per batch	Per laboratory SOP	Qualify data as needed	Lab personnel and/or Data Validator	Precision

ADDENDUM TO FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

Table 3-13B -- Analytical Instrument Calibration for Aldehydes

Matrix	Water				
Analytical Group	Aldehydes				
Analytical Method	EPA 8315A				
Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
High Performance Liquid Chromatography (HPLC) for 8315A	Initial calibration — prior to sample analysis, a minimum of 5 concentration levels for all compounds.	Prior to sample analysis, 5 points for all compounds. Yearly.	Each compound Calibration Factor (CF) $\leq 20\%$ for all compounds or linear $r^2 \geq 0.99$.	Inspect system, correct problem, rerun calibration and affected samples if CF $> 20\%$ or linear $r^2 \geq 0.99$.	Analyst
	Continuing calibration — before sample analysis, 1 standard (midpoint).	Daily or on continuing calibration failure	Each compound percent difference %D $\leq 20\%$.	Inspect system, correct problem, rerun calibration and affected samples if %D $> 20\%$.	