GCP Boom, LLC

Interim Remedial Measures Work Plan

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

June 2025

Interim Remedial Measures Work Plan

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

June 2025

Prepared By:
Arcadis of New York, Inc.
One Lincoln Center, 110 West Fayette Street, Suite 300
Syracuse, NY 13202
United States
Phone: 315 446 9120
Fax: 315 449 0017

Prepared For:
GCP Boom, LLC
C. Gershon Company, Inc.
244 W. 39th Street, 5th Floor
New York, NY 10018

This document is intended only for the use of the individual or entity for which it was prepared and may contain information that is privileged, confidential and exempt from disclosure under applicable law. Any dissemination, distribution or copying of this document is strictly prohibited.

Certification

I, Christopher Engler, certify that I am currently a Professional Engineer as defined in 6 New York Codes, Rules, and Regulations (NYCRR) Part 375 and that this Interim Remedial Measures Work Plan (IRM WP) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation and DER-31 Green Remediation.



Date: 6/24/2025

Christopher Engler, P.E.
NYS P.E. License No. 069748

Contents

Acronyms and Abbreviations iii
1 Introduction 1
1.1 Interim Remedial Measures Work Plan Organization 1
1.2 Site Background 1
1.2.1 Site Description 1
1.2.2 Surrounding Property Land Use 2
1.2.3 Summary of Physiographic, Geologic, and Hydrogeologic Information 2
1.2.3.1 Topography 2
1.2.3.2 Regional Geology 3
1.2.3.3 Local Geology and Hydrogeology 3
1.2.3.4 Wetlands 3
1.2.4 Summary of Previous Environmental Investigations 3
1.2.5 Site Characterization Report Conclusions 4
1.2.6 Area of Concern 4
2 Site Remedy Basis 5
2.1 Remedial Action Objectives 5
2.2 Remediation Areas 6
2.3 Identification of Site Remedy Components 6
3 Proposed Site Remedy 7
3.1 Sub-Slab Depressurization System Overview 7
3.1.1 Basis of Sub-Slab Depressurization System Design 7
3.1.2 Suction Points 7
3.1.3 Suction Riser 8
3.1.4 Inline Fans and Piping 8
3.1.5 Vacuum Monitoring Points 8
3.1.6 Controls 9
3.1.7 Construction of Sub-Slab Depressurization System 9
3.1.8 Indoor Air Sampling and Air Quality 9
3.2 Waste Management 9
3.3 Environmental Easement, Institutional Controls, and Engineering Controls 10
3.4 Site Management Plan 10

4 Interim Remedial Measures Design Submittals and Schedule 11
5 Green Remediation 12
6 Reporting 13
7 References 14

Tables

Table 1 – Interim Remedial Measures Work Plan Organization 1
Table 2 – Remedial Action Objectives 5
Table 3 – Proposed Site Remedy Components 6
Table 4 – IRM Schedule 11

Figures

Figure 1 Site Location Map
Figure 2 Site Plan with Tax Parcel Boundary
Figure 3 Surrounding Properties Map
Figure 4 Pre-Site Characterization Soil Boring and Soil/Groundwater Sampling Locations
Figure 5 Pre-Site Characterization Indoor Air and Sub-Slab Soil Vapor Sample Locations
Figure 6 Site Characterization Borings and Monitoring Wells
Figure 7 Site Characterization Indoor Air and Sub-Slab Soil Vapor Sampling Locations
Figure 8 Estimated Sub-Slab Depressurization System Radius of Influence
Figure 9 Proposed Confirmation Indoor Air and Sub-Slab Soil Vapor Sampling Locations

Appendices

Appendix A SSDS Design Documents
Appendix B Quality Assurance Project Plan
Appendix C Generic Community Air Monitoring Plan
Appendix D Health and Safety Plan

Acronyms and Abbreviations

Arcadis	Arcadis of New York, Inc.
DER	Division of Environmental Remediation
GCP Site	Grand Central Plaza Site, 1020 Center Street, Horseheads, New York
IRM	Interim Remedial Measures
iwc	inches of water column
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PCE	tetrachloroethene
PVC	polyvinyl chloride
RAO	Remedial Action Objective
ROI	radius of influence
Site	Grand Central Plaza Site, 1020 Center Street, Horseheads, New York
SMP	Site Management Plan
SSDS	sub-slab depressurization system
WP	Work Plan

1 Introduction

Arcadis of New York, Inc. (Arcadis) has prepared this Interim Remedial Measures (IRM) Work Plan (WP) for the Grand Central Plaza Site (New York State Department of Environmental Conservation [NYSDEC] Site No. 808053), located at 1020 Center Street, Horseheads, New York, hereafter referred to as "Site" or "GCP Site" (**Figure 1**). The GCP Site is the subject of an Order on Consent between GCP Boom, LLC and the NYSDEC, signed on July 2, 2024 (NYSDEC 2024). The GCP Site has been listed by the NYSDEC as a P-listed site which means that *"preliminary information indicates that the Site may have contamination that makes it eligible for consideration for placement on the Registry of Inactive Hazardous Waste Disposal Sites (commonly referred to as the list of State Superfund Sites)*." Several rounds of due diligence, site investigations, and pilot testing have been conducted, starting in 2022 and culminating with a NYSDEC-approved Site Characterization Plan and subsequent report, which was submitted to the NYSDEC in February 2025 (Arcadis 2025). Work conducted to date supports the conclusion that subsurface tetrachloroethene (PCE) impacts resulting from previous occupancy of a dry-cleaning establishment in the leasehold now occupied by GCP Discount Liquors, is limited to beneath the building slab and has not migrated beyond the building. The driver for remedial measures is sub-slab vapor accumulation and the potential for vapor intrusion into the GCP Discount Liquors, GCP Discount Beer, and First Transit leaseholds, as shown on **Figure 2**. The purpose of this IRM WP is to implement an expedited remedial program in accordance with NYSDEC's letter to GCP Boom, LLC, dated March 19, 2025 (NYSDEC 2025). All work will be conducted under the direction of Mr. Christopher Engler, P.E., a Professional Engineer licensed in New York State.

1.1 Interim Remedial Measures Work Plan Organization

Table 1 – Interim Remedial Measures Work Plan Organization

Section	Description
Section 1 – Introduction	Presents relevant background information, including prior investigations and a summary of Site impacts.
Section 2 – Site Remedy Basis	Presents the basis for the Site remedy proposed in this IRM WP.
Section 3 – Proposed Site Remedy	Presents a description of the proposed Site remedy, including the pre-design soil and groundwater sampling and sub-slab/soil vapor intrusion sampling programs implemented to verify the nature and extent of PCE impacts in the subsurface.
Section 4 – Interim Remedial Measures Design Submittals and Schedule	Identifies the remedial design documents to be prepared in support of the IRM and presents the anticipated project schedule for completing the IRM and implementing the Site remedy.
Section 5 – References	Presents a list of documents used to support preparation of this IRM WP.

1.2 Site Background

1.2.1 Site Description

The GCP Site comprises an approximately 20.60-acre parcel property (Chemung County, New York Tax Parcel ID: 59.13-3-3) improved with approximately 267,250 square feet of single-story commercial buildings, which are referred to as the "Southwestern Building," the "Northwestern Building," and the "Main Building" (**Figure 2**). The

Main Building is situated in a west-east configuration immediately north of Chemung Street; the Southwestern and Northwestern Buildings are situated in a generally north-south configuration along the western boundary of the Site. A fourth and much smaller building, the “Dunkin’ Donuts Building,” is located immediately west of South Center Street and is not discussed further. The remainder of the Site consists of asphalt-paved parking lots and grassy, landscaped areas.

The subject of the IRM work is the Southwestern Building, which is occupied by (from south to north) the First Transit, GCP Discount Liquors, and GCP Discount Beers lease spaces, as shown on **Figure 2**. The Southwestern Building consists of one slab on grade and a common roof and does not share a slab or roof with other buildings on site.

According to the Zoning Map of the Village of Horseheads, New York (Chemung County 2018), the Site is located in a C-1 Neighborhood Residential District.

1.2.2 Surrounding Property Land Use

Land use in the surrounding area consists of commercial, residential, public school, and County Highway Department properties (**Figure 3**). Approximately 0.6 miles west of the Site is the Westinghouse facility, which is a focal point of the Kentucky Avenue Well Field cleanup project. The facility has a large plume of dissolved-phase trichloroethylene that extends in an easterly-southeasterly direction from the Westinghouse facility (towards the Site and surrounding properties). The following properties adjoin the Site:

- **North:** United States Highway I-86, beyond which are mixed residential neighborhoods and the Horseheads High School building complex;
- **East:** South Center Street, beyond which are a used car sales lot, Grand Central Avenue, and a restaurant (Rico’s Pizza and Subs);
- **Southeast:** The corner of South Center Street and Chemung Street, beyond which are an Advance Auto Parts store, a nail salon, and the Elmira Savings Bank;
- **South:** Chemung Street, beyond which are a mixture of commercial businesses (smoke shop, electronics and computer repair business), a vacant commercial property, and residences along Chemung Street, Carroll Street, Fairview Terrace, and Lorraine Boulevard;
- **Southwest:** The corner of Chemung Street and Bolstein Boulevard, beyond which are the Cameron Manufacturing and Design building complex and the Chemung County Highway Department; and
- **West:** A railroad line, beyond which are the New York State Highway Department complex, an Ashley Home Furniture Store, and Lackawanna Avenue.

1.2.3 Summary of Physiographic, Geologic, and Hydrogeologic Information

1.2.3.1 Topography

According to the Horseheads, New York 7.5-minute topographic quadrangle map (United States Geological Survey 2019), elevation at the center of the Site is approximately 890 feet above mean sea level with approximately 5 feet of relief across the Site.

1.2.3.2 Regional Geology

Bedrock beneath the Site is mapped as Upper Devonian shale and siltstone of the West Falls Group (Geologic Map of New York, Finger Lakes Sheet [Rickard and Fisher 1970]). Surficial geology in the area consists of outwash sand and gravel, coarse to fine gravel with sand, pro-glacial fluvial deposition, well-rounded, and stratified (Cadwell et al. 1986).

1.2.3.3 Local Geology and Hydrogeology

The Site is located in an alluvial valley with local hydrologic influence from Newtown Creek, which is located approximately 4,000 feet east of the Site.

Bedrock was not encountered in borings advanced to a maximum depth of 16 feet below ground surface by Arcadis in 2024. Soil borings showed the Site to be underlain by silty sand and gravel with a discontinuous layer of silt and clay. Static depth to groundwater was measured at a depth of 5.45 to 6.37 feet below ground surface during Site Characterization fieldwork in October 2024. Groundwater flow direction was inferred to be generally towards the southeast beneath the leaseholds mentioned above, which is consistent with the findings of work conducted by others (MACTEC Engineering and Consulting, PC, 2006) associated with the nearby Kentucky Wellfield Superfund site.

1.2.3.4 Wetlands

According to information obtained from the U.S. Fish and Wildlife Service National Wetland Inventory and New York State Freshwater Wetlands Mapping, no National Wetland Inventory or New York State delineated wetland areas are located on the Site. The closest delineated wetlands were identified approximately 2,700 feet southwest of the Site.

1.2.4 Summary of Previous Environmental Investigations

Prior environmental investigations of the GCP Site, which were previously provided to the NYSDEC by Arcadis, are summarized in the documents listed below:

- Phase I Environmental Site Assessment, prepared by Fagan Engineers, December 1998;
- Soil Vapor Intrusion Assessment – GCP Liquor Store, prepared by Fagan Engineers, November 1998;
- Phase I Environmental Site Assessment Report, prepared by Arcadis, June 2022;
- Phase II Investigation Summary, prepared by Arcadis, June 2022;
- Sub-slab depressurization pilot testing, conducted by Arcadis, November 2022;
- Sewer Line Inspections, conducted by Arcadis, June and October 2023;
- Site Characterization, conducted by Arcadis, October/November 2024; and
- Site Characterization Report, prepared by Arcadis, submitted February 2025.

Figure 4 shows pre–Site Characterization soil boring and soil/groundwater sampling locations, and **Figure 5** shows pre-Site Characterization soil vapor and indoor air sample locations.

1.2.5 Site Characterization Report Conclusions

The objectives of the Site Characterization were to evaluate the extent of PCE impacts at the Site and to quantify whether those impacts represent a “significant” threat to public health or the environment, such that additional site investigation and/or remediation would be necessary, and whether such a threat is of a sufficient magnitude to warrant placing the Site on the New York State list of Inactive Hazardous Waste Sites. **Figure 6** shows the locations of Site Characterization soil borings and monitoring wells, and **Figure 7** shows the locations of sub-slab soil vapor and indoor air samples collected as part of the Site Characterization.

During the Site Characterization, PCE was not detected in soil and groundwater samples collected proximate to the exterior of the building, but there was a limited extent of elevated soil vapor PCE concentrations beneath the building slab. These findings support the position that additional investigation/Site Characterization is not warranted and that installation and operation of a sub-slab depressurization system (SSDS) beneath the GCP Discount Liquors and First Transit lease spaces is the appropriate remedial approach.

1.2.6 Area of Concern

Based on environmental data gathered to date, the portion of the leasehold (building footprint) currently occupied by First Transit and GCP Discount Liquors is considered as the Area of Concern. The Site Characterization conducted in October and November 2024 verified that PCE in soil and groundwater is restricted to a limited area beneath the GCP Discount Liquors concrete slab. Sub-slab soil vapor sampling conducted during the Site Characterization sampling event in November 2024 also indicated that concentrations of PCE above trace levels were not detected in sub-slab soil vapor and indoor air samples collected from the adjoining GCP Discount Beers lease space.

2 Site Remedy Basis

This section presents the basis for the components proposed to represent the comprehensive remedy for the GCP Site and includes the Remedial Action Objectives (RAOs). Meeting the RAOs is part of a NYSDEC threshold criterion (overall protectiveness of public health and the environment) for remedy selection (NYSDEC 2010).

2.1 Remedial Action Objectives

The RAOs presented in the following table have been identified for the Site through consideration of the results presented in the Site Characterization Report (Arcadis 2025) and are consistent with the generic RAOs listed on the NYSDEC's website (http://www.dec.ny.gov/regulations/67560.html).

Table 2 – Remedial Action Objectives

RAOs for Soil
Prevent inhalation exposure to contaminants volatilizing from soil.
RAOs for Groundwater
Prevent exposure to, contact with, and inhalation of volatiles from contaminated groundwater.
RAO for Soil Vapor
Mitigate impacts to public health resulting from the potential for soil vapor intrusion into the First Transit and GCP Discount Liquors lease spaces.

The RAOs, in combination with the results of investigation activities conducted at the GCP Site by Arcadis (Arcadis 2022, 2025), have been used to identify the following aspects of the GCP Site that form the basis for the remedy presented in this IRM WP. These aspects need to be addressed for the GCP Site remedy to be comprehensive and fully protective of human health and the environment:

Adsorbed phase PCE-impacted soil was identified beneath the GCP Discount Liquors lease-space during Phase II Environmental Site Assessment activities conducted by Arcadis (Arcadis 2022). Concentrations of PCE did not exceed the most stringent soil cleanup objectives for unrestricted use or protection of groundwater in Title 6 of the New York Codes, Rules, and Regulations, Part 375. Site use limitations (as set forth in an Environmental Easement) will be required for this Site. As detailed in the Site Characterization Report (Arcadis 2025), the concentrations of PCE in soil are limited to a zone beneath the GCP Discount Liquors floor slab. No active remediation of soil is required.

Construction and utility workers may be exposed to groundwater during intrusive activities conducted beneath the GCP Discount Liquors floor slab. Additional health and safety measures are required to reduce the potential for future construction and utility workers exposure to impacted groundwater, and these measures have been successfully implemented at numerous sites throughout New York State. No active remediation of groundwater is required.

The potential exists for PCE vapors in the subsurface to migrate into indoor air via the vapor intrusion pathway. As required in NYSDEC's letter of March 19, 2025 (NYSDEC 2025), GCP Boom, LLC will install an SSDS in the Area of Concern.

Site remedy components have been developed based on their ability to meet the RAOs and effectively address Site-specific aspects (identified above) to provide overall protectiveness of public health and the environment.

2.2 Remediation Areas

As identified above, soil vapor concentrations of PCE exceeding “mitigation criteria,” as specified in the New York State Department of Health (NYSDOH) Soil Vapor/Indoor Air Matrix B (NYSDOH 2017), are present beneath the GCP Discount Liquors lease space.

2.3 Identification of Site Remedy Components

Site remedy components were identified based on their ability to meet the RAOs and to be promptly implemented.

Table 3 – Proposed Site Remedy Components

General Response Action	Technology Type	Technology Process Option
Institutional Controls	Institutional Controls	Environmental easement for that portion of the Site occupied by First Transit, GCP Discount Liquors, and GCP Discount Beers to limit exposure, restrict the use of groundwater, and govern future uses of this area of the land.
Institutional Controls	Site Management Plan (SMP)	Preparation of an SMP to describe environmental site management after SSDS installation.
Vapor Mitigation	SSDS	Installation and operation of an SSDS.

The remedial approach represents a proposed Site remedy that comprehensively achieves the best balance of the NYSDEC remedy evaluation criteria set forth in Title 6 of the New York Codes, Rules, and Regulations, Part 375-1.8(f) and (g), which includes the following two threshold criteria: 1) overall protectiveness of public health and the environment; and 2) compliance with applicable standards, criteria, and guidance. These threshold criteria are satisfied by the proposed Site remedy described in the following section.

3 Proposed Site Remedy

This section presents a description of the remedy proposed to be implemented for the GCP Site. As noted in Section 2, the selected remedy will be the installation and operation of an SSDS. The IRM will be implemented in conjunction with engineering/institutional controls (Section 3.2) to constitute a final Site remedy.

3.1 Sub-Slab Depressurization System Overview

The SSDS will be installed to mitigate the potential for sub-slab vapor intrusion into the occupied workspaces within the First Transit and GCP Discount Liquors lease spaces. The portions of these two lease spaces targeted for SSDS are shown on **Figure 8**. Tan shaded circles depict the approximate areas that will be depressurized by the SSDS suction points. Areas shaded in grey hatching will not be mitigated by the SSDS, based upon pilot test data discussed below and assumed homogeneity of fill materials immediately below the building slab.

3.1.1 Basis of Sub-Slab Depressurization System Design

Arcadis performed an SSDS pilot test from October 31, 2022, through November 3, 2022, to assess the potential effectiveness of the SSDS at this building and to obtain pertinent design parameters (e.g., extraction point spacing, applied vacuum, and vapor extraction flow rate). The results of the pilot test indicated that an SSDS could be effective at creating a negative pressure (i.e., vacuum) in the sub-slab relative to indoor air, thereby mitigating the potential for sub-slab soil vapor to migrate into indoor air.

The purpose of the SSDS is to induce a vacuum beneath the building foundation within the target mitigation area to prevent subsurface vapors from migrating into indoor air. During operation of an SSDS system, a minimum vacuum of -0.004 inches of water column (iwc) is commonly used to demonstrate vacuum radius of influence (ROI). The SSDS design is based on a conservative estimated ROI of 45 feet. The ROI of the proposed SSDS is presented on **Figure 8**.

The full-scale SSDS will consist of two suction points; each suction point includes a suction sump (from which sub-slab soil vapor is extracted), a flow-control valve, a vacuum gauge, and conveyance piping connecting the suction sump to one of two exterior-mounted inline fans. Inline fans will be installed with vertical discharge stacks that exhaust sub-slab soil vapors to the atmosphere at a height of 3 feet above the building roofline. A layout of the SSDS and a piping and instrumentation diagram are included in **Appendix A**.

3.1.2 Suction Points

Two suction points (SP-1 and SP-2) will be installed by core-drilling a hole in the concrete slab, removing material from the area immediately beneath the slab to create a sump (approximately 2-foot diameter and 1-foot deep), and placing 2-inch-diameter washed gravel up to the bottom of the slab (refer to Detail 1 on Sheet M-4 in **Appendix A**). A polypropylene strainer will be fitted to the open end of the Schedule 40 polyvinyl chloride (PVC) pipe and installed vertically into each sump, extending to an approximate depth of 4 to 6 inches below the bottom of the concrete floor slab. Prior to installation of new concrete, 6-mil polyethylene sheeting will be placed directly above the washed gravel. Concrete will be installed flush with the surrounding floor surface and troweled smooth with the existing concrete floor.

3.1.3 Suction Riser

SSDS suction points will be installed near building support columns or interior walls, to the extent practicable, to facilitate the installation of riser pipes that will be supported and protected by the columns. Mechanical controls and monitoring accessories for each suction point will be installed on a suction riser that extends vertically from the suction sump. Riser pipes for the suction points will be constructed of Schedule 40 PVC pipe. Each riser pipe consists of the following components:

- An inline, 3-inch-diameter, Schedule 40 PVC flow-control full port ball valve;
- A vacuum gauge (-55 to 0 iwc range); and
- A direct-tap, ½-inch-diameter, stainless-steel ball valve to allow for air velocity measurements or extracted sub-slab soil vapor sampling, if required.

Suction risers are depicted on Detail 3 of Sheet M-4 in **Appendix A**.

An enclosure will be built around the suction riser for SP-2, which is located in an office room. The enclosure will consist of wood framing and ½-inch thick gypsum board panels. Access panels will be installed in the enclosure to provide access to the inline butterfly valve and direct-tap ball valve for SP-2. Finish work for the enclosure will be completed to restore the space to an office setting.

3.1.4 Inline Fans and Piping

Overhead conveyance piping will be installed to connect each suction riser to one of two exterior, wall-mounted, inline fans, F-01 and F-02 (see Sheet P-1 in **Appendix A**). The inline fans are both RadonAway HS-5000 fans and will be installed on the exterior of the building near the roof level. Interior overhead conveyance piping will consist of 3-inch-diameter Schedule 40 PVC. Conveyance piping will be sloped such that any condensate water that may accumulate inside the piping will flow by gravity back to the suction point. Conveyance piping will be installed above the drop-ceiling, where present. The SSDS layout, including conveyance piping routes and inline fan locations, is shown on Sheet M-2 in **Appendix A**. An SSDS suction point schedule, including inline fan make/models and specifications (flow/vacuum and power ratings), is included on Sheets P-1 and P-2 in **Appendix A**.

Each inline fan will be installed with a 3-inch-diameter Schedule 40 PVC vertical discharge stack extending to a height of 3 feet above the building roofline. A zero-loss rain cap (Harrison 1034-WCB-03) will be installed at the top of each discharge stack. All exterior piping will be installed with 1-inch fiberglass insulation and aluminum jacketing. Each fan is rated for exterior use and includes a built-in condensate bypass that allows any condensate that may accumulate above the fan to be directed to the suction side of the fan (i.e., below the fan), where it may drain to the extraction point. Each inline fan includes a variable speed controller to allow for additional adjustment of applied vacuum at SSDS suction points.

Differential pressure transmitters with a range of 0 to 50 iwc will be installed on conveyance piping for each inline fan (two transmitters total) to allow for remote monitoring of applied vacuum.

3.1.5 Vacuum Monitoring Points

Vacuum monitoring points will be installed by hammer-drilling a 5/8-inch-diameter hole through the floor slab. Near the floor surface, a larger, 1.5-inch-diameter hole will be installed roughly 1.75 inches into the slab to facilitate installation of a VaporPin® stainless steel probe and flush-mounted cover (Detail 1 on Sheet M-5 in

Appendix A). A total of five additional sub-slab vacuum monitoring points will be installed throughout the target mitigation area.

3.1.6 Controls

The SSDS is designed to operate continuously and includes remote monitoring functionality. Vacuum transmitters will be installed on each inline fan system to allow for remote monitoring of the SSDS and to verify the fans are operational. Vacuum monitoring points will be installed throughout the target mitigation area to allow sub-slab differential pressure to be manually measured to confirm system effectiveness.

3.1.7 Construction of Sub-Slab Depressurization System

SSDS construction specification and design drawings, stamped by a New York State Licensed Professional Engineer are presented in **Appendix A**. The SSDS has been designed with two suction points, one located in the First Transit lease space and the other in the GCP Discount Liquors lease space. Each suction point is designed to operate with an inline fan. The system will be designed and installed in accordance with industry-accepted practices typically employed for similar projects in New York State. An installation contractor has been selected to install the SSDS in 2025.

3.1.8 Indoor Air Sampling and Air Quality

Indoor air sampling will be conducted after a minimum of 30 days has elapsed after SSDS activation. Based on planned SSDS operation by early September, we propose the post-installation indoor air sampling event to take place at the beginning of the heating season in mid- or late November. Since we are sampling early in the heating season, follow-up sampling during the heating season may be requested by the NYSDEC/NYSDOH if optimal sampling conditions (i.e., windows closed, heating system operating) are not achieved. Paired indoor air and sub-slab soil vapor samples will be collected from the locations shown on **Figure 9** to assess PCE concentrations in indoor air and the sub-slab environment during SSDS operation. Indoor air and sub-slab soil vapor sampling and analysis will be conducted in accordance with methods and protocols outlined in the Guidance for Evaluating Soil Vapor Intrusion in the State of New York and the approved Quality Assurance Project Plan (**Appendix B**).

The objective of installing and operating an SSDS is to maintain indoor air and sub-slab soil vapor concentrations of PCE within the “No Further Action” zone of the NYSDOH Soil Vapor/Indoor Air Matrix B.

3.2 Waste Management

Concrete, scrap PVC, and other construction debris will be disposed as municipal solid waste or recycled as appropriate. Waste generated from the subsurface, such as crushed stone and/or fill/soil from beneath the concrete floor slab, is expected to be non-hazardous by characteristic based on prior sampling and analysis. Subsurface materials will be containerized in DOT-approved, 55-gallon, steel drums and transported by a licensed hauler to an appropriately permitted facility for disposal as non-hazardous waste in accordance with the January 6, 2025 Contained-Out determination granted by the NYSDEC. Groundwater is not expected to be encountered during SSDS installation.

3.3 Environmental Easement, Institutional Controls, and Engineering Controls

In conjunction with the SSDS, the following are proposed additional Site remedy components for GCP Boom, LLC:

- An Engineering Control in the form of a ground surface cover (e.g., building). A ground cover (building with concrete slab) currently exists on the Site.
- Institutional Controls (environmental easement) to govern future development, limit the use of groundwater, and manage subsurface activities. Institutional controls will be established following completion of the IRM construction activities. An SMP will be prepared to describe environmental site management after SSDS installation.

3.4 Site Management Plan

A SMP will be prepared that will (in general) document protocols and requirements to manage exposure to contamination remaining at the Site, including (but not necessarily limited to) the following activities: SSDS operations and maintenance protocols, future subsurface activities (e.g., excavation), methods for reducing and repairing disturbances or damage to the ground surface cover, proper management of potentially impacted material encountered during future subsurface activities, and periodic inspection, certification, and reporting. The SMP will be prepared in accordance with the NYSDEC form document and markup provided with the letter dated March 19, 2025, current NYSDEC guidance and utilizing the most recent NYSDEC SMP template (dated October 2024 as of this writing).

4 Interim Remedial Measures Design Submittals and Schedule

This section identifies the information included in the SSDS IRM Design. The SSDS IRM will be conducted in accordance with the NYSDEC/NYSDOH-approved design documents. Based on receiving no comments from the NYSDEC/NYSDOH on the 95% IRM Design Submittal, and consistent with the requirements set forth in Division of Environmental Remediation (DER)-10 (NYSDEC 2010a), the 100% IRM remedial design submittal is attached hereto.

Based on the limited nature (no exterior intrusive work) of the work, we anticipate that a Community and Environmental Response Plan will not be required. Community air monitoring is proposed to consist of three real-time VOC and particulate monitoring stations placed at various locations inside the lease space during intrusive work. Dust suppression techniques will be employed during concrete cutting and mixing. Arcadis will attempt to perform certain intrusive work during non-business hours to minimize public exposure to potential hazards (e.g., dust, noise). All personnel have the authority to, and are expected to, stop work if conditions exceed established safe criteria.

IRM Design and Operation Schedule

The preliminary anticipated schedule for completing the activities identified in this IRM WP is presented below.

Table 4 – IRM Schedule

Activity	Anticipated Milestone Date
Draft IRM Design WP Submission to NYSDEC	April 24, 2025
Final IRM Design WP Submission to NYSDEC	June 18, 2025
Remedial Contractor Procurement	Completed
Monthly Progress Reports	By 10th day of each month
Complete SSDS Installation IRM	September 1, 2025
Complete Heating Season Indoor Air/Sub-Slab Sampling	December 1, 2025
Receive Executed Environmental Easement	December 31, 2025 or sooner
Provide Validated Data for November 2025 Indoor Air/Sub-Slab Sampling	No later than January 15, 2026
Submit Draft Report	No later than January 15, 2026
Submit Final Report	March 15, 2026
Submit Draft SMP	February 1, 2026
Submit Final SMP	April 30, 2026

5 Green Remediation

In accordance with DER-31, Arcadis will take reasonable and practicable steps to minimize the environmental footprint of the remedial work. Such steps may include but not be limited to:

- Carpooling;
- Renting hybrid or fully electric vehicles;
- Not leaving conventional internal combustion engines idling; and
- Recycling concrete demolition debris when possible.

A brief discussion of the green remediation methodologies employed will be included in the Final Report.

6 Reporting

The remedial measures proposed herein are expected to constitute a final remedy for the Site. Accordingly, a "Final Report" will be prepared that follows the requirements for a Construction Completion Report and Final Engineering Report, as outlined in Section 5.8 of DER-10. The Final Report will include as-built SSDS drawings, validated confirmatory indoor air/sub-slab sampling data (with Data Useability Summary Reports and electronic laboratory deliverables), daily inspection reports, system inspection reports, and community air monitoring data.

Monthly progress reports will be submitted by the 10th of each month and will include, at a minimum, all actions, testing, analyses, and deliverables undertaken during the previous reporting period and those anticipated for the next reporting period. Annual system operations reports may be submitted as required by the NYSDEC/NYSDOH.

7 References

Arcadis 2022 Phase II Investigation Summary, Grand Central Plaza, 1020 Center Street, Horseheads, NY. June.

Arcadis 2025. Site Characterization Report, Grand Central Plaza, 1020 Center Street, Horseheads, NY.

Cadwell, D.H. and Muller, E.H., 1986. Surficial Geologic Map of New York, Finger Lakes Sheet, New York State Museum – Geological Survey, Map and Chart Series #40.

Chemung County. 2018. Zoning Map of the Village of Horseheads, New York. August 15. Available at: https://www.chemungcountyny.gov/DocumentCenter/View/345/Village-of-Horseheads-PDF

MACTEC Engineering and Consulting, PC. 2006. Final Site Characterization Report, Kentucky Avenue Site 1, Horseheads, NY. Site No. 8-08-027.

NYSDEC. 2010a. DER-10 / Technical Guidance for Site Investigation and Remediation. May 3. Available online at: http://www.dec.ny.gov/regulations/67386.html.

NYSDEC. 2010b. DER-31 / Green Remediation. August 11. Available online at: http://www.dec.ny.gov/regulations/67386.html.

NYSDEC. 2024. Order on Consent and Administrative Settlement, Index No.: R8-20240530-27, DEC Site Name: Grand Central Plaza, DEC Site No.: 808053, Site Address: 1020 Center St., Horseheads, NY 14845. July 2.

NYSDEC. 2025. Letter from Mackenzie Rees, P.E. (NYSDEC) to Chris Goldsmith (GCP Boom, LLC). re: Site Characterization Report – Grand Central Plaza. March 19.

NYSDOH. 2006. Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October. Available at:

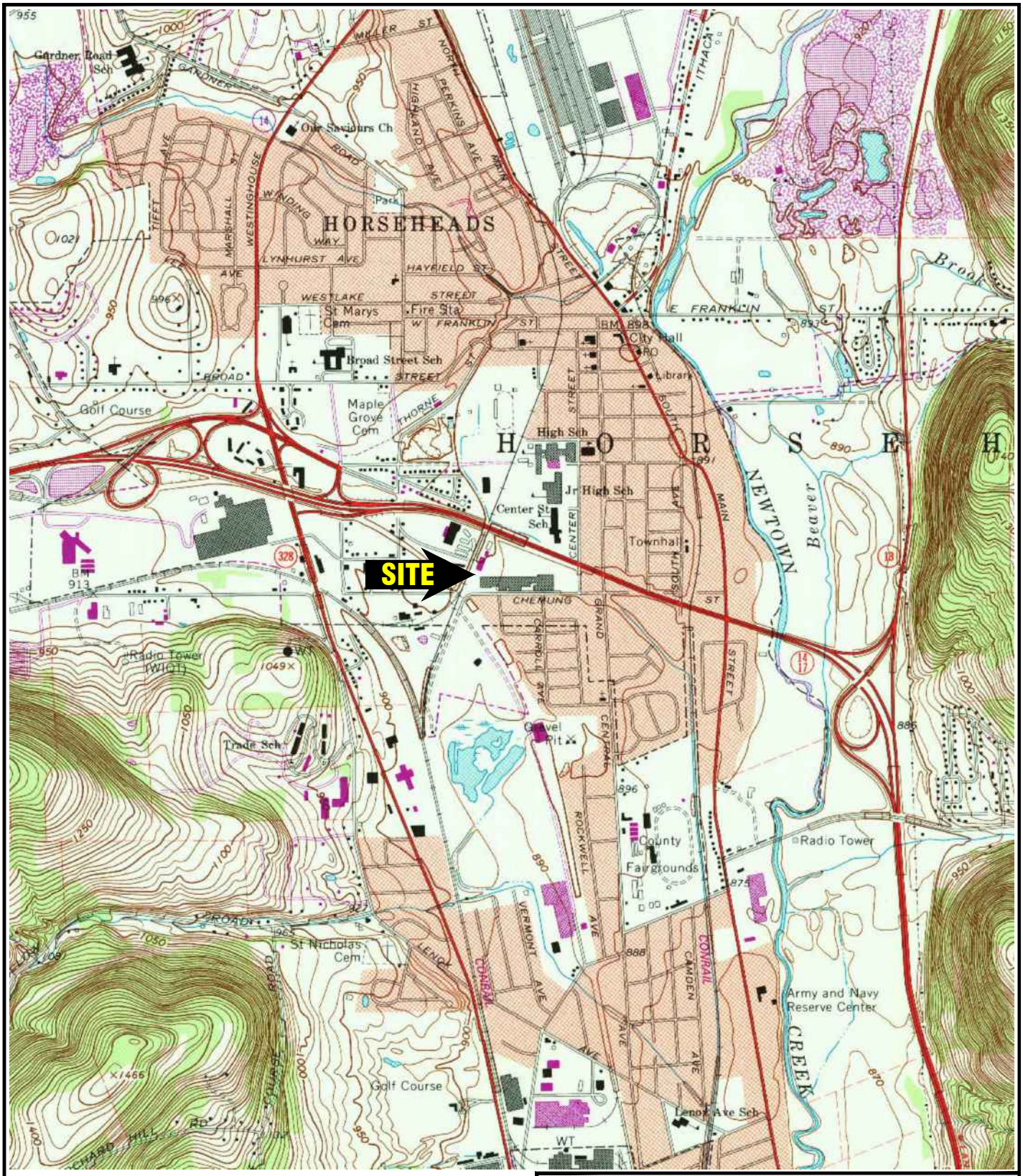
https://health.ny.gov/environmental/indoors/vapor_intrusion/update

NYSDOH. 2017. Soil Vapor/Indoor Air Matrix B. May. Available at: https://health.ny.gov/environmental/indoors/vapor_intrusion/docs/svi_decision_matrices_abc.pdf.

Rickard, L.V., and D.W. Fisher. 1970. Geologic Map of New York, Finger Lakes Sheet, New York State Museum as Science Service, Map and Chart Series #15. Albany: The University of the State of New York.

United States Geological Survey. 2019. Horseheads, NY 7.5-minute topographic quadrangle map.

Figures



SOURCE: USGS
QUAD: HORSEHEADS, NY
DATE: 1978

0 2000' 4000'
GRAPHIC SCALE

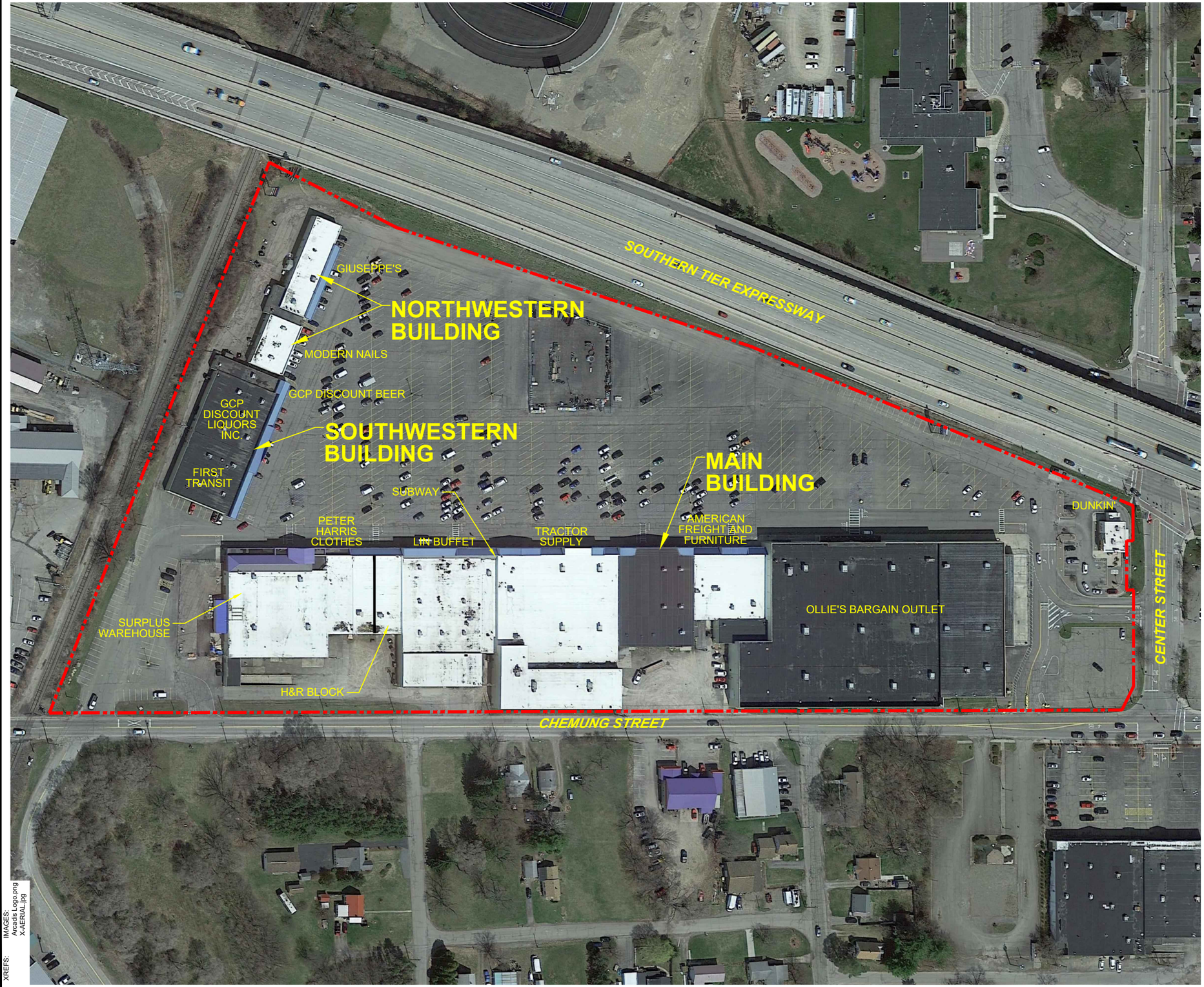
GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK
INTERIM REMEDIAL MEASURES WORK PLAN

SITE LOCATION MAP

ARCADIS

FIGURE
1

C:\Users\BSSmall\DCVACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\IRMWP-F01-SITELOC.dwg LAYOUT: 1 SAVED: 3/24/2025 9:31 AM ACADVER: 24.2S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: --- PLOTTED: 3/24/2025 1:34 PM BY: SMALL, BRIAN



LEGEND:

SITE BOUNDARY - PARCEL 59.13-3-3 BOUNDARY - 1020 CENTER STREET, HORSEHEADS, NY

SOURCE:

AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.

0 150' 300'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

SITE PLAN WITH TAX PARCEL BOUNDARY

ARCADIS

FIGURE 2

C:\Users\BSSmall\DC\ACCDocs\Arcadis ACC USA\US-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\IRMWP-F02-SITE PLAN TAX PARCELS.dwg SAVED: 6/9/2025 4:21 PM BY: SMALL, BRIAN

XREFS:
IMAGES:
Arcadis Logo.png
X-AERIAL.jpg



SOURCE:

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.
2. PARCEL BOUNDARY REFERENCED FROM CHEMUNG COUNTY (NY) REAL PROPERTY TAX SERVICE.

0 200' 400'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

SURROUNDING PROPERTIES MAP

ARCADIS

FIGURE 3

C:\Users\BSSmall\DC\ACCDocs\Arcadis ACC US\AUS-999999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\IRMWP-F03-SURROUNDINGSPROP.dwg SAVED: 3/24/2025 9:31 AM BY: SMALL, BRIAN

XREFS: IMAGES: Arcadis Logo.png X-AERIAL.jpg



LEGEND:

SOIL BORING/TEMPORARY WELL POINT

NOTES:

1. SOIL AND GROUNDWATER SAMPLES COLLECTED FROM SB-1 THROUGH SB-6 COLLECTED MARCH 17, 2022.
2. SOIL AND GROUNDWATER SAMPLES COLLECTED FROM GCP-SB1 AND GCP-SB3 COLLECTED JUNE 12, 2022.
3. SOIL AND GROUNDWATER NOT COLLECTED AT GCP-SB2 DUE TO SHALLOW REFUSAL.
4. SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.

0 80' 160'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

PRE-SITE CHARACTERIZATION SOIL BORING AND SOIL/GROUNDWATER SAMPLING LOCATIONS

ARCADIS

FIGURE 4

C:\Users\BSSmall\DOCACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2022\01-DWG\IRMWP-F04-P-SITE CHAR BORING SAMPLES.dwg LAYOUT: 4 SAVED: 3/24/2025 9:37 AM ACADVER: 24.2S (LMS TECH) PAGESETUP: ----
PLOTSTYLETABLE: ---- PLOTTED: 3/24/2025 1:34 PM BY: SMALL, BRIAN
XREFS: IMAGES: PROJECTNAME: ----
X-AERIAL.jpg



LEGEND:

- AMBIENT AIR SAMPLE LOCATION
- PAIRED INDOOR AIR/SUB-SLAB SOIL GAS LOCATION
- SUB-SLAB SOIL GAS SAMPLE LOCATION
- PILOT TEST ADDITIONAL SUB-SLAB SOIL GAS SAMPLE LOCATION
- SSD PILOT TEST LOCATION AND EFFLUENT SAMPLE

NOTES:

1. SUBSLAB SAMPLES SV-5 THROUGH SV-12 COLLECTED ON MAY 5, 2022.
2. PAIRED INDOOR AIR/SUBSLAB SAMPLES IA-1/SV-1 THROUGH IA-4/SV-4 AND THE AMBIENT AIR SAMPLE OA-1 COLLECTED ON MARCH 18, 2022.
3. SAMPLE LOCATIONS ARE APPROXIMATE.
4. BOLD VALUE: COMPOUND DETECTED ABOVE METHODS DETECTION LIMIT.
5. BOLD AND UNDERLINED (YELLOW SHADED): COMPOUND DETECTED ABOVE NEW YORK STATE DEPARTMENT OF HEALTH SOIL VAPOR MATRIX MITIGATION CRITERIA.
6. SV: SUBSLAB SOIL VAPOR SAMPLE.
7. µg/m3: MICROGRAMS PER CUBIC METER.
8. YELLOW DASHED LINE DENOTES THE INTERNAL WALL SEPARATING TENANT SPACES.

SOURCE:

AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.

0 60' 120'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

PRE SITE CHARACTERIZATION INDOOR AIR AND SUB-SLAB SOIL VAPOR SAMPLE LOCATIONS

ARCADIS

FIGURE
5

C:\Users\BSmall\DC\ACCDocs\Arcadis ACC USVAUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\R\WP-F05-P-SITE CHAR IA SV SAMPLES.dwg LAYOUT: 5 SAVED: 3/24/2025 1:29 PM ACADVER: 24.2S (LMS TECH) PAGESETUP: ----
PLOTSTYLETABLE: ---- PLOTTED: 3/24/2025 1:35 PM BY: SMALL, BRIAN
XREFS: IMAGES: PROJECTNAME: ----
X-AERIAL.jpg



LEGEND:

- MONITORING WELL LOCATION
- SOIL BORING LOCATION
- INTERIOR DIVIDING WALL

SOURCES:

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.
2. BORING AND WELL SURVEY BY TWIN TIER LAND SURVEYING - OCTOBER 18, 2024.

0 50' 100'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

SITE CHARACTERIZATION BORINGS AND MONITORING WELLS

ARCADIS

FIGURE
6

C:\Users\BSSmall\DC\ACCDocs\Arcadis ACC US\AUS-9999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\IRMWP-F06-SITE CHAR BORING MW.dwg LAYOUT: 6 SAVED: 3/24/2025 9:37 AM ACADVER: 24.2S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 3/24/2025 1:35 PM BY: SMALL, BRIAN
XREFS: IMAGES: PROJECTNAME: ----
XAERIAL.jpg



LEGEND:

- AMBIENT AIR SAMPLE LOCATION
- SUB-SLAB SOIL GAS LOCATION
- INDOOR AIR SAMPLE LOCATION

NOTES:

1. SAMPLE LOCATIONS ARE APPROXIMATE.
2. YELLOW DASHED LINE DENOTES THE INTERNAL WALL SEPARATING TENANT SPACES.
3. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.

0 40' 80'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

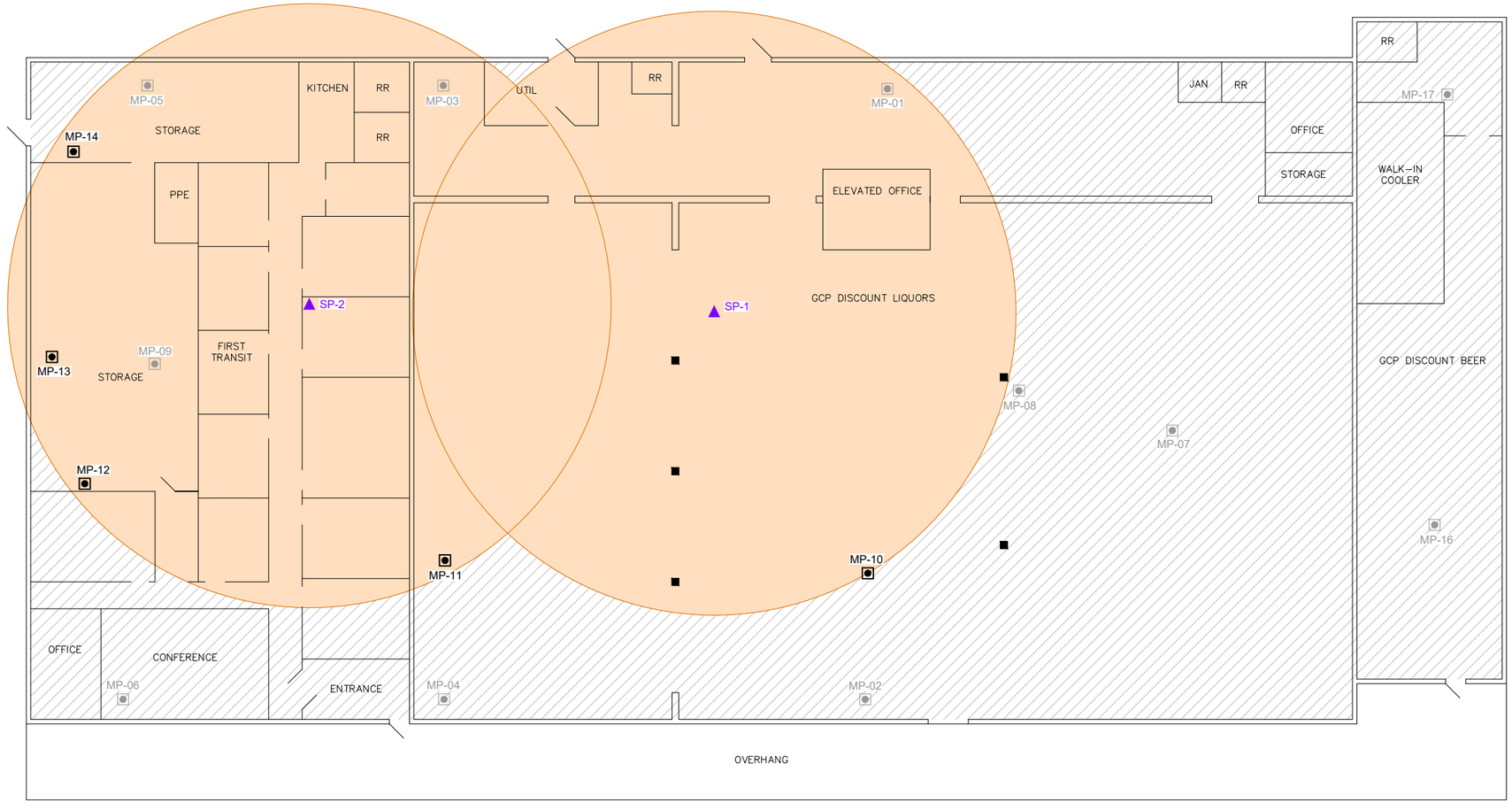
SITE CHARACTERIZATION INDOOR AIR AND SUB-SLAB SOIL VAPOR SAMPLING LOCATIONS

ARCADIS

FIGURE 7

C:\Users\BSSmall\DC\ACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\IRMWP-F07-SITE CHAR IA SV SAMPLES.dwg SAVED: 3/24/2025 1:28 PM BY: SMALL, BRIAN

XREFS:
IMAGES:
Arcadis Logo.png
X-AERIAL.jpg



LEGEND:

- SUCTION POINT AND RADIUS OF INFLUENCE
- PROPOSED MONITORING POINT
- EXISTING MONITORING POINT
- NOT MITIGATED
- EXISTING COLUMN

DRAFT

0 10' 20'
GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK
INTERIM REMEDIAL MEASURES WORK PLAN

ESTIMATED SUB-SLAB DEPRESSURIZATION SYSTEM RADIUS OF INFLUENCE

ARCADIS

FIGURE
8

C:\Users\BSSmall\DC\ACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\IRMWP-F08-ESTIMATED SS ROI.dwg LAYOUT: 8 SAVED: 3/24/2025 9:57 AM ACADVER: 24.2S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ----
PLOTTED: 3/24/2025 1:35 PM BY: SMALL, BRIAN
XREFS: IMAGES: PROJECTNAME: ----
VI-DESIGN-X-BASEMAP
VI-DESIGN-X-AERIAL-GOOGLE.jpg
VI-DESIGN-X-PROPOSED



LEGEND:

- AMBIENT AIR SAMPLE LOCATION (APPROXIMATE)
- SUB-SLAB SOIL GAS LOCATION
- INDOOR AIR SAMPLE LOCATION

NOTES:

1. SAMPLE LOCATIONS ARE APPROXIMATE.
2. YELLOW DASHED LINE DENOTES THE INTERNAL WALL SEPARATING TENANT SPACES.
3. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO - APRIL 5, 2021.

0 30' 60'

GRAPHIC SCALE

GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

INTERIM REMEDIAL MEASURES WORK PLAN

PROPOSED CONFIRMATION INDOOR AIR AND SUB-SLAB SOIL VAPOR SAMPLING LOCATIONS

ARCADIS

FIGURE **9**

XREFS:
IMAGES:
Arcadis Logo.png
X-AERIAL.jpg

C:\Users\bdeclerq\DC\ACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WP\10T_ARC_ENV\2025\01-DWG\IRM\WP-F09-SOIL VAPOR SAMPLES.dwg SAVED: 6/11/2025 1:29 PM BY: DECLERCQ, BRIAN

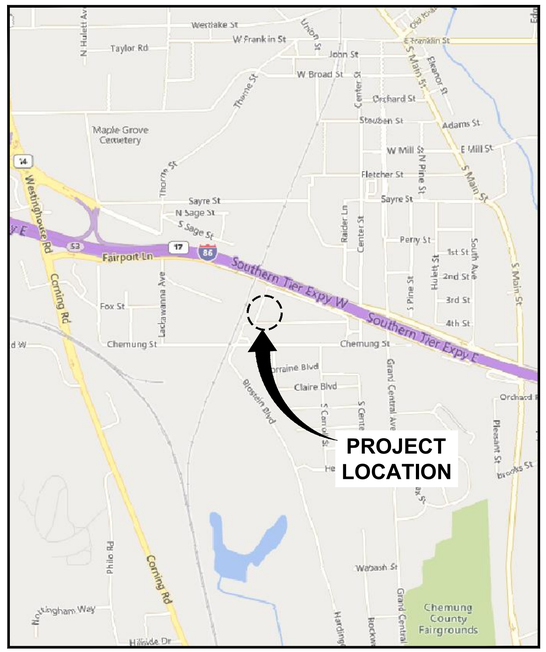
Appendix A

SSDS Design Documents

C:\Users\GSTEINBERGER\DCVACCDocs\Arcadis ACC USVAUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\V1-DESIGN-DR00-Cover.dwg LAYOUT: C0VER SAVED: 1/10/2025 9:21 AM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ----

CONTRACT DRAWINGS

SUB-SLAB DEPRESSURIZATION SYSTEM



LOCATION MAP

0 1000' 2000'

GRAPHIC SCALE



GRAND CENTRAL PLAZA
1020 CENTER STREET
HORSEHEADS, NEW YORK

DATE ISSUED

FEBRUARY 2023

C. GERSHON COMPANY, INC.
244 W. 39TH STREET, 5TH FLOOR
NEW YORK, NY 10018

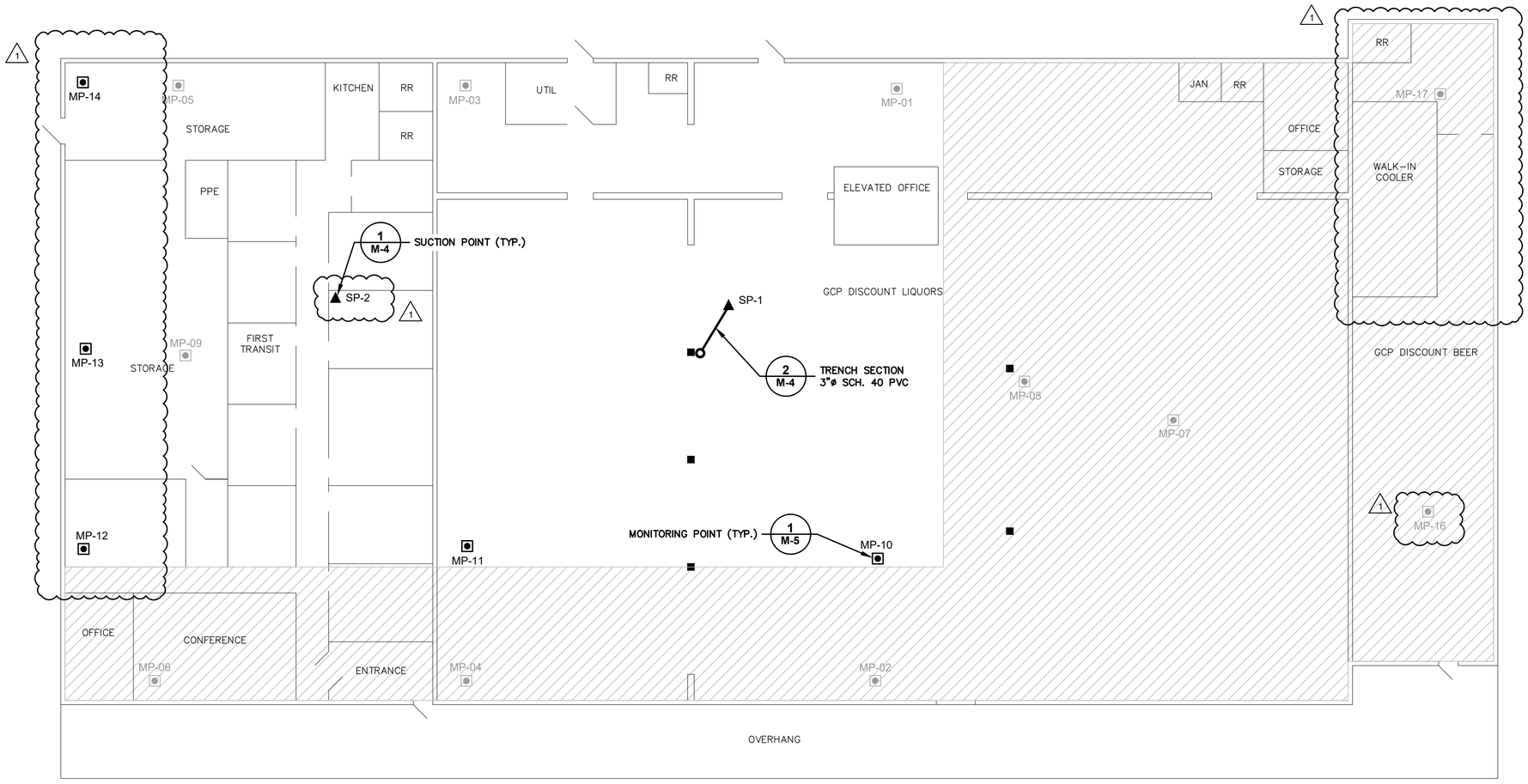
ARCADIS

ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

DRAWING INDEX

	COVER SHEET
M-1	BELOW GRADE PIPING LAYOUT
M-2	ABOVE GRADE PIPING LAYOUT
M-3	VERTICAL DISCHARGE LOCATION
M-4	MECHANICAL DETAILS
M-5	MECHANICAL DETAILS
P-1	PIPING AND INSTRUMENTATION DIAGRAM
P-2	BILL OF MATERIALS
E-1	ELECTRICAL SYMBOL LEGEND AND SPECIFICATIONS
E-2	SINGLE LINE DIAGRAM
E-3	ELECTRICAL PLAN
E-4	CP-1 LAYOUT AND BOM
E-5	CP-1 WIRING DIAGRAM



LEGEND:

- SUCTION POINT
- RISER PIPE
- MONITORING POINT (TO BE INSTALLED BY OTHERS, SEE NOTE 1)
- EXISTING MONITORING POINT
- BELOW GRADE VAPOR EXTRACTION PIPING
- NOT MITIGATED
- EXISTING COLUMN
- X / XX — DETAIL/SECTION NUMBER; DRAWING WHERE DETAIL/SECTION IS SHOWN

NOTES:

1. MONITORING POINTS TO BE INSTALLED BY OTHERS. MONITORING POINTS WILL BE INSTALLED 3 TO 5 FEET AWAY FROM NEAREST BUILDING WALL WITH FOOTING WHERE PRESENT.
2. INSTALL PIPING PLUMB, AND PARALLEL/PERPENDICULAR TO BUILDING WALLS. CUT PIPE SQUARELY AND INSTALL WITHOUT FORCING OR SPRINGING. ENSURE PIPING COMPLETELY BOTTOMS OUT INSIDE FITTING BY MARKING SOCKET DEPTH ON PIPING.
3. ENGINEER TO PERFORM AIR MONITORING WITH PHOTOIONIZATION DETECTOR WHEN SUB-SLAB SOIL IS EXPOSED.
4. INSTALL ALL HORIZONTAL PIPING AT A 1 PERCENT SLOPE, DRAINING TO THE SUCTION POINT.
5. WHERE EXISTING FLOOR COVERING IS REMOVED OR DAMAGED DURING INSTALLATION OF SUCTION POINTS, REPLACE WITH EQUIVALENT FLOOR COVERING MATERIAL. FLOOR COVERING MATERIAL AND APPLICATION METHOD TO BE APPROVED BY ENGINEER BEFORE INSTALLATION.

C:\Users\GSTEINBERGER\DCA\ACCDocs\Arcadis ACC USA\US-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\VI-DESIGN-OR-M01-LAYOUT-BG.dwg LAYOUT: M-1 SAVED: 1/13/2025 12:22 PM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ----
VI-DESIGN-X-ENGR-PE Stamp.jpg
VI-DESIGN-X-ASSESSOR-X-AERIAL-GOOGLE.jpg
VI-DESIGN-X-PROPOSED

10' 0 10' 20'
1"=10'
SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

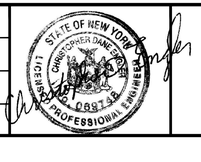
No.	Date	Revisions	By	Ckd
1	1/13/2025	Miscellaneous Revisions	QC	CE
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: CHRISTOPHER ENGLER
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY	2/10/2023	LB

Designed by	Drawn by	Checked by
QC	GS	CE



ARCADIS
ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. • GRAND CENTRAL PLAZA • 1020 CENTER STREET, HORSEHEADS, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

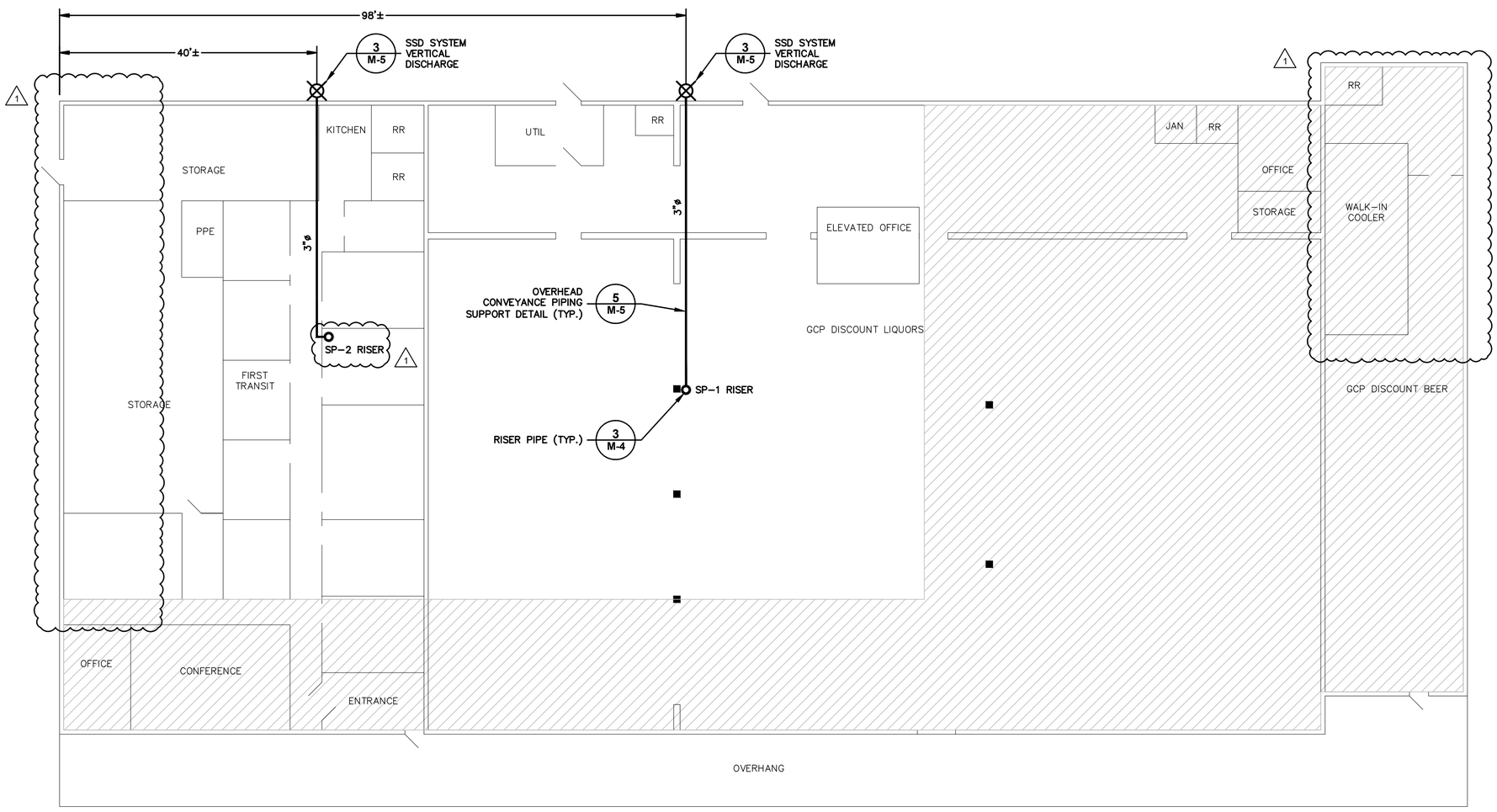
BELOW GRADE PIPING LAYOUT

ARCADIS Project No. 30147184

Date FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

M-1



LEGEND:

- VAPOR EXTRACTION RISER PIPE
- ABOVE GRADE VAPOR EXTRACTION PIPING (SEE NOTE 6)
- NOT MITIGATED
- EXISTING COLUMN
- X / XX — DETAIL/SECTION NUMBER / DRAWING WHERE DETAIL/SECTION IS SHOWN

NOTES:

1. ALL PIPING ELEVATIONS TO BE APPROVED BY ENGINEER PRIOR TO INSTALLATION. PIPING SUPPORTS SHALL BE INSTALLED ON STRUCTURAL MEMBERS.
2. ALL ELBOW FITTINGS INSTALLED MUST BE LONG SWEEP FITTINGS.
3. INSTALL PIPING PLUMB, AND PARALLEL/PERPENDICULAR TO BUILDING WALLS. CUT PIPE SQUARELY AND INSTALL WITHOUT FORCING OR SPRINGING. ENSURE PIPING COMPLETELY BOTTOMS OUT INSIDE FITTING BY MARKING SOCKET DEPTH ON PIPING.
4. ALL CONVEYANCE PIPE AND FITTINGS SHALL BE SOLVENT WELDED USING HEAVY DUTY PRIMER AND CEMENT. APPLY PRIMER AND CEMENT TO BOTH THE FITTING SOCKET AND THE PIPE. ASSEMBLE PIPE FULLY INTO FITTINGS USING A TWISTING MOTION. HOLD PIPE AND FITTING TOGETHER FOR 30 SECONDS UNTIL CEMENT HAS CURED.
5. CONVEYANCE PIPING SHALL BE SUPPORTED EVERY 4 FEET HORIZONTALLY, AND EVERY 10 FEET VERTICALLY.
6. CONVEYANCE PIPING SHALL BE INSTALLED ABOVE DROP CEILING TILES AND AT THE HIGHEST FEASIBLE ELEVATION TO MAINTAIN REQUIRED SLOPE AND EXISTING OBSTRUCTIONS.
7. CONVEYANCE PIPING SHALL BE INSTALLED A MINIMUM OF 2 FEET HORIZONTALLY OR VERTICALLY AWAY FROM SPRINKLER HEADS.
8. INSTALL ALL HORIZONTAL PIPING AT A 1 PERCENT SLOPE, DRAINING TO THE EXTRACTION POINT.
9. WHERE PIPING OF DIFFERENT SIZES MEET AT A TEE, INSTALL TEE SIZED TO MATCH LARGEST DIAMETER PIPING. ALL RISER PIPES AND OVERHEAD PIPING CONVEYING SOIL GAS FROM A SINGLE SUCTION POINT ARE 3–INCH.
10. ALL EXTERIOR PIPING SHALL BE FIT WITH 1 INCH FIBERGLASS INSULATION AND ALUMINUM JACKETING. TERMINATE INSULATION/JACKETING IN A MANNER THAT PREVENTS MOISTURE FROM CONTACTING INSULATION.

C:\Users\GSTEINBERGER\DCA\ACCDocs\Arcadis ACC USA\US-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\VI-DESIGN-DR-M02-LAYOUT-AG.dwg LAYOUT: M-2 SAVED: 1/13/2025 12:22 PM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ----
VI-DESIGN-X-ENGR-PE Stamp.jpg
VI-DESIGN-X-AERIAL-GOOGLE.jpg
VI-DESIGN-X-PROPOSED

10' 0 10' 20'
1"=10'
SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
1	1/13/2025	Miscellaneous Revisions	QC	CE
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: CHRISTOPHER ENGLER
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY	2/10/2023	LB

Designed by	Drawn by	Checked by
QC	GS	CE

STATE OF NEW YORK — CHRISTOPHER DANE ENGLER — 069748 — LICENSED PROFESSIONAL ENGINEER

ARCADIS

ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. • GRAND CENTRAL PLAZA • 1020 CENTER STREET, HORSEHEADS, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

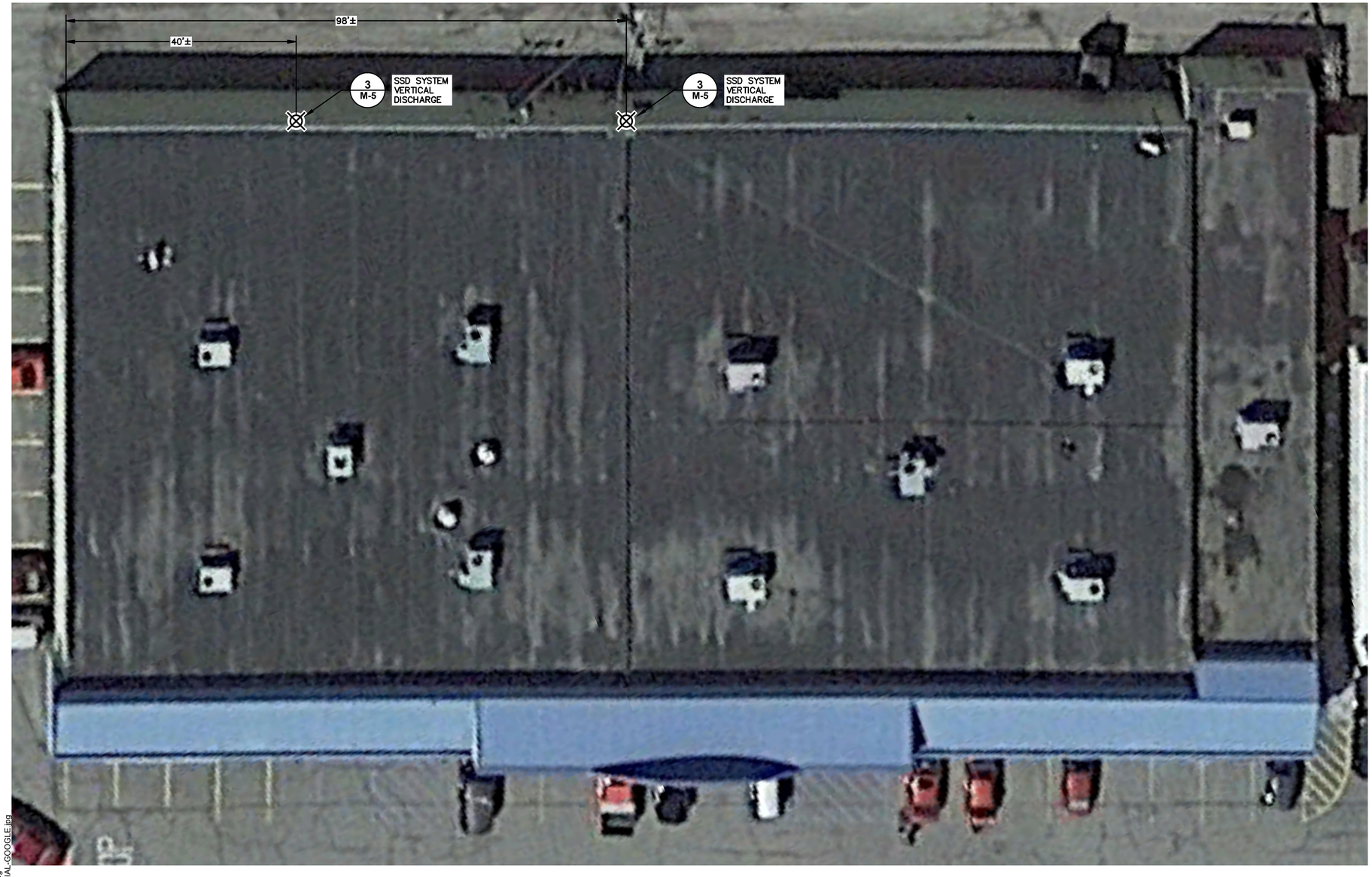
ABOVE GRADE PIPING LAYOUT

ARCADIS Project No.
30147184

Date
FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

M-2



LEGEND:

VERTICAL DISCHARGE

X
XX

DETAIL/SECTION NUMBER

DRAWING WHERE DETAIL/SECTION IS SHOWN

NOTES:

1. BASE MAP AERIAL DATED APRIL 5, 2021 DOWNLOADED FROM GOOGLE EARTH PRO.
2. DISCHARGE STACK SHALL BE VERTICAL AND SHALL BE LOCATED SUCH THAT THE FOLLOWING MINIMUM DISTANCES ARE MAINTAINED:

   –FROM MECHANICAL AIR INTAKES – 30 FEET HORIZONTAL, OR 20 FEET HORIZONTAL AND 5 FEET ABOVE, OR 10 FEET HORIZONTAL AND 10 FEET ABOVE.

   –FROM VENTS OR OTHER OPENINGS – 10 FEET HORIZONTAL OR 4 FEET ABOVE.
3. ALL CONVEYANCE PIPE SHALL BE INSTALLED PLUMB AND PERPENDICULAR. CUT PIPE SQUARELY AND INSTALL WITHOUT FORCING OR SPRINGING. ENSURE PIPING COMPLETELY BOTTOMS OUT INSIDE FITTINGS BY MARKING SOCKET DEPTH ON PIPING.
4. DISCHARGE PIPE LOCATION TO BE APPROVED BY ENGINEER BEFORE INSTALLATION.
5. ALL EXTERIOR PIPING SHALL BE FIT WITH 1 INCH FIBERGLASS INSULATION AND ALUMINUM JACKETING. TERMINATE INSULATION/JACKETING IN A MANNER THAT PREVENTS MOISTURE FROM CONTACTING INSULATION.
6. FINAL LOCATION OF DISCHARGE STACK SHALL BE APPROVED BY ENGINEER BEFORE INSTALLATION.

C:\Users\GSTEINBERGER\DC\ACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\VI-DESIGN-DR-M03-LAYOUT-ROOF.dwg LAYOUT: M-3 SAVED: 1/10/2025 9:21 AM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ---
VI-DESIGN-X-ENGINEER PE Stamp.jpg
VI-DESIGN-X-DETAIL-X-AERIAL-GOOGLE.jpg
VI-DESIGN-X-PROPOSED

10' 0 10' 20'
1"=10'
SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING:

USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name
CHRISTOPHER ENGLER
Professional Engineer's No.
069748

State	Date Signed	Project Mgr.
NY	2/10/2023	LB
Designed by	Drawn by	Checked by
QC	GS	CE

STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · 069748 · LICENSED PROFESSIONAL ENGINEER

ARCADIS

ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. ● GRAND CENTRAL PLAZA ● 1020 CENTER STREET, HORSEHEADS, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

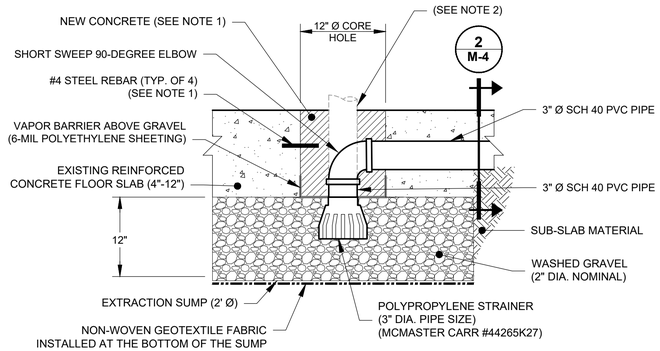
VERTICAL DISCHARGE LOCATION

ARCADIS Project No.
30147184

Date
FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

M-3

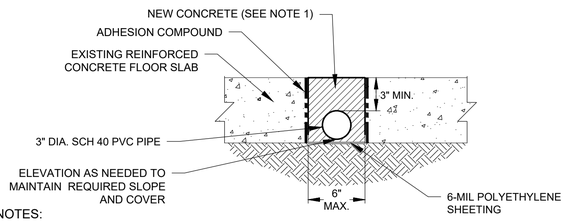


NOTES:

1. USE CONCRETE WITH MINIMUM COMPRESSIVE STRENGTH OF 4,000 POUNDS PER SQUARE INCH. PROVIDE SMOOTH STEEL TROWEL FINISH FLUSH WITH SURROUNDING CONCRETE. CONCRETE BONDING AGENT USED BETWEEN NEW AND EXISTING CONCRETE. INSTALL 6-INCH LONG NO. 4 STEEL REBAR (1/2" DIA.) AROUND CORE HOLE PERIMETER. QUANTITY OF 4 AND INSTALLED AT 1/2 OF TOTAL SLAB THICKNESS. EMBED IN EXISTING CONCRETE A MINIMUM OF 3 INCHES AND USING EPOXY.
2. IF HORIZONTAL SUB-SLAB PIPING IS NOT NEEDED TO ALLOW SUCTION POINT TO AVOID BUILDING/COLUMN FOOTER (I.E., SUCTION POINT IS ABLE TO BE INSTALLED IN THE SAME LOCATION AS RISER), THEN VERTICAL EXTRACTION RISER PIPE MAY EXTEND DIRECTLY FROM SUCTION POINT.
3. SILICA CONTROL PLAN MUST BE IN PLACE AND FOLLOWED DURING ALL CONCRETE CUTTING ACTIVITIES.
4. OVER CUTS ARE NOT PERMITTED FOR THE CUTTING OF THE TRENCH.
5. ENGINEER WILL PERFORM AIR MONITORING WITH PHOTOIONIZATION DETECTOR ANYTIME SUB-SLAB SOIL IS EXPOSED.
6. SUB-SLAB MATERIAL SHALL NOT CONTACT FLOOR OR OTHER PROPERTY, CONTAINERIZE SUB-SLAB MATERIAL IMMEDIATELY.
7. TROWEL FINISH THE CONCRETE AFTER THE BLEED WATER HAS EVAPORATED.
8. CAP/PLUG PIPING, CLOSE VALVE, OR COVER SLAB OPENING WITH POLY SHEETING AND SEAL WITH TAPE WHEN SUCTION POINT IS NOT ACTIVELY BEING WORKED ON.
9. WHERE EXISTING FLOOR COVERING IS REMOVED OR DAMAGED DURING INSTALLATION OF SUCTION POINTS, REPLACE WITH EQUIVALENT FLOOR COVERING MATERIAL. FLOOR COVERING MATERIAL AND APPLICATION METHOD TO BE APPROVED BY ENGINEER BEFORE INSTALLATION.
10. SUCTION POINT LOCATION AND CONFIGURATION TO BE APPROVED BY ENGINEER.

SUCTION POINT 1

NOT TO SCALE

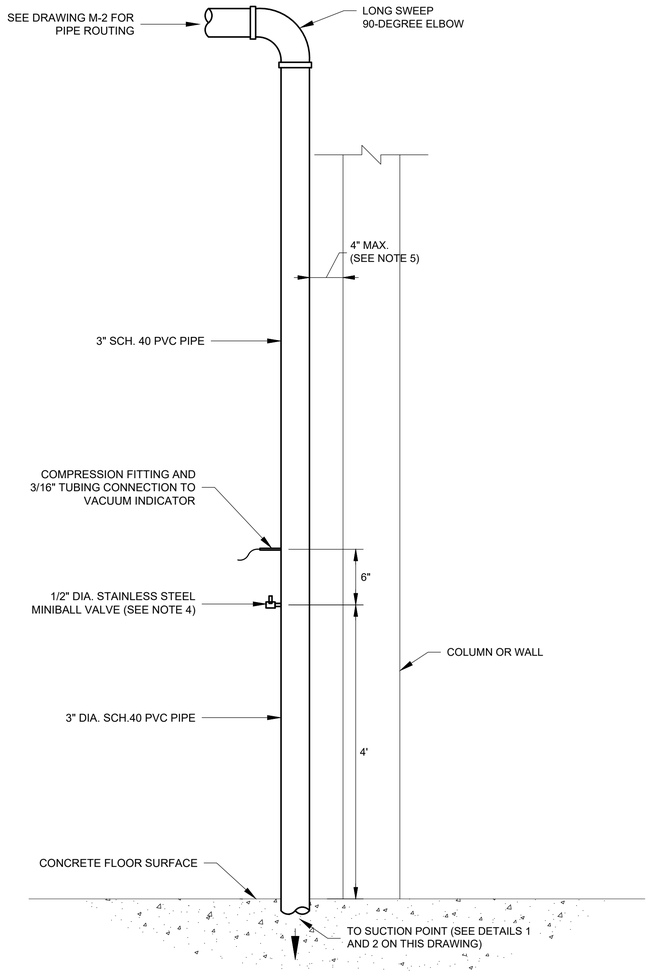


NOTES:

1. REFER TO NOTE 2 OF DETAIL 1 (THIS DRAWING).
2. PIPING SLOPES DOWNWARD TOWARD SUCTION POINT (MIN. 1%). REFER TO DRAWING M-1 FOR DIRECTION OF DOWNWARD SLOPE.
3. WHERE EXISTING FLOOR COVERING IS REMOVED OR DAMAGED DURING INSTALLATION OF SUCTION POINTS, REPLACE WITH EQUIVALENT FLOOR COVERING MATERIAL. FLOOR COVERING MATERIAL AND APPLICATION METHOD TO BE APPROVED BY ENGINEER BEFORE INSTALLATION.
4. OVER CUTS ARE NOT PERMITTED FOR THE CUTTING OF THE TRENCH.
5. SILICA CONTROL PLAN MUST BE IN PLACE AND FOLLOWED DURING ALL CONCRETE CUTTING ACTIVITIES.
6. ENGINEER WILL PERFORM AIR MONITORING WITH PHOTOIONIZATION DETECTOR ANYTIME SUB-SLAB SOIL IS EXPOSED.
7. SUB-SLAB MATERIAL SHALL NOT CONTACT FLOOR OR OTHER PROPERTY. CONTAINERIZE SUB-SLAB MATERIAL IMMEDIATELY.
8. TROWEL FINISH THE CONCRETE AFTER THE BLEED WATER HAS EVAPORATED.

TRENCH SECTION 2

NOT TO SCALE

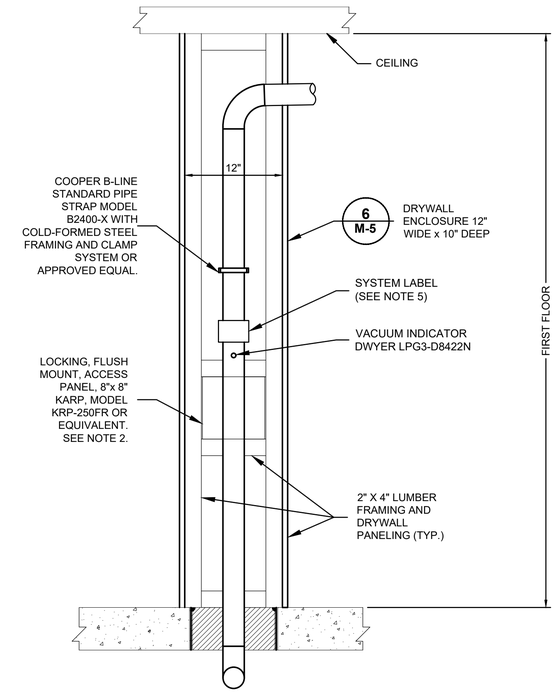


NOTES:

1. SUPPORT VERTICAL PIPE AT LEAST EVERY 10 FEET. SECURE STRUT CHANNEL TO COLUMN/WALL FOR PIPE SUPPORT. INSTALL A MINIMUM OF TWO VERTICAL PIPE SUPPORTS ON THE RISER PIPE.
2. PLACE LABELS EVERY 20 FEET ON ALL INTERIOR CONVEYANCE PIPING INCLUDING SUCTION RISERS. USE WHITE FONT (1/2 INCH TALL) ON GREEN BACKGROUND: "CONTAINS SOIL GAS, IN THE EVENT OF DAMAGE CONTACT MAINTENANCE DEPARTMENT".
3. PLACE LABELS IDENTIFYING SUCTION POINT (I.E., SP-X), VACUUM INDICATOR, AND VALVES. MATCHED ID WITH PIPING AND INSTRUMENTATION DIAGRAM. USE 1/2-INCH TALL BLACK FONT ON WHITE TAPE OR APPROVED ALTERNATE.
4. INSTALL 1/2" DIAMETER STAINLESS STEEL DIRECT TAP BALL VALVE ORIENTATED FOR ANEMOMETER PROBE READINGS (ITEM 3 ON DRAWING P-2).
5. INSTALL RISER PIPE AS CLOSE AS POSSIBLE TO COLUMN OR WALL. INSTALL RISER PIPE INSIDE WEBBING OF STEEL COLUMN IF PRESENT.

RISER PIPE 3

NOT TO SCALE



NOTES:

1. INSTALL NEW DRYWALL ENCLOSURE AROUND RISER PIPING. INSTALL ACCESS PANEL TO ENABLE ACCESS TO SAMPLE PORT AND VACUUM TRANSMITTER. MATCH DRYWALL THICKNESS AND ACCESS PANEL FIRE RATING TO THAT OF EXISTING WALLS. PAINT TO MATCH EXISTING WALLS.
2. INSTALL ACCESS PANEL CENTERED ON THE 1/2" DIA. STAINLESS STEEL MINI BALL VALVE. SEE RISER PIPE DETAIL (DETAIL 3 ON DRAWING M-4) FOR EXACT DIMENSIONS.
3. INSTALL A COMPRESSION FITTING ON RISER PIPING AND INSTALL 3/16" ID TUBING FROM THE COMPRESSION FITTING TO THE LOW PRESSURE PORT ON THE DWYER VACUUM INDICATOR.
4. INSTALL VACUUM INDICATOR (DWYER LPG3-D8442N) 6" ABOVE THE ACCESS PANEL. THE VACUUM INDICATOR LENS SHALL BE INSTALLED IN THE DRYWALL AND VISIBLE.
5. PLACE LABEL ON RISER PIPE, USE 1/2-INCH TALL BLACK FONT ON WHITE TAPE OR APPROVE ALTERNATE: "IF DAMAGED, CONTACT ARCADIS".

EXTRACTION POINT RISER AND ENCLOSURE DETAIL 4

NOT TO SCALE

C:\Users\GSTEINBERGER\DCVACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\VI-DESIGN-XX-DET-M04-M05-DETAILS.dwg LAYOUT: M-4 SAVED: 1/10/2025 9:21 AM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ---
VI-DESIGN-XX-Engineer PE Stamp.jpg

SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name		
CHRISTOPHER ENGLER		
Professional Engineer's No.		
069748		
State	Date Signed	Project Mgr.
NY	2/10/2023	LB
Designed by	Drawn by	Checked by
QC	GS	CE

ARCADIS

ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. ● GRAND CENTRAL PLAZA ● 1020 CENTER STREET, HORSEHEADS, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

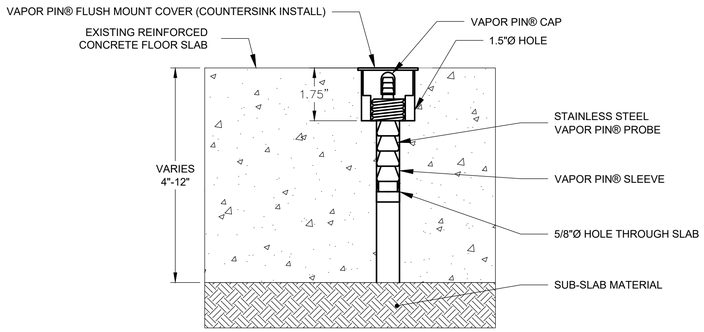
MECHANICAL DETAILS

ARCADIS Project No. 30147184

Date FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

M-4

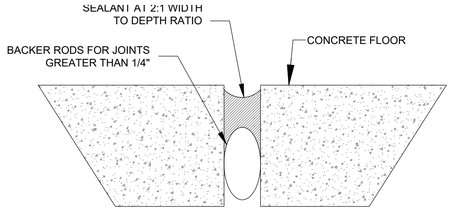


NOTE:

1. INSTALL MONITORING POINT(S) BETWEEN 3 AND 5 FEET FROM NEAREST BUILDING WALL WITH FOOTING.
2. SUB-SLAB MONITORING POINTS TO BE INSTALLED BY OTHERS.

SUB-SLAB MONITORING POINT DETAIL 1

NOT TO SCALE

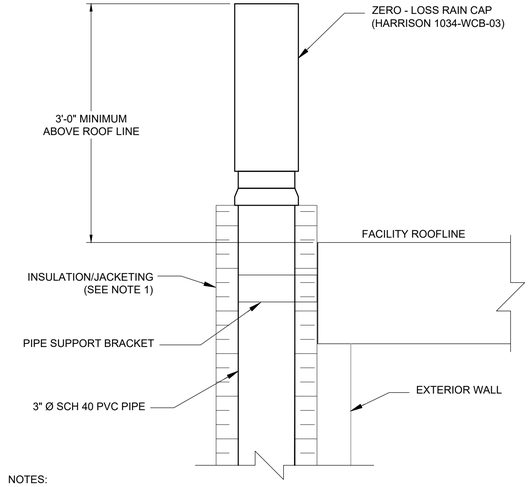


NOTES:

1. ENGINEER SHALL DETERMINE CRACKS TO BE SEALED WITH SIKAFLEX-1A (NON-SELF LEVELING) ELASTOMERIC JOINT SEALANT.
2. SEALANT SHALL BE INSTALLED SUCH THAT IT IS BONDED TO THE CONCRETE FLOOR (ORIGINAL JOINT WALLS).
3. FLOOR SEALANT SHALL BE SMOOTHED SLIGHTLY BELOW FLOOR GRADE TO CREATE A COMPLETE SEAL TO EACH EDGE OF THE JOINT.
4. CLEAN SURFACE AND SEAL IN ACCORDANCE WITH PRODUCT SPECIFICATIONS.

JOINT SEALING DETAIL 2

NOT TO SCALE

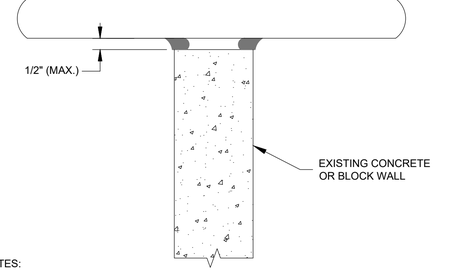


NOTES:

1. ALL EXTERIOR PIPING SHALL BE FIT WITH 1 INCH FIBERGLASS INSULATION. COVER THE SEAM BETWEEN TWO SECTIONS OF INSULATION WITH ASJ MAX TAPE. ALL EXTERIOR PIPING SHALL HAVE CORRUGATED ALUMINUM JACKETING COVERING THE INSULATION (SEE BILL OF MATERIALS ON P-3). SECURE JACKETING WITH GALVANIZED HOSE CLAMPS AND GALVANIZED SCREWS. OVERLAP TWO SECTIONS OF ALUMINUM JACKETING BY A MINIMUM OF 3 INCHES. TERMINATE INSULATION AND JACKETING IN A MANNER THAT PREVENTS MOISTURE FROM CONTACTING INSULATION.
2. USE METAL STRUT AND PIPE CLAMPS TO SUPPORT PIPING. SUPPORT VERTICAL PIPING EVERY 10 FEET AND WITHIN TOP 6 INCH OF BUILDING. USE ANCHORING EPOXY FOR CONCRETE SLEEVE ANCHORS.
3. DISCHARGE SHALL BE AT LEAST 10 FEET (HORIZONTAL) FROM ANY OPERABLE OPENING IN THE BUILDING AND 30 FEET (HORIZONTAL) FROM MECHANICAL AIR INTAKES.
4. SUPPORT VERTICAL PIPING A MINIMUM OF EVERY 10 FEET AND WITHIN 6 INCHES OF THE ROOF.

SYSTEM VERTICAL DISCHARGE DETAIL 3

NOT TO SCALE

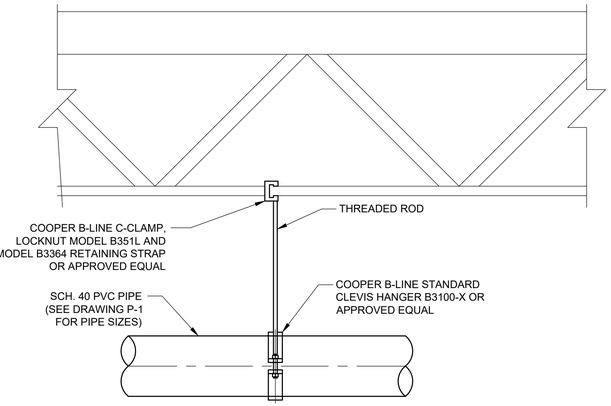


NOTES:

1. USE SIKAFLEX 1A IN ACCORDANCE WITH SPECIFICATIONS. USE FOAM BACKER ROD IF NECESSARY.
2. SUPPORT PIPE WITHIN 1 FOOT ON BOTH SIDES OF WALL.
3. ADVANCE CORE DRILL FROM BOTH SIDES TO PREVENT BLOW OUT.
4. SILICA CONTROL PLAN MUST BE IN PLACE AND FOLLOWED DURING ALL CONCRETE CUTTING ACTIVITIES.

PIPE WALL PENETRATION (NON-FIRE WALL) 4

NOT TO SCALE

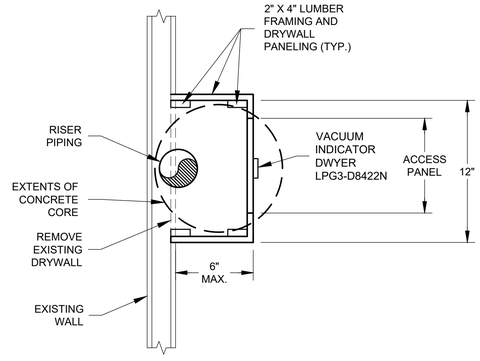


NOTES:

1. HORIZONTAL PIPING SHALL BE SUPPORTED EVERY 4 FEET.
2. HORIZONTAL PIPING SHALL BE PITCHED 1% DOWNWARD TOWARDS THE SUCTION POINT.
3. HORIZONTAL PIPE SUPPORT DETAIL SHOWN IS CONCEPTUAL IN NATURE, CONTRACTOR MAY USE OTHER PIPE SUPPORT METHODS, SUBJECT TO ENGINEER APPROVAL.
4. PLACE "SOIL GAS" LABELS EVERY 20 FEET ON ALL CONVEYANCE PIPING. USE WHITE FONT (1 INCHES TALL) ON GREEN BACKGROUND OR APPROVED ALTERNATE.
5. PIPING ELEVATIONS TO BE APPROVED BY ENGINEER PRIOR TO INSTALLATION.
6. PIPING SHALL BE SUPPORTED FROM BUILDING STRUCTURAL MEMBERS.
7. CONVEYANCE PIPING SHALL BE INSTALLED ABOVE DROP CEILING TILES AND AT THE HIGHEST FEASIBLE ELEVATION TO MAINTAIN REQUIRED SLOPE AND EXISTING OBSTRUCTIONS.

OVERHEAD CONVEYANCE PIPING SUPPORT DETAIL 5

NOT TO SCALE



DRYWALL ENCLOSURE 6

NOT TO SCALE

C:\Users\GSTEINBERGER\DCACCDocs\Arcadis ACC USAUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\202501-DWG\V1-DESIGN-OR-M04-M05-DETAILS.dwg LAYOUT: M-5 SAVED: 1/10/2025 9:21 AM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ----
V1-DESIGN-X-Engineer PE Stamp.jpg

SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: CHRISTOPHER ENGLER
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY	2/10/2023	LB
Designed by	Drawn by	Checked by
QC	GS	CE



ARCADIS

ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. ● GRAND CENTRAL PLAZA ● 1020 CENTER STREET, HORSEHEADS, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

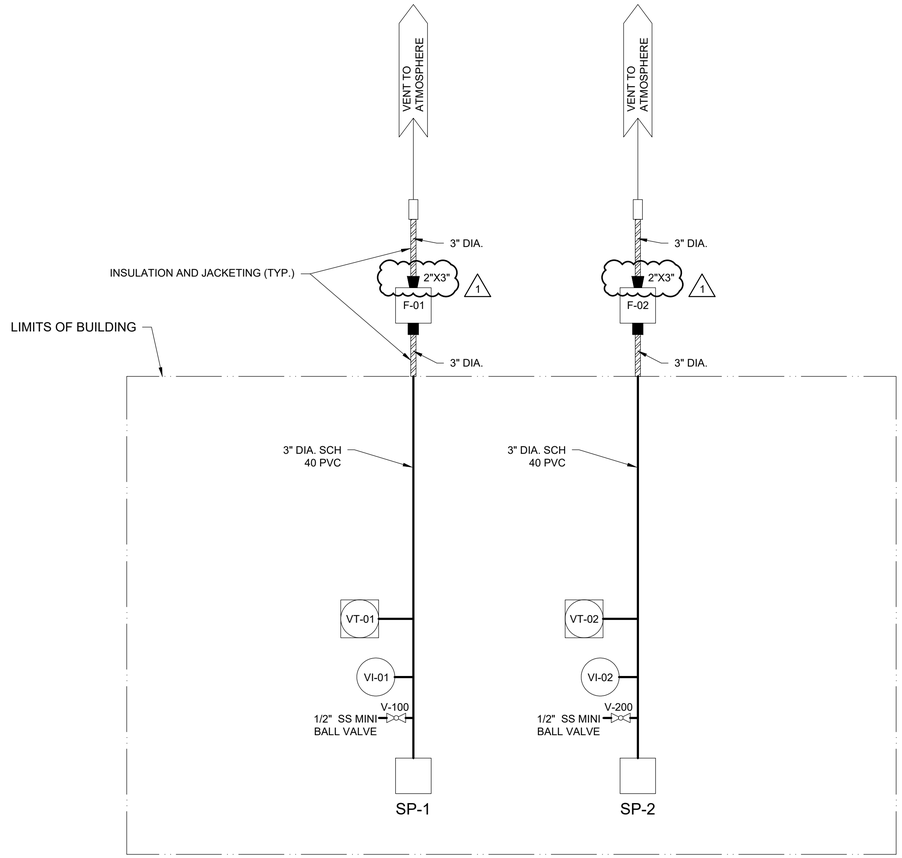
MECHANICAL DETAILS

ARCADIS Project No.
30147184

Date
FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

M-5



GENERAL PROCESS DESCRIPTION:

SUB-SLAB SOIL VAPOR WILL BE EXTRACTED FROM TWO (2) SUCTION POINTS VIA TWO (2) ROOF-MOUNTED INLINE FANS. A VACUUM TRANSMITTER WILL BE INSTALLED FOR EACH SUCTION POINT AND CONNECTED TO AN AUTODIALER. THE SYSTEM IS DESIGNED TO OPERATE CONTINUOUSLY.

ALARMS:

SYSTEM ALARMS WILL INCLUDE LOW AND HIGH VACUUM ALARMS, WHICH WILL TRIGGER REMOTE NOTIFICATION VIA EMAIL BUT WILL NOT AFFECT SYSTEM OPERATION. VACUUM ALARM SETPOINTS WILL BE ADJUSTABLE AND DETERMINED AFTER SYSTEM STARTUP.

SSDS DESIGN PARAMETERS:

SP-1: 20 SCFM, 35 IWC
SP-2: 20 SCFM, 35 IWC

VALVE SCHEDULE:

V-100: 1/2" STAINLESS STEEL MINI FULL PORT BALL VALVE
V-200: 1/2" STAINLESS STEEL MINI FULL PORT BALL VALVE

LEGEND:

- VAPOR PROCESS PIPING
- BUILDING LIMITS
- FULL PORT BALL VALVE
- COUPLING (FLEXIBLE RUBBER)
- REDUCER (FLEXIBLE RUBBER)
- FLANGE
- UNION
- TRANSITION
- INSTRUMENT CONNECTED TO PROCESS LINE
- INTERLOCKED INSTRUMENT CONNECTED TO CONTROL PANEL
- F-01 — INLINE FAN

ABBREVIATIONS:

IWC	INCHES OF WATER COLUMN
MIN	MINIMUM
PVC	POLYVINYL CHLORIDE
SCH.	SCHEDULE
SP	SUCTION POINT
SS	STAINLESS STEEL
TYP.	TYPICAL
V	VALVE
VI	VACUUM INDICATOR
VT	VACUUM TRANSMITTER

NOTES:

1. USE SCHEDULE 40 PVC FOR ALL HORIZONTAL CONVEYANCE PIPING INSTALLED WITHIN THE FACILITY UNLESS OTHERWISE NOTED.
2. INSTALL DWYER LPG3-D8422N (DIFFERENTIAL PRESSURE GAUGE, RANGE -55 - 0" W.C.) AT VI-01 AND VI-02.
3. ALL EXTERIOR PIPING SHALL BE FIT WITH 1 INCH FIBERGLASS INSULATION AND ALUMINUM JACKETING. TERMINATE INSULATION/JACKETING IN A MANNER THAT PREVENTS MOISTURE FROM CONTACTING INSULATION.
4. VALVE SCHEDULE IS PROVIDED IN BILL OF MATERIALS ON P-2.

C:\Users\GSTEINBERGER\DC\ACCDocs\Arcadis ACC USA\US-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\VI-DESIGN-DR-P01-P02-PID.dwg LAYOUT: P-1 SAVED: 2/21/2025 8:58 AM ACADVER: 24.3S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 2/21/2025 8:58 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ----
VI-DESIGN-XEngineer PE Stamp.jpg

SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: ——— USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
1	2/21/2025	Miscellaneous Revisions	QC	CE
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: **CHRISTOPHER ENGLER**
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY	2/10/2023	LB
Designed by	**Drawn by**	**Checked by**
QC	GS	CE

STATE OF NEW YORK — CHRISTOPHER DANE ENGLER — 069748 — LICENSED PROFESSIONAL ENGINEER

ARCADIS

ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. ● GRAND CENTRAL PLAZA ● 1020 CENTER STREET, HORSEHEADS, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

PIPING AND INSTRUMENTATION DIAGRAM

ARCADIS Project No. 30147184

Date FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

P-1

Grand Central Plaza Sub-Slab Depressurization System Bill of Materials								
Item	**QTY**	**PID Tag**	**Location**	**Connection**	**Description and Details**	**Model**	**Make**	**Responsible Party for Procurement**
1	2	-	Suction Point Sump	3" NPT	**Large-Particle Suction Strainer** Construction: Polypropylene Plastic Size and Thread Type: 3 inch, Female NPT Dimensions: 5" Height, 7 1/8" Diameter	44265K27	McMaster Carr	Contractor
2	2	VI-01, VI-02	Suction Point Riser Pipes	1/4" NPT	**Vacuum Indicator** Range: -55 to 0 iwc Dial Size: 2.5" Connection: 1/4" NPT bottom	LPG3-D8442N	Dwyer	Contractor
3	2	V-100, V-200	Suction Point Riser Pipes	1/2" Male NPT x 1/2" Female NPT	**Mini Ball Valve** 1/2" Stainless Steel Mini Ball Valve 1/2" Male NPT x 1/2" Female NPT	BV050-SS-M-M/F	Pro Flow Dynamics	Contractor
4	2	VT-101, VT-201	Fan Header Pipe	-	**Vacuum Transmitter** Pressure Connection: {F01} 1/8 NPT Female Output Signal: {42} 4-20 mA Output Electrical Termination: {ST} Screw Terminals Scale: Bidirectional Pressure Range - inches of H20 Pressure Range: {50IWL} ±50.00 inches h20	RX7F0142ST50IWL-XCENNV9X1	Ashcroft	Contractor
5	-	-	Exterior Piping	-	**Fiberglass Pipe Insulation** 1" Thick, faced insulation for 4" pipe Seal seams with ASJ MAX Tape	110060	Owens Corning /Johns Manville	Contractor
6	-	-	Exterior Piping	-	**Corrugated Aluminum Jacketing** Thickness: 0.016" Secure jacketing with galvanized hose clamps and galvanized screws	3609C016	Johns Manville	Contractor
7	2	F-01, F-02	Discharge Stack	3" and 2" PVC Socket	**Inline Mitigation Fan** Connections: Inlet - 3" dia. PVC socket, Outlet - 2" dia. PVC socket Power: 120VAC Mounting: Four 1/4" stainless steel bolts Weight: 19.25 lbs Size: 17.5" W x 9.0" D x 18.5" H	HS-5500	Radon Away	Contractor
8	1	-	Discharge Stack	3" PVC Socket	**Zero-Loss PVC Duct Rain Cap** Construction: PVC Diameter: 6.625", Height: 26" Weight: 6 lbs	1034-WCB-03	Harrison Plastic	Contractor
9	2	MP-10, MP-11, MP-12	Liquor Store and Transit Office	3" NPT	**Monitoring Point Pin** Construction: Stainless Steel Lenght: 3.22" Weight: 0.15 lbs	Stainless Steel Vapor Pin Sampling Device	Vapor Pin	Engineer
10	2	MP-10, MP-11, MP-12	Liquor Store and Transit Office	3" NPT	**Monitoring Point Cover** Construction: Stainless Steel Height: 1.59" ID: 0.72" Top Diameter: 2" Weight: 0.80 lbs	Stainless Steel Secured Cover	Vapor Pin	Engineer
11	1	-	Control Panel	-	**Remote Telemetry** 120 Volt power adapter	Sentinel SCD-1200	Sensaphone	Contractor
12	1	-	Control Panel	-	**Cellular Modem** Sim card size: Mini-SIM Ethernet connection to Sentinel Omni-directional antenna	Pepwave MAX BR1 Mini	Peplink	Contractor

C:\Users\GSTEINBERGER\DC\ACCDocs\Arcadis ACC US\AUS-99999999-C GERSHON_HORSEHEADS_NY\Project Files\10_WIP\10T_ARC_ENV\2025\01-DWG\VI-DESIGN-DR-P01-P02-PID.dwg LAYOUT: P-2 SAVED: 2/21/2025 8:55 AM ACADVER: 24.3S (LMS TECH) PAGESETUP: PDF-D
PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 2/21/2025 8:56 AM BY: STEINBERGER, GEORGE
XREFS: IMAGES: PROJECTNAME: ----
VI-DESIGN-XEngineer PE Stamp.jpg

SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd
0	2/10/2023	Issued for Bid	QC	CE

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: CHRISTOPHER ENGLER
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY	2/10/2023	LB
Designed by	Drawn by	Checked by
QC	GS	CE



ARCADIS
ARCADIS OF NEW YORK, INC.

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

C. GERSHON COMPANY, INC. ● GRAND CENTRAL PLAZA ● 1020 CENTER STREET, HORSEHEADS, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

BILL OF MATERIALS

ARCADIS Project No.
30147184

Date
FEBRUARY 2023

ARCADIS
One Lincoln Center
110 West Fayette Street, Suite 300
Syracuse, NY 13202
Tel: 315.446.9120

P-2

Appendix B

Quality Assurance Project Plan

GCP Boom, LLC

Quality Assurance Project Plan

Grand Central Plaza – 1020 Center Street
Horseheads, New York
Site No. 808053

September 2024
Revised November 2024
Revised June 2025

Quality Assurance Project Plan

Grand Central Plaza – 1020 Center Street
Horseheads, New York
Site No. 808053

September 2024
Revised November 2024
Revised June 2025

Prepared By:
Arcadis of New York, Inc.
One Lincoln Center, 110 West Fayette Street, Suite 300
Syracuse, NY 13202
United States
Phone: 315 446 9120
Fax: 315 449 0017

Prepared For:
GCP Boom, LLC.
C. Gershon Company, Inc.
244 W. 39th Street, 5th Floor
New York, NY 10018

Our Ref:
30147184

This document is intended only for the use of the individual or entity for which it was prepared and may contain information that is privileged, confidential and exempt from disclosure under applicable law. Any dissemination, distribution or copying of this document is strictly prohibited.

Contents

Acronyms and Abbreviations v
1 Introduction 1
1.1 Purpose 1
1.2 Scope of Work 1
1.3 QAPP Organization 2
2 Project Organization 3
2.1.1 Arcadis of New York, Inc. 3
2.1.2 Analytical Laboratory 4
2.1.3 Regulatory Agencies 5
3 Quality Objectives and Criteria for Measurement Data 6
3.1 Data Categories 8
3.2 Field Investigations 9
4 Special Training Requirements/Certification 12
5 Documentation and Records 13
5.1 Sample Designation System 13
5.2 Field Documentation 13
5.3 Laboratory Documentation Files 14
5.3.1 Laboratory Project Files 14
5.3.2 Laboratory Logbooks 14
5.3.3 Computer and Hard Copy Storage 15
5.4 Data Reporting Requirements 15
5.4.1 Field Data Reporting 15
5.4.2 Laboratory Data Reporting 15
5.5 Project File 17
6 Sampling Process Design 18
7 Sampling Method Requirements 19
8 Sample Handling and Custody Requirements 20
8.1 Sample Containers and Preservation 20
8.2 Field Custody Procedures 20
8.2.1 Field Logbooks 20
8.2.2 Sample Labeling 21

8.2.3 Field Chain-of-Custody Forms 21
8.2.4 Sample Custody Seals 23
8.3 Management of Investigation-Derived Materials and Wastes 23
8.4 Packing, Handling, and Shipping Requirements 23
8.5 Laboratory Custody Procedures 24
8.5.1 Sample Receipt and Storage 24
8.5.2 Sample Analysis 25
8.5.3 Sample Storage Following Analysis 25
9 Analytical Method Requirements 26
9.1 Field Analytical Procedures 26
9.2 Laboratory Parameters and Methods 26
9.2.1 Soil and Groundwater 26
9.2.2 Air 26
10 Quality Control Requirements 27
10.1 Data Quality Indicators 27
10.1.1 Representativeness 27
10.1.2 Comparability 27
10.1.3 Completeness 27
10.1.4 Precision 28
10.1.5 Accuracy 28
10.1.6 Sensitivity 28
10.2 Field Quality Control Checks 28
10.2.1 Sample Containers 28
10.2.2 Field Duplicates 28
10.3 Analytical Laboratory Quality Control Checks 28
10.3.1 Method Blanks 29
10.3.2 Matrix Spike/Matrix Spike Duplicates 29
10.3.3 Laboratory Control Samples 29
10.3.4 Surrogate Spikes 29
10.3.5 Calibration Standards 29
10.3.6 Internal Standards 30
10.4 Data Precision Assessment Procedures 30
10.5 Data Accuracy Assessment Procedures 30

10.6 Data Representative Assessment Procedures 31
10.7 Blank Sample Assessment Procedures 31
10.8 Data Completeness Assessment Procedures 31
11 Instrument/Equipment Testing, Inspection, and Maintenance Requirements 32
11.1 Field Instruments and Equipment 32
11.2 Laboratory Instruments and Equipment 32
12 Instrument Calibration Frequency 34
12.1 Field Equipment Calibration Procedures and Frequency 34
12.2 Laboratory Equipment Calibration Procedures and Frequency 34
13 Inspection/Acceptance Requirements for Supplies and Consumables 36
14 Data Management 37
14.1 Sample Designation System 37
14.2 Field Activities 37
14.2.1 Field Documentation 37
14.2.2 Data Security 38
14.3 Sample Tracking and Management 38
14.4 Data Management System 38
14.4.1 Computer Hardware 38
14.4.2 Computer Software 38
14.4.3 Survey Information 39
14.4.4 Field Observations 39
14.4.5 Analytical Results 39
14.4.6 Data Analysis and Reporting 40
14.5 Document Control and Inventory 40
15 Assessment and Response Actions 41
15.1 Field Audits 41
15.2 Laboratory Audits 41
15.3 Corrective Action 41
15.3.1 Field Procedures 41
15.3.2 Laboratory Procedures 42
16 Reports to Management 43
16.1 Field Reports 43
16.2 Laboratory Reports 43

17 Data Reduction and Review 44
17.1 Field Data Reduction and Review 44
17.1.1 Field Data Reduction 44
17.1.2 Field Data Review 44
17.2 Laboratory Data Reduction and Review 44
17.2.1 Laboratory Data Reduction 45
17.2.2 Laboratory Data Review 45
18 Data Verification and Validation 46
18.1 Data Validation Process 46
18.2 Data Verification 47
19 Reconciliation with User Requirements 49
20 References 50

Attachments

Attachment 1 Project Team Resumes
Attachment 2 Analytical Method Detection and Reporting Limits
Attachment 3 EQuIS™ Laboratory Standard Operating Procedure
Attachment 4 Field Sampling Plan
Attachment 5 Analytical Methods, Holding Times, QA/QC

Acronyms and Abbreviations

%	percent
AOC	Area of Concern
Arcadis	Arcadis of New York, Inc.
ASP	Analytical Services Protocol
ASTM	ASTM International
bgs	below ground surface
CAMP	Community Air Monitoring Program
COC	chain-of-custody
DER	Division of Environmental Remediation
DQO	data quality objective
EDD	electronic data deliverable
ELAP	Environmental Laboratory Approval Program
eV	electron volt
FSP	Field Sampling Plan
GC/MS	gas chromatography/mass spectrometry
IDW	investigation-derived waste
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NAD	North American Datum
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PFAS	per- and polyfluoroalkyl substances
OSHA	Occupational Safety and Health Administration

OSWER	Office of Solid Waste and Emergency Response
PDF	portable document format
PPE	personal protective equipment
QA	quality assurance
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	quality control
REC	Recognized Environmental Condition
RL	reporting limit
SDG	sample delivery group
SOP	standard operating procedure
SVOC	semi-volatile organic compound
TAL	Target Analyte List
TGI	Technical Guidance Instructions
TIC	Tentatively Identified Compound
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 Introduction

This Quality Assurance Project Plan (QAPP) supports the September 2024 Site Characterization Work Plan (SCWP) and provides guidance for data collection associated with the 20.60 acre, “Grand Central Plaza” site at 1020 Center Street, Horseheads, New York (the “Site”). The Site was P-listed by the New York State Department of Environmental Conservation (NYSDEC) on January 12, 2024 and assigned site number 808053.

This QAPP specifies analytical methods to be used to ensure that data collected during site characterization are precise, accurate, representative, comparable, complete, and meet the sensitivity requirements of the project.

1.1 Purpose

This QAPP is intended to guide all sampling, measurement, and other field and laboratory activities conducted as part of the SCWP. This QAPP contains laboratory analysis procedures and quality control (QC) methods to be used to characterize environmental media to include soil and groundwater.

This QAPP is applicable to the SCWP. To the extent that other work plans are written and approved relevant to this QAPP, those activities will be incorporated by reference to the scope of the QAPP herein.

This QAPP was prepared in a manner consistent with the following documents, where applicable:

- United States Environmental Protection Agency (USEPA) guidance document entitled *EPA Requirements for Quality Assurance Project Plans*, EPA-QA/R-5 (USEPA 2001) (https://www.epa.gov/quality/agency-wide-quality-system-documents);
- USEPA *Guidance for Quality Assurance Project Plans,* EPA-QA/G-5 (USEPA 2002b) (https://www.epa.gov/quality/agency-wide-quality-system-documents); and
- The National Enforcement Investigations Center Policies and Procedures Manual (USEPA 1991) (https://www.epa.gov/quality/agency-wide-quality-system-documents).

1.2 Scope of Work

Implementation of the SCWP will include the advancement of soil borings, installation of groundwater monitoring wells, the collection of soil and groundwater samples and the collection of indoor air, sub-slab and ambient air samples. The scope of work is described in detail in the SCWP. A Community Air Monitoring Plan (CAMP) will be implemented during ground intrusive activities. The following work will be completed as part of the SCWP:

Geophysical Survey

- The survey will attempt to identify underground utilities, and other subsurface anomalies. The findings of the geophysical survey will inform the placement of sample locations.

Soil Borings and Sampling

- Advancement of 8 soil borings (terminal depth of 15 feet) targeting potential shallow tetrachloroethene (PCE) impacts. A minimum of one shallow and one deep soil samples will be analyzed for the full list of analytical parameters (Section 3.2 and SCWP Table 1). Additional samples will be collected and analyzed for VOCs plus TICs if visual, olfactory or PID evidence of solvent or petroleum impacts are identified. The minimum base number of soil samples will be 2 soil samples (plus quality assurance/quality control [QA/QC] samples).

Monitoring Well Installation and Sampling

- Installation of 4 monitoring wells (terminal depth of 15 feet) within soil borings.
- Collection of one groundwater sample from each newly installed monitoring well for analysis of VOCs plus TICs. One upgradient and one downgradient sample will also be analyzed for the full suite of parameters as shown in Section 3.2 and SCWP Table 1 for a total of 4 groundwater samples (plus QA/QC sampling).
- Surveying and gauging of monitoring wells to evaluate groundwater flow direction.

Sub-slab Soil Vapor and Indoor Air Sampling

- Installation of two permanent soil vapor pins (designated as SV-16 and SV-17) in the GCP Beers leasehold at approximate locations as shown on Figure 2 of the Site Characterization Work Plan Addendum.
- Collection of paired indoor air and subslab soil vapor samples from the two new locations and from pre-existing locations SV-13 and SV-14.
- Collection of QA/QC samples to include one indoor air duplicate, one sub-slab duplicate and an outdoor ambient air sample to establish background conditions.

Air matrix samples will be analyzed for the parameters as shown in Section 3.2 and the revised QAPP Attachment 2.

1.3 QAPP Organization

The information contained in this QAPP has been organized as presented in the following table.

Section	Content
Project Management	
1	Introduction
2	Project Organization
3	Quality Objectives and Criteria for Measurement Data
4	Special Training Requirements/Certification
5	Documentation and Records
Measurement/Data Acquisition	
6	Sampling Process Design
7	Sampling Method Requirements
8	Sample Handling and Custody Requirements
9	Analytical Method Requirements
10	Quality Control Requirements
11	Instrument/Equipment Testing, Inspection, and Maintenance Requirements
12	Instrument Calibration and Frequency
13	Inspection/Acceptance Requirements for Supplies and Consumables
14	Data Management
Assessment/Oversight	
15	Assessment and Response Actions
16	Reports to Management

Section	Content
Data Validation and Usability	
17	Data Reduction and Review
18	Data Verification and Validation
19	Reconciliation with User Requirements
20	References

Details on each of the subjects listed above are provided in the subsequent sections.

2 Project Organization

The SCWP will be overseen by Arcadis on behalf of GCP Boom, LLC. Arcadis will perform the sampling collection as described in the SCWP and will subcontract drilling, geophysical, and analytical services. Arcadis will also arrange data analysis and reporting tasks.

Soil and groundwater analytical services will be performed by Eurofins Environment Testing USA Laboratories, Inc. of Amherst, New York (NELAP certification number 10026). Air matrix analyses will be performed by Eurofins Environment Testing USA Laboratories, Inc. of South Burlington, VT (NELAP certification number 10391). Data validation services will be performed by Arcadis.

2.1.1 Arcadis of New York, Inc.

Project Manager/Assistant Project Manager

The Arcadis Project Manager/Assistant Project Manager responsibilities and duties include:

- Manage and coordinate the project as defined in the SCWP, and any other related work plans, with an emphasis on adhering to the objectives of the site activities.
- Review documents prepared by subcontractors.
- Verify that corrective actions are taken for deficiencies cited during any audits of site activities.

Task Managers

The sampling components will be managed by various Arcadis Task Managers. The duties of each Task Manager include, as appropriate:

- Manage relevant day-to-day activities.
- Develop, establish, and maintain files on relevant site activities.
- Review data reductions from the relevant site activities.
- Perform a final data review of field data reductions and reports on relevant site activities.
- Verify that corrective actions are taken for deficiencies cited during audits of relevant site activities.
- Perform overall quality assurance (QA)/QC of the relevant portions of the site activities.
- Review relevant field records and logs.
- Instruct personnel working on relevant site activities.

- Coordinate field and laboratory schedules pertaining to relevant site activities.
- Request sample bottles from the laboratory.
- Review field instrument maintenance and calibration to meet quality objectives.
- Prepare reports pertaining to relevant site activities.
- Maintain field and laboratory files of notebooks/logs, data reductions, and calculations. Transmit the original files to the Project Manager.

Field Personnel

The Arcadis field personnel responsibilities and duties include:

- Perform field procedures associated with the investigations as set forth in the specific work plan.
- Perform field analyses and collect QA samples.
- Calibrate, operate, and maintain field equipment.
- Reduce field data.
- Maintain sample custody.
- Prepare field records and logs.

Quality Assurance Coordinator

The Quality Assurance Coordinator (QAC) Responsibilities and duties include:

- Review laboratory data packages.
- Oversee and interface with the analytical laboratory.
- Coordinate field QA/QC procedures with the Task Managers, concentrating on field analytical measurements and practices to meet the data quality objectives (DQOs).
- Perform and review audit reports.
- Prepare interim QA/QC compliance reports.
- Prepare a QA/QC report in accordance with USEPA guidelines, including an evaluation of laboratory data and data usability reports.

2.1.2 Analytical Laboratory

The general responsibilities and duties of the analytical laboratory includes:

- Perform sample analyses and associated laboratory QA/QC procedures.
- Supply sample bottles and coolers.
- Maintain laboratory custody of sample.
- Strictly adhere to all protocols in the QAPP.

Laboratory Project Manager

The laboratory Project Manager responsibilities and duties include:

- Serve as the primary communication link between the environmental consultant and the laboratory technical staff.
- Monitor the workload and maintain an availability of resources.
- Oversee the preparation of analytical reports.
- Supervise the in-house chain-of-custody (COC).

Quality Assurance Manager

The laboratory Quality Assurance Manager (QAM) responsibilities and duties include:

- Supervise the personnel who are reviewing and inspecting all project-related laboratory activities.
- Conduct audits of all laboratory activities.

2.1.3 Regulatory Agencies

Lead regulatory oversight will be provided by the New York State Department of Environmental Conservation (NYSDEC) in association with the New York State Department of Health (NYSDOH).

Project Manager

The regulatory agency Project Manager responsibilities and duties include:

- Provide review and approval of the QAPP, work plans, supporting documents, and future deliverables.
- Monitor the progress of site activities.

Key project contacts are listed below. Resumes of Arcadis personnel are presented in **Attachment 1**.

Herold Law, representing GCP Boom, LLC:	Mr. Anthony Reitano, Esq. Telephone: (908) 647-1022
Arcadis Engineer of Record and Qualified Environmental Professional:	Mr. Christopher Engler, PE Telephone: (315) 671-9331
Arcadis Project Manager:	Mr. Larry Brunt Telephone: (908) 391-4371
Arcadis Assistant Project Manager:	Mr. Andrew Korik Telephone: (315) 671-9323
Arcadis Quality Assurance Officer (QAO):	Mr. Nicholas Beyrle Telephone: (585) 662-404
Arcadis Program Quality Assurance Monitor/ Data Validation Supervisor	Mr. Dennis Capria (Arcadis) Telephone: (315) 671-9299

Laboratory Representative (soil and groundwater):	Mr. John Schove (Eurofins) Telephone: (716) 504-9838
Laboratory Representative (air matrix):	Ms. Peggy Gray-Erdmann Telephone: (716) 504-9829
Arcadis Field Personnel:	Mr. Quinn Carnahan (Field Team Leader) Telephone: (585) 662-4023
	Mr. Adam Svensson (Field Geologist/Field Safety Officer) Telephone: (716) 909-9063

3 Quality Objectives and Criteria for Measurement Data

The DQO process, as described in *Guidance for Quality Assurance Project Plans* (USEPA 2002b), is intended to provide a "logical framework" for planning field investigations. This section addresses, in turn, each of the seven sequential steps in the USEPA's QAPP DQO process, listed below.

Step 1: Problem Statement

The site is impacted by PCE related to historical drycleaning operations conducted at the property. Previous investigation utilizing a limited compound analytical list has not revealed other constituents above regulatory criteria in soil or groundwater. The pending site characterization will include analyses for the full list of DER-10 compounds.

Step 2: Goal Identification

The goal of the sampling program will depend on the specific sampling needs for the site. In general, the goal will be to protect human health and the environment and manage the remaining site impacts in accordance with applicable rules and regulations. Analytical results of constituents will be compared to applicable NYSDEC standards/guidance values and any other applicable regulations. The analyzed environmental media will then be managed and handled accordingly. Based on analytical results, additional characterization or remedial measures may be required.

Step 3: Identifying Decision Inputs

Decision inputs incorporate both the concentration and distribution of constituents in site media. A fundamental basis for decision making is that a sufficient number of data points of acceptable quality must be available to support decisions. Thus, the necessary inputs for the decision are: 1) the proportion of non-rejected (usable) data points; and 2) the quantity of data needed to evaluate whether there is unacceptable risk to human health and the environment at and surrounding the site.

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

Step 4: Defining the Study Boundaries

The site is a strip mall located in a mixed residential, commercial and light industrial area in the Village of Horseheads, Chemung County, New York (SCWP Figures 1 and 2). The site comprises an approximately 20.60-acre, parcel property (Chemung County, NY Tax Parcel ID: 59.13-3-3) improved with approximately 267,250 square feet of single-story commercial buildings, which are referred to as the “Western Building” and the “Main Building” (SCWP Figure 2). The Main Building is situated in a west-east configuration immediately north of Chemung Street, the Western Building is situated in a generally north-south configuration along the western boundary of the Site. A third and much smaller “Dunkin’ Donuts Building” is located immediately west of South-Central Street and is not discussed further. The remainder of the Site consists of asphalt-paved parking lots and grassy, landscaped areas. Land use in the surrounding area consists of commercial, residential, public school and County Highway Department properties (SCWP Figure 3). Approximately 0.6 miles west of the Site is the Westinghouse facility, which is a focal point of the Kentucky Avenue Well Field cleanup project. The facility has a large plume of trichloroethylene (TCE) that extends in an easterly-southeasterly direction from the Westinghouse facility (towards the Site and surrounding properties).

Step 5: Developing a Decision Rule

The decision on whether data can be used will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions will be noted. Media-specific sampling plans have been devised so that the loss of any single data point will not hinder the description of the distribution of constituents or the development of a remediation plan. Given this, a reasonable decision rule would be that 90 percent (%) of the data points are not rejected or deemed unusable.

The usable data will be evaluated versus the applicable NYSDEC standards and guidance values. Laboratory method detection limits (MDLs) and reporting limits (RLs) are presented in **Attachment 2**. The lowest achievable MDLs and RLs will be reported by the laboratory and, where possible, at or below the screening criteria. Applicable actions would be evaluated, if needed, based on the results of the exposure evaluation.

Step 6: Limits on Decision Errors

Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability; and 2) understanding the representative nature of the sampling design. This QAPP has been designed to meet both specifications for this step. The sampling and analysis programs have been developed based on a review of previous site data and knowledge of present site conditions. The representative nature of the sampling design has been facilitated by discussions among professionals familiar with the site and the appropriate government agencies.

Step 7: Design Optimization

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

A DQO summary for the anticipated sampling efforts is presented in the following subsections. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria. Field sampling procedures are detailed in Attachment 1 of the Field Sampling Plan (FSP) provided as **Attachment 3** of this QAPP.

3.1 Data Categories

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

Screening Data

Screening data affords a rapid preliminary assessment of site characteristics or conditions. The collection activities for screening data involve rapid, non-rigorous methods of analysis and QA. Screening DQOs are generally applied to the physical and/or chemical properties of samples, preliminary ecological and/or human health and safety indicators, and visual or other qualitative observations used to make rapid assessment decisions for deployment or additional assessment.

Screening Data with Definitive Confirmation

Screening data provide rapid identification and quantitation; however, because screening generally involves the use of less precise methods of analysis with less rigorous sample preparation, the quantitation may be relatively imprecise. Generally, at least 10% of the data are confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data with definitive confirmation can also be used to verify less rigorous laboratory-based methods and is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings.

Definitive Data

Definitive data are generated using rigorous analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. These methods produce tangible raw data (e.g., chromatograms, spectra, digital values). Definitive data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For data to be definitive, either the analytical or total measurement error must be determined. Definitive data are used for formal site characterization, environmental monitoring, the confirmation of field data, decision-making, and risk assessments.

Definitive data will be collected during this investigation. All soil and water samples will be analyzed at an off-site laboratory using definitive techniques.

For the purposes of this investigation, two levels of data reporting have been defined in accordance with the NYSDEC Analytical Services Protocol (ASP)(NYSDEC 2005). They are as follows:

Category A

Category A reporting is used for analyses that do not generate or require extensive supporting documentation. For this investigation, Category A reporting will be required for liquid and solid waste characterization samples.

Category A laboratory data reports include the following items:

- A sample delivery group (SDG) narrative;
- Sample information sheets;
- NYSDEC data package summary forms;
- COC forms; and
- Test analysis results.

Category B

Category B reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols. For this investigation, Category B reporting will be provided for soil and groundwater (and future indoor are and subslab soil vapor) analyses.

Category B laboratory data reports include the following items:

- An SDG narrative;
- Sample information sheets;
- NYSDEC data package summary forms;
- COC forms;
- Test analysis results;
- Calibration standards;
- Surrogate recoveries;
- Blank results (method blank [MB], instrument blanks);
- Spike recoveries (matrix spike [MS]/matrix spike duplicate [MSD], laboratory control sample [LCS]);
- Laboratory duplicate results;
- Confirmation samples;
- An internal standard area and retention time summary;
- Chromatograms;
- Raw data files; and
- Other method-specific information.

Analytical results will be reported by the laboratory in the electronic data deliverable (EDD) format, which will be in either an ASCII comma-separated value format or a format outlined in the EQuIS™ Laboratory Standard Operating Procedure (SOP) (**Attachment 4**). The Form Is (results sheets) will be in either a portable document format (PDF) or an electronic spreadsheet format. The analytical results will be provided within 15 working days from the date of sample receipt.

3.2 Field Investigations

To obtain the information necessary to meet the objectives stated above, additional field sampling will be conducted to support the DQOs. For the purposes of the QAPP, anticipated sampling details are provided in the SCWP and this appendix.

Groundwater and soil samples will be analyzed for the following:

- VOCs plus TICs using USEPA SW-846 Method 8260C;
- SVOCs plus TICs using USEPA SW-846 Method 8270D;
- PCBs using USEPA SW-846 Method 8082A;
- Metals (As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, Zn) using USEPA SW-846 Methods 6010/6020;
- Mercury using USEPA SW-846 Method 7471B

- Chromium III and VI using USEPA SW-846 Method 7196A
- Cyanide using USEPA SW-846 Method 9014;
- PFOA/PFOS – using NY 537 modified list of 40 compounds by method 1633;
- 1,4-Dioxane using USEPA Method 8270 SIM;
- Pesticides/Herbicides using USEPA SW-846 Method 8081B

Indoor air and sub-slab vapor samples will be analyzed for the following:

- VOCs using USEPA Method TO-15.

A detailed FSP is presented in **Attachment 3**.

Data Uses

Data generated as part of the field sampling will be used in any future work plan.

Data Quantity

Field activities will involve collecting environmental samples and associated QC samples for laboratory analyses. The anticipated minimum number of samples to be collected, the number of QC samples, and the constituents to be analyzed are outlined below:

Groundwater

LOCATION (see SCWP Figure 4)	PARAMETERS (see list above and SCWP Table 1)	NOMENCLATURE	QA/QC SAMPLES	RATIONALE
MW-1	Full Suite	MW-1-GW-DATE	TB	Upgradient
MW-2	Full Suite	MW-2-GW-DATE	FB, TB, DUP, MS/MSD	Downgradient
MW-3	VOC + TICs	MW-3-GW-DATE	TB	Downgradient
MW-4	VOC + TICs	MW-4-GW-DATE	TB	Crossgradient

Soil

LOCATION (see SCWP Figure 4)	PARAMETERS (see list above and SCWP Table 1)	NOMENCLATURE	QA/QC SAMPLES	DEPTH	RATIONALE
MW-1	Full Suite	MW-1-Soil-DEPTH	TB	Shallow	Upgradient
MW-2	VOC + TICs	MW-1-Soil-DEPTH	TB	Only if impacts observed	
MW-3	Full Suite	MW-3-Soil-DEPTH	FB, TB, DUP, MS/MSD	Deep	Downgradient
MW-4	VOC + TICs	MW-4-Soil-DEPTH	TB	Only if impacts observed	
SB-7	VOC + TICs	SB-7-Soil-DEPTH	TB	Only if impacts observed	
SB-8	VOC + TICs	SB-8-Soil-DEPTH	TB	Only if impacts observed	
SB-9	VOC + TICs	SB-9-Soil-DEPTH	TB	Only if impacts observed	
SB-10	VOC + TICs	SB-10-Soil-DEPTH	TB	Only if impacts observed	

LOCATION (see SCWP Addendum Figure 2)	PARAMETERS (see list above)	NOMENCLATURE	QA/QC SAMPLES
SV-13	VOC	SV-13-IA-DATE	Duplicate
SV-13	VOC	SV-13-SS-DATE	
SV-14	VOC	SV-14-IA-DATE	
SV-14	VOC	SV-14-SS-DATE	
SV-16	VOC	SV-16-IA-DATE	
SV-16	VOC	SV-16-SS-DATE	Duplicate
SV-17	VOC	SV-17-IA-DATE	
SV-17	VOC	SV-17-SS-DATE	
Ambient	VOC	AMB-Outdoor-DATE	

Sampling and Analytical Methods

Sampling procedures are presented in SCWP sections 3.2, 3.3 and the FSP in **Attachment 1**. The laboratory analytical methods for the chemical constituents are listed in the QAPP **Attachment 2**. Category B will be used for data deliverables reporting (as defined previously).

4 Special Training Requirements/Certification

In compliance with the Occupational Safety and Health Administration's (OSHA's) final rule, "Hazardous Waste: Operations and Emergency Response," 29 Code of Federal Regulations 1910.120(e)", all personnel performing sampling activities at the site, except as noted below, will have completed the requirements for OSHA 40-Hour Hazardous Waste Operations and Emergency Response initial training and have current 8-hour refresher training. Persons in field supervisory positions will have also completed the additional OSHA 8-Hour Supervisory Training.

Field personnel involved with the shipping of samples to the subcontracted laboratory will have completed United States Department of Transportation Hazardous Materials #1 – United States Department of Transportation/International Air Transportation Association Hazardous Materials Shipping and Transportation training.

5 Documentation and Records

Samples will be collected as described in the SCWP Appendix D. Detailed descriptions of the documentation and reporting requirements are presented below.

5.1 Sample Designation System

Samples will be identified with a unique designation system that will facilitate sample tracking. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events and conditions. An alpha-numeric system is considered appropriate and will be used by field personnel to assign each sample with a unique sample identification number.

The sample identification number will begin with a two- or three-letter prefix indicating the sample type and two digits indicating the sequential sample number collected from the location.

The sample types (if applicable) will be designated using the following codes:

- Surface Soil Sample – “SS;”
- Subsurface Soil Sample – “SB;”
- Groundwater Sample – “GW” or “MW;”
- Indoor Ambient Air – “IA;”
- Sub-Slab Soil Vapor -- “SV;”
- Trip Blank Sample – “TB;”
- Field Duplicate Sample – “DUP;”
- Equipment Blank Sample – “EB;”
- Matrix Spike and Matrix Spike Duplicate – “MS” and MSD;” and
- Waste Characterization – “WC.”

The location code will follow the sample type code. The sample code will also be a six-digit number indicating the month, day, and year the sample was obtained. For example, a groundwater sample collected from MW-10 on March 11, 2022, will be designated MW-10(220311).

QA/QC samples will be designated using the sample type code followed by the six-digit sample collection date. For example, a field blank collected on March 11, 2022, during groundwater samples collection would be designated GW-FB1-220311. The locations of field duplicates must be recorded in the field logbook.

5.2 Field Documentation

Field personnel will provide comprehensive documentation covering various aspects of field sampling, field analysis, and sample COC. This documentation consists of a record that allows reconstruction of field events to aid in the data review and interpretation process. Documents, records, and information relating to the performance of the field work will be retained electronically and in hard-copy in the project file.

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

- Sampling Information – Detailed notes will be made as to the exact sampling location, physical observations, and weather conditions (as appropriate).
- Field Logbooks/Forms – All pertinent information regarding the site and sampling procedures will be documented. A field notebook consists of a waterproof, bound notebook that will contain a record of all activities performed at the site. Detailed notes will be made as to the exact sampling location, physical observations, and weather conditions (as appropriate). To ensure that data collected in the field is consistent, accurate, and complete, forms may be used during repetitive data collection (e.g., depth to groundwater in monitoring wells during groundwater sampling).
- Sample Labels – Sample labels reduce the possibility of confusing sample containers and provide information necessary to complete COC forms. To the extent practical, sample containers will be pre-labeled before sample collection (with all the required information, except the date and time of the sample collection). The labels will be protected with a clear tape covering.
- Sample COC – COC forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by field personnel responsible for sample custody. In the event that samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.
- Field Equipment, Calibration, and Maintenance Logs – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory calibrated.

5.3 Laboratory Documentation Files

Analytical laboratory documentation requirements are presented in the following subsections.

5.3.1 Laboratory Project Files

The laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, telephone logs, and COC forms. The laboratory will retain project files and data packages for a period not less than 5 years.

5.3.2 Laboratory Logbooks

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

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

5.3.3 Computer and Hard Copy Storage

All electronic files and deliverables will be retained by the laboratory for not less than 5 years. Hard copy data packages (or electronic copies) will also be retained for not less than 5 years.

5.4 Data Reporting Requirements

Data will be reported both in the field and by the analytical laboratory, as described below. All field data forms will be scanned for electronic storage in the project file.

5.4.1 Field Data Reporting

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

If applicable, field data forms and calculations will be processed and included as appendices to the appropriate reports (when generated). The original field logs, documents, and data reductions will be kept in the project file.

5.4.2 Laboratory Data Reporting

Analytical results will be provided by the laboratory in a digital format. The data packages will be examined to ensure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the QAC will be notified and will promptly follow up with the laboratory to resolve any issues.

If validation is required, each data package will be validated in accordance with the procedures presented in this QAPP. Data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation, the data review will be used to populate the appropriate database tables. This format specifies one data record for each constituent and each sample analyzed. Specific fields include:

- Sample identification number;
- Date sampled;
- Date analyzed;
- Parameter name;

- Analytical result;
- Units;
- Detection limit; and
- Qualifier(s).

The individual EDDs supplied by the laboratory, which will be in either an ASCII comma-separated value format or a format outlined in the EQuIS™ Laboratory SOP (**Attachment 4**), will be loaded into the appropriate database table. Analytical data that cannot be provided by the laboratory in electronic format will be entered manually. Hand-keyed data will be reviewed for accuracy. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data were received.

The analytical laboratory is responsible for preparing Category B data packages for all samples, except solid and liquid waste characterization samples. Data reports for all parameters will include, at a minimum, the following items:

Narrative

The narrative will contain a summary of activities that took place during the course of sample analysis, including the following information:

- Laboratory name and address;
- Date of sample receipt;
- Cross-reference of the laboratory identification number to the sample identification;
- Analytical methods used;
- Deviations from specified protocol; and
- Corrective actions taken.

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results

Analytical results will be reported according to the analysis type and will include the following information, as applicable:

- Sample identification;
- Laboratory identification;
- Date of collection;
- Date of receipt;
- Date of extraction;
- Date of analysis;
- Dilution factor; and
- Detection limits.

Sample results on the report forms will be corrected for dilutions. Unless otherwise specified, all results will be reported uncorrected for blank contamination.

5.5 Project File

Project documentation will be placed in project files according to Arcadis of New York's (Arcadis') protocol for document management. Project files typically consist of the following components:

1. Agreements/Proposals (filed chronologically).
2. Change Orders/Purchase Orders (filed chronologically).
3. Invoices (filed chronologically).
4. Project Management (filed by topic).
5. Correspondence (filed chronologically).
6. Notes and Data (filed by topic).
7. Public Relations Information (filed by topic).
8. Regulatory Documents (filed chronologically).
9. Marketing Documents (filed chronologically).
10. Final Reports/Presentations (filed chronologically).
11. Draft Reports/Presentations (filed chronologically).
12. Documents Prepared by Others (filed chronologically).

Final reports (including QA reports) are filed in a designated folder within the project file. Analytical laboratory documentation (when received) and field data will also be filed in a designated folder within the project file.

6 Sampling Process Design

Information regarding the sampling design and rationale and associated sampling locations are presented in the SCWP.

7 Sampling Method Requirements

Sampling of site media will be collected as described in Sections 3.2, 3.3 and the FSP in **Attachment 3** of this QAPP. The approximate sample and field QC sample quantities are shown in Table 1 of the SCWP and **Attachment 5** of this QAPP.

8 Sample Handling and Custody Requirements

Sampling handling requirements for various project personnel are presented in the following subsections.

8.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in **Attachment 5**.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned to USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and appropriately preserving samples. Sample labeling procedures are discussed in Section 8.2.2.

8.2 Field Custody Procedures

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

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

8.2.1 Field Logbooks

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

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

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

Entries will be made in indelible ink with no erasures. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed by the person making the correction.

Recorded information in field logbooks typically includes, but may not be limited to, the following:

- Name and location of the site;
- Date and time of arrival and departure;
- Name and signature of person keeping the logbook;
- Names of all persons on site;
- Purpose of the site visit;
- Level of personal protective equipment (PPE) used;
- Field instrument identification and calibration information;
- Location of sampling points;
- Results of field measurements made;
- Number and volume of samples taken;
- Preservation;
- Method of sample collection and any factors that may affect its quality;
- Name of sample collector;
- All sample identification numbers (assigned prior to sample collection);
- Description of samples, including, as applicable, the depth at which the sample was collected;
- Weather conditions on the day of sampling and any field observations; and
- Number and description of photographs taken, if any.

8.2.2 Sample Labeling

The following information is required on each sample label:

- Project name;
- Date collected;
- Time collected;
- Location;
- Sampler;
- Analysis to be performed;
- Preservative; and
- Sample identification number.

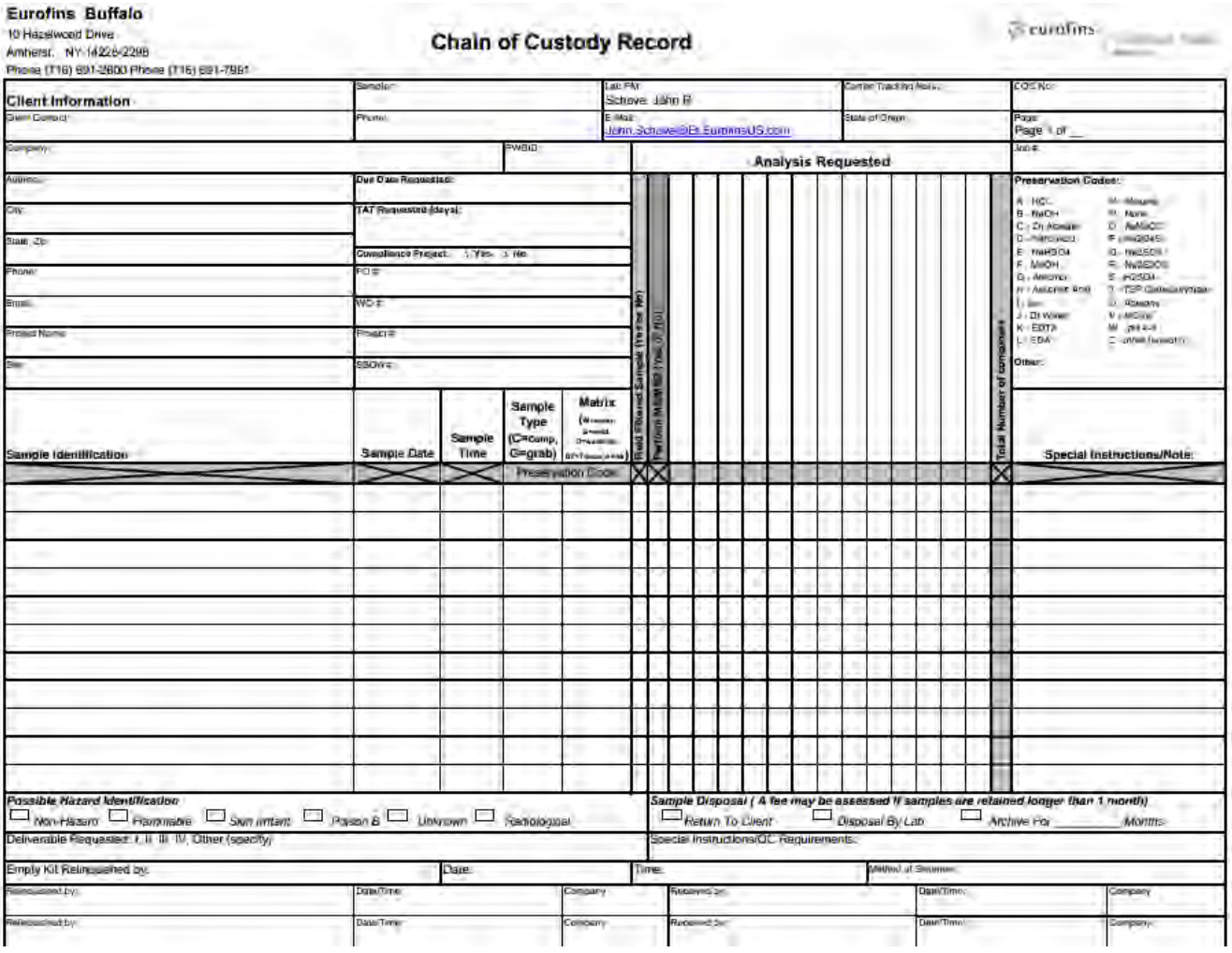
8.2.3 Field Chain-of-Custody Forms

Completed COC forms will be required for all samples to be analyzed. COC forms will be initiated by the sampling crew in the field. The COC forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original COC form will accompany the samples to the laboratory. Copies of the COC form will be made prior to shipment (or multiple-copy forms will be used) for field documentation. The COC forms will remain with the samples at all times. The

samples and signed COC forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), hand delivered to a courier or to the laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink. The labels will include the information listed in Section 8.2.2. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate COC form will be prepared for those samples and marked to identify the party with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space. A sample blank laboratory COC is shown below:



Eurofins Buffalo
10 Hazelwood Drive
Amherst, NY 14228-2298
Phone (716) 691-2600 Phone (716) 691-7991

Chain of Custody Record

eurofins

Client Information

Sampler:
Lab PM: Schove, John R
Carrier Tracking No(s):
COC No:
Client Contact:
Phone:
E-Mail: John.Schove@Et.EurofinsUS.com
State of Origin:
Page: Page 1 of __
Company:
PWSID:
Analysis Requested
Job #:
Address:
Due Date Requested:
City:
TAT Requested (days):
State, Zip:
Compliance Project: Yes No
Phone:
PO #:
Email:
WO #:
Project Name:
Project #:
Site:
SSOW#:
Preservation Codes:
A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S2O3
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (Water, Solid, Oil/Waste, Air, Tissue, A/V)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	Total Number of containers	Special Instructions/Note:
			Preservation Code:					

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

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

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:
Date:
Time:
Method of Shipment:

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

8.2.4 Sample Custody Seals

Custody seals are narrow strips of adhesive paper or glass fiber used to demonstrate that no tampering of the shipping container has occurred. The custody seals will be signed and dated by the sampling crew and placed across the opening of the lid and body of the shipping containers and at least on one side and the front of the container. The custody seals will be covered with clear, wide tape. These custody seals shall be plainly visible.

8.3 Management of Investigation-Derived Materials and Wastes

IDW will be generated during site activities and may include decontamination liquids, PPE, sorbent materials, purge water, and disposable sampling materials that may have come into contact with potentially impacted materials. The intent of managing IDW is to insure that impacted materials and media are not allowed to contaminate non-impacted materials and media. An example of an impacting event would be the purging of impacted groundwater and discharging that water onto non-impacted soil and shallow groundwater. Those kinds of activities will not be allowed.

Where necessary to promote the safe, efficient, and environmentally protective performance of work, management of investigation-derived materials and wastes will be performed consistent with the USEPA guidance, *Guide to Management of Investigation-Derived Wastes*, 9345.3-03FS (USEPA 1992). Disposable equipment (including PPE) will be containerized, appropriately labeled during the sampling events, and disposed of appropriately. All purged groundwater and water generated during equipment decontamination will be containerized, temporarily staged on site in 55-gallon drums and disposed of appropriately based on analytical results. Equipment will be decontaminated, as appropriate.

8.4 Packing, Handling, and Shipping Requirements

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

Samples will be packaged for shipment as outlined below:

- Securely affix the sample label to the container with clear packing tape.
- Check the cap on the sample container to confirm that it is properly sealed.
- Wrap the sample container cap with clear packing tape to prevent the cap from becoming loose.
- Complete the COC form with the required sampling information and confirm that the recorded information matches the sample labels.

  NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC form prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer.
- Wrap the glass sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags, seal the bags, and place the bags loosely in the cooler.

- Fill the remaining space in the cooler with cushioning material.
- Place the COC forms in a plastic bag and seal the bag. Tape the COC forms to the inside of the cooler lid.
- Close the lid of the cooler and secure the lid with duct tape.
- Wrap strapping tape (or equivalent) around both ends of the cooler at least twice.
- Mark the cooler on the outside with the shipping address and the return address, affix “Fragile” labels to the cooler, and draw (or affix) arrows indicating “this side up” on the cooler. Cover the shipping labels with clear plastic tape. If the samples are being delivered directly to the laboratory or will be picked up by the laboratory’s courier service, this step is eliminated.
- Place a signed custody seal over the sample cooler lid.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will be hand-delivered by Arcadis, a laboratory courier or delivered by an express carrier within 48 hours of the time of collection. In some cases, the analytical method may require analysis within a shorter holding time, and arrangements will need to be made to accommodate the laboratory requirements. Shipments will be accompanied by the COC form identifying the contents. The original COC form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form, as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. As described above, the filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

8.5 Laboratory Custody Procedures

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field COC form will accompany all samples requiring laboratory analysis. The laboratory will use COC guidelines described in the USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

8.5.1 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the integrity of the cooler seal, open the cooler, and compare the contents against the field COC form. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, the Arcadis Project Manager and/or QAC will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

8.5.2 Sample Analysis

Analysis of an acceptable sample will be initiated by a work sheet that will contain pertinent information for analysis. The routing sheet will be forwarded to the analyst, and the sample will be moved into an appropriate storage location to await analysis. The document control officer will file the COC forms in the project file.

Samples will be organized into SDGs by the laboratory. An SDG may contain up to 20 field samples (field duplicates and trip blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG will be received by the laboratory over a maximum of 7 calendar days and must be processed through the laboratory (preparation, analysis, and reporting) as a group. If reanalysis of a sample is required, it may be re-run separately from the original SDG; however, the resulting data will be reported with the original SDG.

Every SDG must include a minimum of one MB and one MS/MSD pair; each SDG will, therefore, be self-contained for all of the required QC samples. Project samples to be used for MS/MSDs will be noted on the COC form.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded in a laboratory notebook by the analyst. These notes will be dated and identify the analyst, the instrument used, and the instrument conditions.

8.5.3 Sample Storage Following Analysis

Samples will be maintained by the laboratory for at least 1 month after the final report is delivered. The laboratory will be responsible for the eventual and appropriate disposal of the samples. The analytical laboratory will inform the environmental consultant before any samples are disposed. Unused portions of the samples, sample extracts, and associated wastes will be disposed of by the laboratory in accordance with applicable rules and regulations.

9 Analytical Method Requirements

Analytical method requirements are presented in the following subsections.

9.1 Field Analytical Procedures

Specific field measurement protocols are provided in Attachment 1 of the FSP.

9.2 Laboratory Parameters and Methods

The laboratory analytical requirements presented in the subsections below include a general summary of the requirements, the specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. Current USEPA-approved methods will be used for all applicable parameters and sample media.

9.2.1 Soil and Groundwater

The primary sources of the analytical methods to be used during the investigation are provided in USEPA SW-846. Quantitation limits for the analyses are shown in **Attachment 2**. The laboratory will make every effort to achieve quantitation limits as low as practicable, unless dilution or interference effects make it necessary to report at higher levels. Results quantitated below the RLs will be reported as estimated concentrations and flagged with a "J".

9.2.2 Air

The primary sources of the analytical methods to be used during subslab and indoor air sampling are provided in USEPA TO-15. Quantitation limits for the analyses are shown in **Attachment 2**. The laboratory will make every effort to achieve quantitation limits as low as practicable, unless dilution or interference effects make it necessary to report at higher levels. Results quantitated below the RLs will be reported as estimated concentrations and flagged with a "J".

10 Quality Control Requirements

The following subsections present a summary of the project QC requirements.

10.1 Data Quality Indicators

The overall DQO for this assessment is to develop and implement procedures for sampling, COC, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action, such that valid data will be generated for site assessment purposes. These DQ procedures are presented or referenced in subsequent sections of the QAPP.

DQOs are generally defined in terms of the following parameters:

- Representativeness;
- Comparability;
- Completeness;
- Precision;
- Accuracy; and
- Sensitivity.

Each parameter is defined below. Specific objectives for this assessment are set forth in other sections of this QAPP as referenced below.

10.1.1 Representativeness

Representativeness is the extent to which measurements represent the site conditions. It is dependent on sampling and analytical variability and the variability (or homogeneity) of the site itself. The sampling activities have been designed to assess the presence of the constituents at the time of sampling. This QAPP presents field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods, with associated holding times and preservation requirements, are intended to provide representative data.

10.1.2 Comparability

Comparability is defined as the extent to which data from one data set can be compared directly to similar or related data sets and/or decision-making standards. Comparability between this investigation and, to the extent possible, with existing data will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP, applicable analytical methods, stringent application of established QA/QC procedures, and utilization of appropriately trained personnel.

10.1.3 Completeness

Completeness is defined as a measure of the amount of usable data collected compared to the total amount of data that was expected to be obtained. This will be determined upon final assessment of the analytical results.

10.1.4 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the site assessment. To maximize precision, sampling and analytical procedures will be strictly followed and work will adhere to established protocols presented in the QAPP and sampling plans. Checks for analytical precision will include the analysis of MS/MSD pairs, laboratory duplicates, and field duplicates. Field measurement precision will be monitored by obtaining duplicate field measurements.

10.1.5 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Recovery of reference standards, MSs, laboratory control standards, and surrogate standards will be used to assess the accuracy of the analytical data.

10.1.6 Sensitivity

Sensitivity is defined as the ability of the method or instrument to detect the contaminant of concern and other target compounds at the level of interest. The MDL is defined as the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero and is determined from repeated analysis of a sample in a given matrix containing the analyte. MDLs have been determined as required in Title 40 Code of Federal Regulations Part 136B. The RL is greater than or equal to the lowest standard used to establish the calibration curve. The RLs for this investigation are generally at least 3 times greater than the MDL. Results greater than the MDL and less than the RL will be qualified estimated (“J”) by the laboratory. Non-detected results will be reported at the RL.

10.2 Field Quality Control Checks

Field QC requirements are presented in the following subsections.

10.2.1 Sample Containers

For soil and groundwater samples, certified, clean sample containers (Eagle Picher pre-cleaned containers or equivalent), in accordance with Exhibit I of the NYSDEC ASP (NYSDEC 2005), will be supplied by the laboratory.

For air matrix samples, batch-certified, flow-controllers and passivated canisters will be supplied by the laboratory.

10.2.2 Field Duplicates

Field duplicates will be collected to verify the reproducibility of the sampling methods. In general, field duplicates will be analyzed at a 5% frequency (every 20 samples) for the chemical constituents.

10.3 Analytical Laboratory Quality Control Checks

Internal laboratory QC checks will be used to monitor data integrity. These checks will include MBs, LCSs, MS/MSDs, laboratory duplicates, internal standards, surrogate samples, and calibration standards. Laboratory control charts will be used to determine long-term instrument trends.

10.3.1 Method Blanks

Sources of contamination in the analytical process, whether from specific analyses or interferences, must be identified, isolated, and corrected. The MB is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the MB be initiated at the beginning of the analytical process and encompass all aspects of the analytical work. As such, the MB would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources that could affect sample analysis. One MB will be analyzed with each analytical series associated with no more than 20 samples.

10.3.2 Matrix Spike/Matrix Spike Duplicates

MS/MSDs will be used to measure the accuracy of analyte recovery from the sample matrices and will be site-specific. MS/MSD pairs will be analyzed at a 5% frequency (every 20 samples).

When MS recoveries are outside QC limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results.

10.3.3 Laboratory Control Samples

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

10.3.4 Surrogate Spikes

Surrogates are compounds that are unlikely to occur under natural conditions but have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to the sample matrix.

If surrogate spike recoveries exceed specified QC limits, the analytical results must be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable, and reanalysis of the samples with additional control may be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

10.3.5 Calibration Standards

The initial calibration of instruments will be performed as required in the analytical methods and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in each analytical method.

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. Ongoing calibration verification will be performed as specified in the analytical methods to monitor instrument performance. In general, the calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In the event that an ongoing calibration does not meet control limits, the analysis of samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any samples analyzed while the instrument was out of control specifications will be reanalyzed.

10.3.6 Internal Standards

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

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

10.4 Data Precision Assessment Procedures

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

Laboratory data precision for analyses will be monitored through the use of MSDs, laboratory duplicates, and field duplicates as discussed above.

The precision of data will be measured by calculation of the relative percent difference by the following equation:

$$RPD = \frac{abs(D1 - D2)}{\frac{(D1 + D2)}{2}} \times 100$$

Where:

abs = absolute value
RPD = relative percent difference
D1 = sample value
D2 = duplicate sample value

10.5 Data Accuracy Assessment Procedures

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

Laboratory accuracy will be assessed by using MSs, surrogate spikes, internal standards and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A - X}{B} \times 100$$

Where:

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

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy.

10.6 Data Representative Assessment Procedures

Representativeness will be assessed by examining sample preservation, results of the precision and accuracy evaluation, and adherence to method holding times. Failure of the field or laboratory personnel to properly handle samples may result in qualification of the data as estimated or unusable. The use of laboratory data from a sample with a failed holding time could render the data unusable. In particular, for volatile organic compound analysis, there is a potential for the loss of compounds, and the concentration may be biased low. The representativeness review will qualitatively consider whether precision and/or accuracy are sufficient to characterize the representativeness of the samples.

10.7 Blank Sample Assessment Procedures

Blank samples will be used to determine the existence and magnitude of contamination resulting from laboratory or field activities. The MB is used as a check on laboratory procedures, as well as possible contamination from laboratory equipment (i.e., reagents, glassware, etc.). Trip blanks determine the integrity of the sample container for loss or addition of analytes due to handling and transport. Detections in any blank samples will be used to qualify similar detections in associated field samples.

10.8 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$Completeness = \frac{usable\ data\ points\ obtained}{total\ data\ points\ planned} \times 100$$

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

11 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Testing and maintenance schedules have been developed for both field and laboratory instruments. This section summarizes the testing and maintenance activities to be performed.

11.1 Field Instruments and Equipment

Prior to field sampling, each piece of field equipment will be calibrated (if necessary) and inspected to confirm that it is operational. If the equipment is not operational, it will be serviced prior to use. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, the appropriate field activities Task Manager or field personnel will be responsible for following the maintenance schedule and arranging for timely service. Field instruments will be maintained according to the manufacturers' instructions.

Field instrumentation to be used in this study includes meters to measure pH, oxidation reduction potential, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Field equipment also includes sampling devices for groundwater.

All measuring and test equipment to be used in support of the field sampling activities that directly affect the quality of the analytical data will be subject to preventive maintenance measures that minimize equipment downtime. Equipment will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual to confirm that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to verify that any prior equipment problems are not overlooked and that any necessary repairs to the equipment have been carried out. However, in most cases, the environmental consultant will use field meters maintained and calibrated by national, reputable environmental rental equipment companies; calibration and maintenance records are provided with these pieces of rental equipment and will be maintained as part of the project file.

Field equipment returned from the site will be inspected to confirm that it is in working order. The inspection will be recorded in the logbook or field notebooks, as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook. Non-operational field equipment will either be repaired or replaced. Appropriate spare parts for field equipment/meters will be available from the rental companies or manufacturers. Consultant-/subcontractor-owned or leased equipment will be maintained in accordance with the manufacturers' instructions.

11.2 Laboratory Instruments and Equipment

Laboratory instrument and equipment documentation procedures include the details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (including information regarding the repair and the individual who performed the repair).

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

Maintenance schedules for laboratory equipment adhere to each manufacturer's recommendations. Equipment service records will reflect the complete history of each instrument and specify the timeframe for future maintenance. Major repairs or maintenance procedures are performed through service contracts with the manufacturer or qualified contractors. Paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the laboratory. Any routine preventive maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the analytical method used, and/or the judgment of the Laboratory Systems Manager.

All major instruments are backed up by comparable (if not equivalent) instrument systems for use in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

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

12 Instrument Calibration Frequency

Instrument calibration requirements are presented in the following subsections.

12.1 Field Equipment Calibration Procedures and Frequency

Calibration checks will be performed daily, or as often as required, to ensure the accuracy of field equipment. Field calibration solutions, standards, and gases will be used within specified expiration dates and will be obtained from manufacturers or authorized suppliers. Calibration solutions, standards, and gases will be discarded or returned to the supplier if expiration dates have been exceeded.

Field personnel are responsible for confirming that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. A calibration log for each specific field instrument (as identified by serial/instrument number) will be used to link daily calibrations to that specific field instrument. Where applicable, each log will include, at a minimum, the following information in order to link daily calibrations to specific field instruments:

- Name of the device and/or instrument calibrated;
- Device/instrument serial/identification numbers;
- Calibration method;
- Tolerance;
- Calibration standard used;
- Frequency of calibration;
- Date(s) of calibration(s); and
- Name of the person(s) performing the calibration(s).

The instruments and equipment used to gather, generate, or measure environmental data will be calibrated at the intervals specified by the manufacturer, or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. If an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service. Equipment found to be out of tolerance during the period of use will be removed from the field, and measuring and testing activities performed using the equipment will be addressed via the corrective action system described in Section 15.3 of this QAPP.

12.2 Laboratory Equipment Calibration Procedures and Frequency

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used.

When analyses are conducted according to USEPA methods, the calibration procedures and frequencies specified in the applicable method will be followed. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to a QA audit. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors.

All standards used to calibrate equipment are traceable, directly or indirectly, to the National Institute of Standards and Technology. All standards received will be logged into standard receipt logs maintained by the individual analytical groups. Each group will maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

13 Inspection/Acceptance Requirements for Supplies and Consumables

All supplies to be used in the field and laboratory will be available when needed. They will be free of target chemicals and interferences.

All laboratory reagents will be tested for acceptability prior to use in the analyses of site samples. All standards will be verified against a second source standard. The laboratory will follow a “first in/first out” procedure for the storage and use of all consumables to minimize the risk of contamination and degradation.

14 Data Management

The purpose of data management is to provide for the accuracy and ready accessibility of all of the necessary data to meet the analytical and reporting objectives of the project.

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

The data management plan has five elements:

1. Sample designation system.
2. Field activities.
3. Sample tracking and management.
4. Data management system.
5. Document control and inventory.

Each of these elements is discussed in the following subsections.

14.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sampled collected, as outlined in Section 5.1.

14.2 Field Activities

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

14.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field activities. When interpreting analytical results and identifying data trends, field notes are an important part of the review and validation process. To confirm that all aspects of the field investigation are thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including field logs, instrument calibration records, and COC forms. A description of each of these types of field documentation is provided in previous sections of this QAPP.

14.2.2 Data Security

Measures will be taken during the field investigation to prevent samples and records from being lost, damaged, or altered. When not in use, all field notebooks and logbooks will be stored at the field office or locked in the field vehicle. An electronic copy (e.g., scan to PDF) of all field data and laboratory data are available to all project team members.

14.3 Sample Tracking and Management

A record of all field documentation will be maintained to provide verification of the validity of data used in the site analysis. To effectively execute such documentation, specific sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms, as summarized in Section 8.2.3. The completed COC forms associated with samples collected will be faxed and/or scanned and emailed to the Task Manager. Copies of all completed COC forms will be maintained in the field office. The laboratory will verify receipt of the samples electronically (via email) on the following day.

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

14.4 Data Management System

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

14.4.1 Computer Hardware

The database will be constructed on personal computer workstations connected through a network server. The network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners, and modems. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

14.4.2 Computer Software

The data will be warehoused in a database using CORE or EQuIS™ software. Geographic information system applications will be developed using ESRI ArcGIS software, with additional customization performed with Visual Basic. Tables and other database reports will be generated through Microsoft® Access in conjunction with

Microsoft® Excel and/or Microsoft® Word. These software products will be upgraded to current industrial standards, as necessary.

14.4.3 Survey Information

In general, each location sampled will be surveyed or located using a global positioning system, with sub-meter accuracy, to confirm the accurate documentation of sample locations for mapping and geographic information system purposes (if appropriate) and to facilitate the re-sampling of select sample locations during future monitoring programs, if needed, and for any potential remediation activities. The surveying activities that will occur in the field will consist of the collection of information that will be used to compute a northing and easting in state plane coordinates for each sample location and the collection of information to compute elevations relative to the North American Vertical Datum of 1988 for select sample locations, as appropriate. All field logbooks associated with surveying activities will be stored as a record of the project activities.

14.4.4 Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field.

During each sampling event, appropriate field documentation will be prepared by the field personnel who performed the sampling activities. The purpose of the documentation is to create a summary and a record of the sampling event. Items included may be the locations sampled, the sampling methodologies used, blind duplicate and sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any noteworthy events that occurred.

14.4.5 Analytical Results

Analytical results will be provided by the laboratory in digital format. The data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the QAC will be notified and will promptly follow up with the laboratory to resolve any issues.

Each data package will be validated in accordance with the procedures presented in Section 18. Any data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of those data may not necessarily be restricted.

Following completion of the data validation, the digital files will be used to populate the appropriate database tables. An example of the EDD format is included in the EQuIS™ Laboratory SOP in **Attachment 4**. This format specifies one data record for each constituent for each sample analyzed. Specific fields include:

- Sample identification number;
- Date sampled;
- Date analyzed;
- Parameter name;
- Analytical result;

- Units;
- Detection limit; and
- Qualifier(s).

The individual EDDs, supplied by the laboratory in EQuIS™ file format, will be loaded into the appropriate database. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

14.4.6 Data Analysis and Reporting

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

A valuable function of the data management system will be the generation of tables of analytical results from the project databases. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function creates a digital file of analytical results and qualifiers for a given media. The file can then be processed into a table of rows and columns that can be transferred to word processing software (e.g., Microsoft® Excel) for final formatting and addition of titles and notes. Tables of analytical data will be produced as part of data interpretation tasks and the reporting of data to the USEPA.

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

14.5 Document Control and Inventory

Arcadis will maintain project files as discussed in Section 5.5.

15 Assessment and Response Actions

Performance and systems audits may be completed in the field and in the laboratory during sampling, as described below.

15.1 Field Audits

Field performance audit summaries will contain an evaluation of field activities to verify that the activities are performed according to established protocols. Field performance audits may be performed by the NYSDEC and the Arcadis Project Manager (or designee). The auditor(s) will review field reports and communicate concerns to the Arcadis Project Manager and/or Task Managers, and/or NYSDEC Project Manager, as appropriate. The observations made during field performance audits and any recommended changes/deviations to the field procedures will be recorded and documented.

In addition, systems audits comparing scheduled QA/QC activities from this QAPP with actual QA/QC activities completed will be performed. The appropriate Task Manager and QAC will periodically confirm that work is being performed consistent with this QAPP.

15.2 Laboratory Audits

Internal laboratory audits are conducted by the Laboratory QAM. As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory QA manual and SOPs. The results of the audits are summarized and issued to each department supervisor, the Laboratory Manager, and the Laboratory Director. A systems audit of each laboratory may be performed by the QAM to determine whether the procedures implemented by each laboratory are in compliance with the QA manual and SOPs.

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

15.3 Corrective Action

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

15.3.1 Field Procedures

When conducting field work, if a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Any condition identification, cause, and

corrective action implemented by the Field Manager or designee will be documented on a Corrective Action Form and reported to the appropriate Task Manager, QAC, and Project Manager. The QAC or designee will be responsible for follow-up and acceptance of corrective actions.

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

- Protocols, as defined by the QAPP, SOPs, and/or work plans, have not been followed.
- The equipment is not in proper working order or properly calibrated.
- QC requirements have not been met.
- There are issues resulting from performance or systems audits.

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

15.3.2 Laboratory Procedures

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

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

- Protocols, as defined by this QAPP, have not been followed.
- Predetermined data acceptance standards are not obtained.
- The equipment is not in proper working order or calibrated.
- The sample and test results are not completely traceable.
- QC requirements have not been met.
- There are issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities. Corrective action will be initiated upon identification of a problem. At whatever level this occurs (analyst, supervisor, data review or QC), it will be brought to the attention of the Laboratory QAM and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director. If previously reported data are affected by a situation requiring correction or if the corrective action impacts a project budget or schedule, the action will directly involve the Arcadis Project Manager and QAC.

A corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, sample re-preparation, sample re-analysis, cleanup, dilution, matrix modification, or other activities deemed necessary to assure usable analytical data.

16 Reports to Management

The QAC will audit the implementation of the QAPP. Each project component will result in some type of QA report or, by its absence, will indicate that no significant QA or QC deviations occurred. Items that may result in a QA report include:

- Changes or updates to the QAPP;
- Deviations from the QAPP or work plan specifications;
- Results of system and performance audits;
- Significant QA/QC problems, recommended solutions, and results of corrective actions; and
- Limitations on the use of measurement data.

16.1 Field Reports

Reporting of the quality of field sample collection and field measurements will be the responsibility of the Field Supervisor or designee.

16.2 Laboratory Reports

The laboratory will maintain QA records related to analyses, QC, and corrective action. This information will be made available to the Project Manager upon request. Routine reporting will include documenting all internal QC checks performed for this project.

17 Data Reduction and Review

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

- Data reduction or manipulation, mathematically or otherwise, into meaningful and useful forms;
- Data validation;
- Review; and
- Organization, interpretation, and reporting.

17.1 Field Data Reduction and Review

Requirements for field data reduction and review are presented in the following subsections.

17.1.1 Field Data Reduction

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

17.1.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and QAC. Field documentation and data reduction prepared by field personnel will be reviewed by the appropriate Task Manager and the QAC. Logs and documents will be checked for:

- General completeness;
- Readability;
- Usage of appropriate procedures;
- Appropriate instrument calibration and maintenance;
- Reasonableness in comparison to present and past data collected;
- Correct sample locations; and
- Correct calculations and interpretations.

17.2 Laboratory Data Reduction and Review

Requirements for laboratory data reduction and review are presented in the following subsections.

17.2.1 Laboratory Data Reduction

The calculations used for data reduction will be in accordance with the analytical methods. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered must be sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using internal standards for GC/MS methodology.

Unless otherwise specified, all values will be reported as uncorrected for blank contamination.

17.2.2 Laboratory Data Review

Data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The QAM will review the final data reports, and the Laboratory Director will review a cross-section of the final data reports prior to release.

If discrepancies or deficiencies are present in the analytical results, corrective action will be taken, as discussed in Section 15. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the Project Manager and QAC.

18 Data Verification and Validation

For samples where Category B report is requested, data validation will be conducted as outlined in the USEPA's *Guidance on Environmental Data Verification and Data Validation*, EPA QA/G-8 (USEPA 2002a).

Data validation is a standardized review process for judging the analytical quality and usefulness of a discrete set of chemical data and is necessary to ensure that data of known and documented quality are used in making environmental decisions that meet the DQOs of the site. Data validation is a systematic process that compares a body of data to the requirements in a set of documented acceptance criteria to ascertain its completeness, correctness, and consistency. The data validation personnel will work independently from all other project teams. Data validators will not be involved in sampling or data analysis/reporting for the end user.

18.1 Data Validation Process

All data generated will be validated using the most recent versions of:

- The *National Functional Guidelines for Organic Superfund Methods Data Review*, EPA 540-R-2017-002 (USEPA 2017a) (with reference to the historical *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, OSWER 9240.1-05A-P [USEPA 1999], as appropriate);
- The *National Functional Guidelines for Inorganic Superfund Methods Data Review*, EPA 540-R-2017-001 (USEPA 2017b) (with reference to the historical *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, OSWER 9240.1-45 [USEPA 2004], as appropriate);
- USEPA SW-846 methodology;
- NYSDEC ASP (NYSDEC 2005); and
- QA/QC and reporting deliverables requirements for data validation available at the time of project initiation, where appropriate.

These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, and editing to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements, apart from those specified in this QAPP, will be detailed on the COC forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate the completeness of the data package.
- Verify that the field COC forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Document holding time exceedances, if any occur. Flag data for all samples exceeding holding time requirements as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.
- Verify that parameters were analyzed according to the analytical methods specified.

- Review QA/QC data (i.e., confirm that duplicates, blanks, and LCSs were analyzed for the required number of samples, as specified in the analytical method, and verify that duplicate relative percent differences are acceptable).
- Investigate any anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response to the deficiencies, will be documented and submitted in the form of a written report addressing the following topics, as applicable to each analytical method:

- Assessment of the data package;
- Description of any protocol deviations;
- Failures to reconcile reported and/or raw data;
- Assessment of any compromised data;
- Laboratory case narrative;
- Overall appraisal of the analytical data; and
- Table of site name, sample quantities, data submitted to the laboratory, year of protocol used, matrix, and fractions analyzed.

18.2 Data Verification

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean that data must be produced without QC qualifiers. Qualified data can provide useful information.

During the review process, laboratory qualified and unqualified data are verified against the supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data reviewer. Results will be qualified with the following codes in accordance with the National Functional Guidelines.

Qualifier	Definition
Concentration Qualifiers (Laboratory Assigned)	
U	The analyte/compound was analyzed for but not detected. The associated value is the compound RL.
B	The analyte/compound has been found in the sample as well as its associated blank; its presence in the sample may be suspect. (Note: Laboratory assigned B qualifiers will be removed during data validation in the event that the concentration detected in the sample is greater than 5 times the concentration detected in the associated blank.)
J	The analyte/compound was positively identified; however, the associated numerical value is an estimated concentration only.
Quantitation Qualifiers (Laboratory Assigned)	
E	The compound was quantitated above the calibration range.
D	The concentration is based on a diluted sample analysis.
P	The lower of the two values is reported when the percent difference between the results of two GC columns is greater than 40%.

Qualifier	Definition
Validation Qualifiers	
UJ	The analyte/compound was not detected above the reported sample quantitation limit; however, the reported limit is approximate and may or may not represent the actual RL.
UB	The analyte/compound is considered non-detect at the listed value due to associated blank contamination (i.e., concentration in the sample is less than 5 times the concentration detected in the associated blank).
J	The analyte/compound was positively identified; however, the associated numerical value is an estimated concentration.
R	The sample results are rejected.

Two notes to all data users:

- The “R” qualifier means that the associated value is unusable. In other words, due to significant QC problems, the analysis is invalid and provides no information as to whether the compound is present or not. “R” values should not appear on data tables because they cannot be relied upon, even as a last resort.
- No compound concentration, even if it has passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in the data, but any value potentially contains an error.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the QAC at this point.

Data validation reports will be kept in electronic format (e.g., PDF) at the environmental consultant’s office.

19 Reconciliation with User Requirements

The data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from the objectives will be noted. Additional action may be warranted when the performance does not meet the performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

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

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

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

- Extrapolation of missing data from existing data points;
- Use of historical data; and
- Evaluation of the critical/non-critical nature of the sample.

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, additional sample collection and analysis may be required.

20 References

NYSDEC. 2005 Analytical Services Protocol. July.

USEPA. 1991. National Enforcement Investigations Center Policies and Procedures Manual. August.

USEPA. 1992. Guide to Management of Investigation-Derived Wastes. 9345.3-03FS. Office of Solid Waste and Emergency Response. April.

USEPA. 1999. Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA-540/R-99-008. October.

USEPA. 2001. EPA Requirements for QA Project Plans for Environmental Operations. EPA-QA/R-5. Office of Environmental Information. March.

USEPA. 2002a. Guidance on Environmental Data Verification and Data Validation. EPA QA/G-8. Office of Environmental Information. November.

USEPA. 2002b. Guidance for Quality Assurance Project Plans. EPA-QA/G-5. Office of Environmental Information. December.

USEPA. 2004. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. OSWER 9240.1-45. October.

USEPA. 2017a. National Functional Guidelines for Organic Superfund Methods Data Review, EPA 540-R-2017-002, January.

USEPA. 2017b. National Functional Guidelines for Inorganic Superfund Methods Data Review, EPA-540-R-2017-001, January.

Attachment 1

Project Team Resumes



Christopher Engler

Client Program Manager

Mr. Engler has more than 38 years of professional engineering experience and has served as Technical Expert and Engineer of Record for the design and construction of numerous groundwater pump and treatment programs, vapor intrusion mitigation systems, soil remediation design and construction oversight, building characterization and demolition, facilities retrofit, asbestos/lead paint abatement management, and fire protection engineering projects. Additionally, Mr. Engler has experience in the preparation of feasibility studies for coal tar/NAPL sites, underground storage tank leak investigations, closure and site assessments, environmental sampling and site monitoring, storm water sampling program management, storm water pollution prevention plan preparation, and Phase I and II environmental liability assessments. Mr. Engler's facilities engineering projects have included mechanical process piping and pumping systems design and layout, cost estimation, fire protection system design, heating, process engineering ventilating, air conditioning (HVAC) systems design, and cooling tower ozonation.

Key Information

Core skills

- Engineer of Record for Large Remedial Programs
- Vapor Intrusion
- Groundwater Remediation
- Soil Remediation
- Facilities Design
- Pre-Demolition Environmental Building Characterization

Education & Qualifications

- BS, Mechanical Engineer, Lehigh University, 1986

Licenses & certifications

- Asbestos Designer - New York, NY
- Qualified Fire Protection Engineer – Dept. of Defense

Professional Qualifications

- National Society of Professional Engineers

Years of experience

- Total – 38 years
- With Arcadis– 17 years

Project Experience

Engineer of Record

Confidential Client, Bethpage, New York

Engineer of Record for a New York State Superfund project focused on the containment and remediation of one of the largest and deepest groundwater plumes in the country. The site wide treatment systems at this former aerospace facility also include a soil vapor extraction system to establish a “vacuum curtain” to prevent offsite migration of VOC impacted soil gas and two groundwater pump and treatment systems with flow rates of 2.1 MGD, 3.5 MGD, and

3.6 MGD respectively. As Engineer of Record for this project, Mr. Engler’s responsibilities have included:

- Review and signature of all engineering documents submitted to regulatory agencies including quarterly and annual system performance reports, operations and maintenance manuals and associated updates, corrective action reports, and periodic review reports.

Project Experience Continued

- Engineer of Record for the design, procurement, and construction oversight for a 3.5 MGD groundwater remediation system that includes 3 remedial wells with an average depth of 700 feet, 10,000 linear feet of dual wall conveyance piping, and a 13,500 sq. ft. groundwater treatment building including liquid phase granular activated carbon, filtration and volute presses for the management of iron, and an advanced oxidation process system for the treatment of both volatile organic compounds and 1,4- Dioxane. As Engineer of Record, Mr. Engler was responsible for the following aspects of the program:
  - Investigation of off-site contaminant impacts through complex three- dimensional contaminant modelling
  - Evaluation of water chemistry to optimize remedial selection
  - Evaluation and bench scale testing of various remedial options
  - Preparation of detailed cost estimates to evaluate treatment systems options and associated life cycle costs
  - Determination of off-site remedial well placement and pumping rates to ensure plume capture
  - Evaluation of hydrology for the re-introduction of treated water into the aquifer
  - Design, construction oversight, and commissioning of the 3.5 MGD groundwater treatment system utilizing an Advanced Oxidation Process for the treatment of VOCs and 1,4-Dioxane and solids handling for the removal of iron utilizing pressure filters and volute presses.
  - Specific design responsibilities included integration of multiple technical trades including mechanical, electrical, structural, process, civil, controls, and architectural. Responsibilities also included oversight of all permitting and land access/right-of-way negotiations.
  - Regulatory negotiations with NYSDEC and USEPA, implementation of various project related documents including records of decisions, remedial investigations, feasibility studies, remedial action plans, site management plans, and final engineering reports.
  - Presentations to stakeholders (including regulators, community leaders, and the public) to discuss proposed design and construction activities and modified project conditions as necessary to address stakeholder concerns.

Engineer of Record

Confidential Client, Lake Success, New York

Engineer of Record for a soil excavation project at a NYS Superfund site that included the preparation of contract documents and construction oversight that included the removal of a portion of the building slab to allow for installation of equipment foundations, water, sewer and/or roof drain pipelines within an occupied building were soil and soil vapor contamination were known to exist. The construction was carried out by saw-cutting the building slab, removing impacted portions of the slab, excavating the soil from beneath the slab, installing the foundation and/or utilities pipelines, backfilling the excavation and restoring the concrete slab. Prior to the start of construction activities, temporary partitions were installed to isolate the construction areas from occupied areas.

Engineer of Record

Confidential Client, Bethpage, New York

Engineer of Record for a project involving a feasibility study for a soil remediation project at a New York State Superfund Site that included investigation, delineation, and development of remedial options for approximately 3,800 cubic yards to soil impacted with VOCs, SVOCs, metals, and PCBs. Key aspects of the project included:

- Development of an Environmental Visualization Software (EVS) model to contour data in 3-dimensions and to develop estimates of impacted soil. These EVS contours and estimates were reviewed and modified based on experience and site conditions.
- Consideration of various remedial options for each constituent including:
  - Excavation and off-site treatment with disposal
  - Excavation and on-site treatment via soil washing
  - Soil vapor extraction
  - Enhanced stabilization/solidification/treatment (ZVI/Clay)
  - In-situ chemical oxidation
  - Thermal destruction
- Development of a Soil Excavation Plan to remediate soils at depths up to 40 feet below land surface. Soil stabilization methods included traditional sloping and benching as well as sheeting and shoring using both sheet piles and horizontal tiebacks based on the localized excavation depths and surrounding site conditions (i.e., open land vs. adjacent buildings).
- Regulatory oversight for this project was provided by the NYSDEC and USEPA.

Engineer of Record

Confidential Client, Lake Success, New York

Engineer of Record and responsible for project management, engineering design of system upgrades, client coordination and oversight of operation, maintenance and monitoring, as well as on-going upgrades associated with five remedial systems at a New York State Superfund Site. The systems include two groundwater pump-and-treat systems recovering and treating a combined flow of approximately 2 MGD, one soil vapor/perched water recovery system, and two sub-slab vapor intrusion mitigation systems. The pump and treat systems recover groundwater utilizing a total of four extraction wells, treat the VOCs and re-inject treated water into the aquifer through a network of six active reinjection wells. Each pump-and-treat system consists of two tower air strippers arranged in series equipped with the corresponding wet wells and wet well pumps, the associated air blowers operating at 5,000 scfm as well as the air heaters (electric and gas). The air stripper off-gas is treated through a series of three lead-lag 20,000 lb VPGAC and two 25,000 lb PPZ emission control units at one plant and of two 20,000 lb. VPGAC arranged in series with two 35,000 lb. PPZ emission control units at the other plant.

Engineer of Record

Confidential Client, Lake Success, New York

Engineer of Record for the design and construction of a vapor intrusion mitigation system throughout a 1 million sq. ft. facility. The sub-slab depressurization system (SSDS) consists of four 150-horsepower (hp) vacuum blowers, a moisture separator, condensate storage tank, air heat exchanger, water chiller, condenser, two 10,000-pound vapor- phase carbon vessels, an emergency generator, and miscellaneous transfer pumps. The blowers are connected to vapor conveyance piping and soil-vapor extraction points installed beneath the floor slab throughout the building interior. The SSDS is designed to extract up to 6,000 standard cubic feet per minute (scfm) of soil vapor from the extraction points and maintain a minimum differential pressure of negative 0.004-inch wc between the sub-slab space and the indoor air space of the building thereby preventing advective flow of soil vapor into the building interior. Each EP is equipped with flow and pressure monitoring devices, as well as a motorized control valve, to monitor and control flow and vacuum at each EP via a Master Control Panel.

The SSDS is also equipped with thermal dispersion flow meters. Several areas throughout the building are equipped with room status monitors to continuously record the pressure differential across the floor slab. The monitors provide real-time data, confirming that the SSDS is maintaining adequate differential in monitored locations. The common SSDS suction header includes sample and measuring ports to monitor the performance of the SSDS, pre-carbon vapor concentrations, and quality of the air discharged to the atmosphere (post carbon) through a roof stack.

During the design phase of the program, Mr Engler lead a team of mechanical, electrical, instrumentation/controls, and structural engineers to developed detailed design drawings and specifications used for public bidding. During the construction phase, responsibilities included preparation of construction permit applications, construction oversight, review of requests for information (RFIs), review of progress payment applications, change order negotiations, attendance of weekly construction meetings, preparation of as-built record drawings, and close out activities.

Litigation Support as Technical Expert

Binghamton Housing Authority, Binghamton, NY

Provided expert testimony during deposition to support client-initiated litigation for improper asbestos abatement protocols at a public housing authority. In addition to deposition services and in preparation of litigation, Mr. Engler provided technical documentation to the client team regarding specific contractor violations of both USEPA and New York State Department of Labor regulations.

Site Wide Pre-Demolition Environmental Assessment and Coordination

Confidential Client, Rio de Janeiro, Brazil

Coordinated numerous environmental pre-demolition activities including the oversight of waste classification, staging, storage, and off-site disposal activities, building decontamination, and demolition permit preparation. Responsibilities also included review and evaluation of groundwater and soil gas analytical data and modelling results and assisting in the development of site-wide remedial alternatives.

Asbestos and Lead-Based Paint Remediation

Mirant Power, Tompkins Cove, New York

Provided professional services associated with the clean-up and remediation of asbestos and lead-based paint containing materials following the explosion of a boiler at a major power generating facility. The project included an assessment of potential asbestos and lead-based paint debris contamination both inside and outside the facility, preparation of bid documents for asbestos abatement operations, selection of abatement contractors, coordination

between power company officials and regulatory agencies (including the New York State Department of Labor, New York State Department of Health, and the Occupational Safety and Health Administration), and contractor oversight through the completion of asbestos abatement operations.

Asbestos Survey

Broome County Department of Public Works, Binghamton, New York

Managed asbestos issues associated with a multi- year $20,000,000 renovation project. The airport remained fully functional during all phases of the project, including completion of the asbestos survey and asbestos abatement operations. Following a comprehensive survey throughout the airport terminal and control tower buildings, design documents were prepared, which required extensive consultation with FAA officials to ensure compliance with FAA's asbestos abatement requirements and to coordinate the timing and phasing issues associated with the relocation of the control tower during asbestos abatement operations.

Construction phase services included construction oversight, review of requests for information (RFIs), review of progress payment applications, change order negotiations, attendance of weekly construction meetings, preparation of as-built record drawings, and project close out activities.

Manufacturing Process Relocation

Koehler-Bright Star, Wilkes Barre, Pennsylvania

Koehler-Bright Star. Prepared design of mechanical components such as lead oxide dust collection system, two 20,000-lb lead oxide storage silos, three 9000-cfm gas-fired makeup air units, and acid scrubber exhaust fans. Also designed plumbing components such as wastewater treatment system, process cooling and wastewater piping, central vacuum system, and sanitary systems.

Building Demolition

Confidential Client, Bridgeport CT – 1.5 million ft2 former electrical product manufacturing facility

Ford Motor Company, Hapeville, GA – 1.3 million ft2 former automotive assembly facility

Ford Motor Company, Virginia Beach, VA – 2.1 million ft2 former automotive assembly facility

For each of the three projects listed above, Mr. Engler was responsible for the development and implementation of a site wide pre-demolition sampling program that included organics, inorganics, PCB, asbestos, heavy metals, and lead based paint. Once environmental issues were delineated, managed a project team to develop contract documents to abate environmental impacts and demolish the facility through final site grading. Performed contractor oversight during abatement and demolition and coordinated with the property owner and regulatory agencies throughout all phases of the project.

Environmental Compliance Evaluation

Medgar Evers College, New York City, New York

Completed multi-media evaluation of environmental compliance issues. The major areas of concern addressed during the evaluation included environmental management procedures, wastewater and storm water discharges, air emissions, hazardous waste management, universal waste management, solid waste management, bulk storage (USTs and aboveground storage tanks), asbestos identification and management, chemical management, spill incident reporting. Performed oversight of field investigations, consulted with college faculty assisting with the audit, evaluated applicable regulations, and prepared the audit findings.

Environmental Site Assessment

Signature Resorts, Inc., St. Croix, Virgin Island

An environmental and structural site assessment was performed to evaluate the existence of potential mechanical, electrical, environmental, and structural issues associated with the subject property as a result of past and/or present site activities and current site conditions. Performed an evaluation of mechanical, electrical, structural, and environmental conditions at the site, consulted with management of the resort, and prepared the project report.

Firing Range Lead Contamination Investigation

Broome County Department of Public Works, Broome County, Binghamton, New York

Prepared an investigation plan for lead contamination at Broome County Sheriff's Firing Range. Implemented the investigations, which included soil sampling with hand and power auger, and collecting stream sediments. Upon completion of investigation, reviewed analytical data, evaluated impacts with state-recommended clean-up levels, and prepared investigation report, which included remedial options.

Hazardous Waste Investigation

Anitec, Binghamton, New York

Investigated hazardous waste contamination of property owned by a film manufacturing plant. The project involved identifying the source of the contamination and determining the extent to which the surrounding property was affected. This was done using soil vapor/gas chromatograph techniques. Site remediation consisted of a vapor extraction

system and a series of extraction wells installed to a depth of approximately 40 feet. The vapor extraction system consisted of a skid-mounted blower systems that removed contamination through an extraction well. Monitoring the operation of the system included recording temperature, pressure, flowrates, lower explosive limit percentages, and oxygen concentration of the exhaust air. The raw operating data was later evaluated to calculate contaminant mass flowrates and total pounds of solvent removed.

Environmental Investigation and Remediation

Broome County Department of Public Works, Binghamton, New York

Managed an environmental investigation and remediation services associated with the release of ethylene glycol and propylene glycol at a community ice rink. A remedial investigation was performed to define the lateral and vertical extent of contamination including the installation of monitoring ground water wells at the site, monitoring a drinking water supply well located approximately 700 ft. down gradient from the ice rink, installing and sampling soil borings, and conducting soil sampling.

Lead Based Paint Sampling Program

McGuire Air Force Base, New Jersey

Prepared a work plan, coordinated field efforts, evaluated data, prepared final report, and presented results to client for a lead-based paint sampling program at McGuire Air Force Base. Field instrumentation included an X-ray Fluorescence device capable of determining the lead content in up to twenty-one layers of paint. The program included over 2,100 sample locations that were downloaded to a computer database.

Pre-demolition Survey

Binghamton Housing Authority, Binghamton, New York

Completed a pre-demolition asbestos building survey, prepared contract documents, and monitored abatement activity for a Public Housing Authority as required by the New York State Department of Labor for three buildings scheduled to be demolished. The survey included the preparation of building drawings indicating the location of ACM, compiling sample analytical data into a spreadsheet, and preparing a report of the survey results.

Construction phase services included preparation of construction permit applications, construction oversight, review of requests for information (RFIs), review of progress payment applications, change order negotiations, attendance construction meetings, preparation of as- built record drawings, and project close out activities.

Chemical Bulk Storage Tank Survey

Confidential Client, Endicott, New York

Performed a survey of approximately 800 bulk chemical storage tanks for a large industrial facility. Gathered data on tank contents, construction materials, volume, supporting process, level controls, high-level alarms, and secondary containment size and construction material. Prepared a separate data sheet for individual tanks and generated a computer database that included information on each tank.

Worldwide Asbestos Survey

Confidential Client, Various States

Completed a $1.2M program that involved the preparation of asbestos surveys and management plans at over 100 locations for a Fortune 500 manufacturing conglomerate. Mr. Engler was responsible for the coordination of 20 field engineers, report writers, and technicians to ensure that project deliverables were completed within the scope, budget, and schedule parameters established in the project contract. Project data was managed utilizing a relational database involving text, spreadsheets, AUTOCAD drawings, and digital photographs.

Engineer of Record

Confidential Client, New York

Engineer of Record for the design and construction of one of the largest vapor intrusion sites in the US. This project involved the design and installation of approximately 500 vapor intrusion mitigation systems throughout residential and commercial properties in Endicott, NY. Design efforts included sub-slab pressure gradient mapping, fan sizing, pipe routing, sealing of all foundation cracks and utility penetrations, and backdraft testing. The systems were proven to be highly effective in the mitigation of sub-slab and indoor concentrations of VOCs a demonstrated by post mitigation vapor sampling.

Vapor Intrusion Remediation

Confidential Client, Rahway, New Jersey

Completed installation of numerous vapor intrusion mitigation systems throughout a 50,000 ft2 day care facility. Based on client requirements, the systems were designed, installed, and commissioned over a ten-day period with no disruption to the day care operations. This was accomplished by performing system installation and commissioning activities during night and weekend shifts with design and installation team members having extensive experience with vapor intrusion mitigation systems.

Vapor Intrusion Remediation

New York State Department of Environmental Conservation (NYSDEC), Norwich, NY

Program manager for a vapor intrusion mitigation project in Norwich NY resulting from a chlorinated solvent plume in groundwater. The project included the collection and data evaluation of sub-slab, indoor air, and ambient air samples along with the design, construction, and commissioning of sub-slab depressurization systems throughout 22 homes and commercial structures that were 75 – 100 years old. Air sampling data was compared to New York State guidance documents to identify the extent of the remedial program. Due to limited head clearance and dirt floors throughout basement areas, structural modifications were made to most structures to remove existing basement jack posts, install sub-slab depressurization systems, pour new concrete floors, and install new jack posts to support the structure. The project also involved extensive asbestos abatement and parging of built-up stone foundation walls to prevent short circuiting of the sub-slab negative pressure gradient.

Vapor Intrusion Remediation

Confidential Client, Richmond, VA

Program manager for a vapor intrusion mitigation project in Richmond, VA resulting from the rupture of a major petroleum distribution pipeline in a residential neighbourhood. Mr. Engler was responsible for the design of sub-membrane mitigation systems to address vapor intrusion concerns throughout homes in the neighbourhood. Sub-membrane systems were installed throughout multi-million dollar homes constructed on frost walls with dirt floor crawl spaces. Supervised construction phase and system commissioning activities. Coordinated activities with the client, regulators, and homeowners.

Vapor Intrusion Presentations

Vapor Intrusion – Design and Construction of One of the Largest Vapor Intrusion Mitigation Systems in the US, Presenter, 2015 “Sub-Slab De-Pressurization System for Vapor Intrusion Mitigation,” Presented at Environmental Show of the South, April 23rd, 2015

“Vapor Intrusion Mitigation System – Design, Installation & Commissioning,” Presentation at the Air and Waste Management Association Conference, Philadelphia, PA. January, 2006

“Vapor Intrusion Mitigation System – Design, Installation & Commissioning,” Presentation at the Air and Waste Management Association Conference, Los Angles, California. September, 2006

“Vapor Intrusion Mitigation System – Design, Installation & Commissioning” Presented on behalf of the NYSDEC to over 500 attendees in Albany, NY, Rochester, NY, Syracuse, NY, and New York, NY, summer, 2005. The presentations were sponsored by the NYSDEC to provide information to business owners, consultants, and interested members of the public regarding the recently released NYSDEC vapor intrusion guidance documents

Co-Presenter. “Vapor Intrusion - Emerging Issues and Perspectives,” Presented to DuPont, July 9, 2004. Wilmington, Delaware.

“Vapor Intrusion Investigations in NYS” – Presentation to the Kansas City Army Core, Kansas City Missouri. November, 2005

“Design Considerations for Vapor Intrusion Mitigation Systems” Co-presented with the California Department of Toxic Substances and Control, California Environmental Protection Agency, San Jose California. June, 2006.

Vapor Intrusion - Emerging Issues and Perspectives, Co-Presenter. 2004. "Vapor Intrusion - Emerging Issues and Perspectives," Presented with MDM&C to DuPont, Wilmington, Delaware.

Vapor Intrusion Mitigation System - Design, Installation & Commissioning, 2004. "Vapor Intrusion Mitigation System - Design, Installation & Commissioning," Presented to NYSDEC, Albany, New York.

Education
BS Summa Cum Laude, Civil Engineering, Bucknell University, 1977

Years of Experience
Total - 47
With ARCADIS - 19

Lawrence G. Brunt, PE

Principal Engineer

Mr. Brunt has 47 years of experience in the environmental, process and civil engineering fields. He has directed numerous projects involving site investigation and remediation of contaminated industrial sites. He has worked on several hundred projects in New Jersey dealing with the Industrial Site Recovery Act (ISRA). These projects have included the development of sampling plans, performance of remedial site investigations, evaluation of cleanup alternatives, completion of feasibility studies, design of remediation systems, and supervision and management of final cleanup activities. Mr. Brunt also has directed numerous compliance and due diligence audits of industrial and commercial facilities to identify potential liabilities, evaluate facility environmental compliance programs and permitting, and to evaluate waste disposal and handling procedures. He developed guidelines for the petrochemical industry for performing field investigations and evaluating and selecting remedial measures at contaminated sites. Mr. Brunt has provided expert testimony and litigation support on several ISRA matters and a variety of sites involving soil and groundwater contamination.

Project Experience

Analysis and Expert Testimony
Principal Environmental Engineer providing analysis and expert testimony regarding impacts from past underground storage tank (UST) operations onsite. Reviewed site characterization data and documents related to groundwater contamination and operations at site. Performed decay modeling and evaluated site data to determine potential age of contamination. Prepared expert report concerning sources and age of contamination. Provided depositional testimony and developed investigation plan for settlement agreement. Negotiated with New Jersey Department of Environmental Protection (NJDEP) concerning required site activities. Currently managing the ongoing soil and groundwater investigation activities.

Site Investigation and Remedial Actions
Project Manager for site investigation and remedial actions being implemented at IMO Industries Trenton facility pursuant to ISRA. The investigation and remediation activities have included delineating areas of soil contamination and groundwater impacted with free product, assessing the extent of fill material in areas at the site, evaluating the impacts to groundwater from previous UST operations, and performing aquifer characterization tasks for the preparation of a groundwater Classification Exception Area (CEA). The project objectives are to close the ISRA case through the completion of additional investigation activities and the establishment of engineering and institutional controls for residual contamination of groundwater and soil.

Soil and Groundwater Remediation Project

Principal Environmental Engineer for soil and groundwater remediation project at a Former Hot-Stamping Foil Production Facility. The project involved extensive soil and groundwater investigation/remediation activities required as part of an ISRA triggering event. The activities included removal of seven solvent/waste solvent USTs, removal of drums and soil containing pigments and polychlorinated biphenyls (PCBs), installation of over 20 shallow and deep monitoring wells, and installation and operation of a soil vapor extraction and groundwater recovery and treatment system Additional activities included the delineation of PCBs in over 3 acres of wetlands and the preparation of an Ecological Risk Assessment to evaluate the impact of the PCBs on the natural environment in the area. Preparation for the remedial activities included the preparation of Freshwater Wetlands, Stream Encroachment and Soil Erosion Control Permits.

ISRA Compliance and Expert Testimony Activities

Project Director for ISRA compliance and expert testimony activities for a Former Fragrance Manufacturer. Performed site investigation and remedial activities for numerous areas of concern to address free product, priority pollutant metals, base neutrals, PCBs and volatile organic compounds in soil and groundwater. Reviewed aerial photographs, documents and historic information to determine sources of contamination and past uses of site. Evaluated alternate cleanup levels and performed remedial alternatives analysis to identify potential remedial options. Prepared contractor bid documents for remedial actions, and performed bid evaluations and contractor reviews. Supervised contractors and implementation of remedial actions. For expert case, reviewed site characterization data, operational information and documents related to soil and groundwater contamination at site. Prepared expert report for sources, extent, and age of contamination. Developed cost estimates and performed risk analysis on remedial scenarios. Provided depositional testimony and technical assistance in negotiations with plaintiff.

Expert Testimony Regarding Investigation and ISRA Compliance Activities

Provided Expert Testimony Regarding Investigation and ISRA Compliance Activities for a Fabric Printing and Dyeing Operation located in Paterson, New Jersey. Performed site investigation activities for various areas of concern to address free product, PCBs and volatile organic compounds in soil and groundwater. Reviewed documents and historic information to evaluate ISRA compliance and determine sources of contamination and past uses of site. Evaluated site characterization data, operational information and documents related to soil and groundwater contamination at site. Prepared expert report and provided technical assistance and litigation support to counsel.

Regulatory and ISRA Compliance Activities

Project Director for Regulatory and ISRA Compliance Activities at a Sealant Manufacturer. The activities included the removal of underground solvent tanks, waste tank and fuel oil tanks. Additional site activities included the delineation, removal and disposal of PCB contaminated soils

in a hazardous waste landfill. The sampling, remediation and site restoration were conducted during on-going facility operations, which required intensive coordination with facility material delivery and production requirements. Groundwater monitoring activities also were conducted which indicated impact to the groundwater by chlorinated solvents. A review of facility operations, groundwater flow directions and off-site facilities confirmed that the contamination was due to off-site sources. As a major facility storing petroleum and hazardous substances, a DPCC and DCR plan was prepared pursuant to the New Jersey (NJ) Spill Act. In addition, facility operations were evaluated to minimize VOC emissions and optimize production capacity. Subchapter 8 air permits were subsequently amended to reflect the optimized operations.

Multi-Phase Investigation and Remediation of Hexavalent Chromium Contamination
Project director for all aspects of the investigation and remediation of hexavalent chromium contamination in the soil, groundwater and surface water at this former electroplating facility for locomotive crank shafts. Forty-five years of chromium plating operations had impacted the soil and groundwater underlying the facility. The contamination had impacted a downgradient stream through transport in the weathered rock and fractures in the shallow bedrock beneath the site. An in-situ chemical reduction program was developed and implemented using calcium polysulfide to convert hexavalent chromium to trivalent chromium in the impacted soils and groundwater at the site. Groundwater and surface water monitoring is ongoing to evaluate the effects of the treatment activities. In addition, treatment systems which intercept seeps of contaminated water were re-designed and upgraded during the remediation process. The activities are being performed under the superfund program and have been coordinated through USEPA and PADEP. As part of the remedy implementation, various public participation activities were conducted to communicate the remediation activities to the nearby residents.

Regulatory Compliance Support
Provided Ongoing Regulatory Compliance Support for a Specialty Lubricant Manufacturer. Inventoried air emission sources, prepared Subchapter 8 permits, performed State-of-the-Art Analysis, evaluated and determined strategies for Title V compliance, and prepared annual emission statements. Performed ongoing NJPDES Discharge to Groundwater and Surface Water monitoring activities and reporting. Evaluated manufacturing operations and provided recommendations for performance improvement and environmental management systems. Identified pollution prevention opportunities for development of pollution prevention plan. Evaluated stormwater permitting requirements, prepared permit application, and developed Stormwater Pollution Prevention (SWPP) Plan. Evaluated facility Spill Prevention Control and Countermeasures (SPCC) and discharge prevention, containment and countermeasure (DPCC) and discharge cleanup and removal (DCR) plans and provided recommendations for upgrades.

ISRA Compliance Activities
Project Director for the site investigation of a former lead chromate pigment production plant in Paterson, New Jersey. The change of ownership and subsequent cessation of operations

triggered the NJDEP ISRA investigation of this facility. Site investigation activities included sampling of soils beneath the concrete floor of the plant, as well as outside beneath an aboveground storage tank farm. The findings prompted the installation of shallow and deep groundwater monitoring wells at this site adjacent to the Passaic River. Extensive lead contamination was detected in the soils as well as in an area of the groundwater beneath the facility. TCE contamination also was found in the groundwater, but was determined to be originating from an off-site source. A Remedial Investigation Report and Remedial Action Workplan were prepared proposing removal of the exposed lead contaminated soils and capping/Deed Notice (DN) for the impacted soils beneath the facility floor. Preparation of a Classification Exception Area (CEA) was proposed for the area of groundwater containing elevated levels of lead.

ISRA Remedial Investigation Activities

Principal Environmental Engineer for the investigation and remediation of a former foundry site which involved extensive soil sampling, delineation of groundwater plumes (toluene, xylenes and PCE/TCE) using groundwater probes and shallow, deep and bedrock monitoring wells, and removal of USTs (gasoline, solvent and fuel oil). Remedial activities included facility decommissioning, removal and disposal of PCB-containing transformers, soil excavation/capping and Deed Notices, and installation of a soil vapor extraction system. A Remedial Action Workplan for groundwater remediation (in-situ oxidation) and NJPDES Discharge to Groundwater Permit Application also were prepared and submitted to NJDEP for review.

Brownfields Redevelopment Oversight

Project Director for oversight and monitoring of the site development and remediation activities performed as part of a Brownfields Redevelopment project in which a retail facility was constructed on the site of a former chemical manufacturing plant (PVO Foods International) where soil and groundwater had been impacted with a variety of contaminants including volatile organic compounds and metals. Responsible for overall client coordination and direction of field oversight monitoring during the site redevelopment and environmental remediation. Reviewed Site Management and Remedial Action Workplans and developed a strategy and schedule for monitoring the development activities and collecting the necessary information for documenting the redevelopment with NJDEP. Provided recommendations to Boonton Investors as the redevelopment occurs. Prepared required documents, including Remedial Action Report and Deed Notice, to establish the institutional controls and document the redevelopment activities with NJDEP at the completion of the site redevelopment.

Program Manager for National Contract to Provide Environmental Due Diligence and Regulatory Compliance Services for JPMorgan Chase NA throughout the United States.

Developed audit procedures and managed multi-facility audits during acquisition of other institutions such as Bank of New York and Washington Mutual. Managed program for ongoing Phase I and Phase II assessments of potential new build sites. Directed indoor air quality assessments, mold investigations and remediation, asbestos surveys and abatement, lead based assessments, vapor intrusion assessments and remediation, and other regulatory compliance

issues such as underground storage tank compliance, Spill Prevention Control and Countermeasures Plans, and air permitting for operating facilities.

Environmental Site Assessment (ESA) Audit Program

Project Director for an Environmental Site Assessment (ESA) Audit Program for Over 50 Facilities in the Northeastern United States (US). Developed audit program for millwork and building supply facilities. Prepared audit protocol to comply with American Society for Testing and Materials (ASTM) requirements and the lending institution's requirements. Developed schedule and procedures for completing audits, reviewed with staff and provided training. Coordinated audit activities and provided Quality Assurance (QA) and Quality Control (QC) review of audit reports. Performed risk analysis and developed costs for potential liabilities identified in audit program. Completed activities within 60 days.

QA/QC

Principal Environmental Engineer for QA/QC of Environmental Activities Completed in Accordance with ASTM and Client Requirements at Proposed Wireless Telecommunication Facilities for Major Northeast US Telecommunication Providers. Prepared Phase I ESA reports documenting environmental conditions and providing recommendations for individual sites. Directed Phase II investigations as recommended in Phase I ESAs and as required to meet client objectives.

Insurance Recovery Activities

Expert for Insurance Recovery Activities for Impacts Associated with a Release from a Gasoline Service Center. Performed remedial investigation activities to evaluate the extent of volatile organic compounds (VOCs) contaminated soil and groundwater at the site. Reviewed documents and historic information to determine sources of contamination. Evaluated site characterization data, operational information and documents related to soil and groundwater contamination at site. Performed remedial alternatives analysis to determine recommended remedial actions. Developed cost estimates and performed risk analysis on remedial scenarios. Provided technical assistance to counsel in ongoing negotiations with insurance companies. Successfully negotiated agreement for completing investigation and performing remedial actions.

SPCC Plan, DPCC and DCR Plan

Project Engineer for Development of a SPCC Plan, DPCC and DCR Plan at a Pharmaceutical Manufacturing Facility in New Jersey. Responsibilities included site inspection and assessment of existing chemical handling and storage facilities and practices, development of Best Management Practices, review of the SPCC plan and development of the DPCC/DCR plans. The DPCC/DCR Plans are required pursuant to the NJ Spill Act for major facilities storing petroleum or hazardous substances.

EDUCATION

Masters Degrees:
- Ecology and Ecosystems, expected completion 5/2025
- Environmental Science, completed in 2007

The State University of New York College of Environmental Science and Forestry

Bachelor of Science: Atmospheric Science. Cornell University (Air Force Reserve Officer Training Corps 4-year scholarship program), completed in 1985

YEARS OF EXPERIENCE

Total – 39 years
With Arcadis – 17 years

PROFESSIONAL LICENSURE

Professional Geologist – NY - License #60

PROFESSIONAL ASSOCIATIONS

New York State Council of Professional Geologists
Central New York Association of Professional Geologists

TRAINING/CERTIFICATIONS

OSHA 40-Hour Hazardous Waste Operations and Refresher
OSHA 10-hour Construction Safety
OSHA 8-Hour Supervisor for Hazardous Waste Operations
DOT/IATA Hazardous Materials Shipping and Transportation
RCRA Hazardous Waste
Lead/Benzene/Hydrogen Sulfide
First Aid/CPR/BBP

Mr. Korik has over 35 years of multidisciplinary technical and project management experience in the earth, environmental and atmospheric sciences with substantial project management experience directing field investigations at Brownfield sites, state and federal Superfund sites, and petroleum spills sites. Properties investigated include industrial/manufacturing, mixed chemical/radiological waste disposal facilities, former manufactured gas plant (MGP) and petroleum refining sites, pharmaceutical plants, bulk terminal and retail petroleum sites. He has conducted hundreds of Phase I and Phase II Environmental Site Assessments and has expertise in the field of soil vapor intrusion (SVI). Mr. Korik has extensive knowledge of New York State Department of Environmental Conservation (NYSDEC) petroleum and chemical spill and site remediation regulations, and New York State Department of Health (NYSDOH) soil vapor intrusion regulations. He has managed RI/FS projects, emergency spill response under NYSDEC contract and supervised multi-media environmental investigations throughout the eastern United States with significant work in New York State.

Project Experience

Remedial Investigations

Confidential Client, Upstate New York

Project manager for remedial investigation and reporting at a major pharmaceutical manufacturing facility. Responsible for assembling technical project teams to implement overburden, bedrock, sediment, groundwater, and soil vapor investigations in association with Brownfield site redevelopment and restoration. Contaminants of concern included volatile and semivolatile organic compounds, solvents and pharmaceutical compounds. Project required extensive and complicated negotiations with multiple regulatory agencies. Technical responsibilities also included daily review of Community Air Monitoring Program (CAMP) data and preparation of weekly CAMP summaries.

Project Experience Continued

Confidential Client, Hastings-On-Hudson, New York

Associate project manager for multiple phases of work associated with investigation and remediation of a former chemical manufacturing facility (NY State Superfund program) along the Hudson River in Westchester County, NY. Responsibilities included representing the client at community meetings, direction of field personnel during impacted soil hotspot area excavations (lead, VOC and SVOC), and oversight of community air monitoring during placement of a remedial soil cap over an approximately 7-acre impacted area. Responsibilities also included assisting with preparation of the Site Management Plan (SMP). Responsible for profiling, manifesting and proper transportation and disposal of multiple hazardous and non-hazardous waste streams.

Confidential Client, Brooklyn, New York

Lead scientist for remedial investigation and reporting at two adjoining Brownfield projects at a former chemical manufacturing and petroleum refining site. Responsible for transitioning project from incumbent consultant to Arcadis, assembling technical project team and directing field implementation (to include sampling for emerging contaminants – PFOA/PFAS in soil and groundwater) and reporting. Written deliverables included Health and Safety Plans, Site Investigation Reports, Human Health Exposure Assessments and Citizen Participation Plans.

Environmental Due Diligence

Multiple Clients throughout New York State

Conducted Phase I Environmental Site Assessments at commercial and industrial facilities.

Soil Vapor Intrusion Investigations

Multiple Clients, New York and Pennsylvania

Directed field teams and subsequent reporting for soil vapor intrusion investigations at numerous residential, commercial and industrial properties including state and federal superfund sites.

Investigation and Remediation at Petroleum-impacted Facilities

Chevron, Marathon Petroleum, BP, Penske, USACE

Directed site investigations and remediation at numerous retail gasoline stations and petroleum storage facilities in the northeast United States. Remedial technologies involved implementation of in-situ treatment using calcium nitrate and sodium persulfate injections, and installation of air sparge/soil vapor extraction systems.

Sheen Remedy Pilot Study

Confidential Client, Rensselaer, New York

Associate Project Manager, responsible for directing field teams conducting LNAPL migration and mobility investigation at a former petroleum fuel bulk terminal facility along the Hudson River using laser induced fluorescence (LIF) technology. Participated in negotiations and project meetings with regulatory (NYSDEC) personnel. Assisted project team with implementation of specialty technologies including deployment of an oleophilic bio barrier. Also, responsible for management of hazardous and non-hazardous waste streams associated with remedial activities.

Project Experience Continued

Waste Management
Multiple Clients

Responsible for the management of RCRA-hazardous, TSCA, and non-hazardous waste associated with site investigation and remediation activities at multiple sites in the northeast, including state and federal Superfund sites.

Meteorology
Multiple Clients, United States

Arcadis subject-matter expert in synoptic meteorology

Part of project team that provided ocean-bottom current assessment (confidential client) associated with oil pipeline damage sustained during a major hurricane in the Gulf of Mexico.

Provided site-specific weather forecasts to project teams during incident responses associated with train derailments and associated chemical releases.

Provided duration and magnitude forecasts of diurnal pressure fluctuations in support of a long-term landfill gas sampling event at The Dalles, Oregon.

Regulatory
Has extensive experience working with regulatory agencies including:

- Connecticut Department of Energy and Environmental Protection
- New Hampshire Department of Environmental Services
- New Jersey Department of Environmental Protection
- New York State Department of Environmental Conservation
- New York State Department of Health
- New York City Department of Environmental Protection
- Pennsylvania Department of Environmental Protection
- United States Environmental Protection Agency
- Various County Health Departments in New York State

Experience Prior to Arcadis (1985 – 2007)

Site Investigations and Remediation
Multiple Clients throughout the Northeastern US

Conducted hundreds of Phase I and Phase II Environmental Site Assessments at commercial and industrial facilities.

Project Experience Continued

Bristol Myers, Missouri

Directed field investigations and reporting as part of a pharmaceutical plant decommissioning project in St. Louis, MO,

Academic Institutions, Eastern United States

Directed multi-phase soil, groundwater, surface water and sediment investigations as part of Remedial Investigations at former chemical and mixed chemical/radiological waste disposal sites at Cornell and Duke Universities.

Remington Arms, Illion, New York

Project manager for the investigation and reporting of contaminated historical fill in the former Erie Canal bed adjacent to the Remington Arms manufacturing facility.

New York State Department of Environmental Conservation, New York

Conducted a bedrock investigation/fracture trace study (in the Chaumont Limestone) associated with a solvent-contaminated municipal water supply well in northern NY State. Directed the subsequent sizing and installation of a 100-gpm air stripper tower.

Participated in emergency spill responses.

Investigated soil and groundwater contamination at multiple current and former retail petroleum facilities and installed shallow-tray and packed tower air strippers.

Climatology/Air Quality/Meteorology

Multiple Clients, United States

Co-managed an atmospheric boundary layer study at the Nine Mile Point Nuclear Power Plant along the Lake Ontario shoreline near Oswego, NY. The primary objective was to collect data to characterize meteorological parameters related to the transport and diffusion from power generating facilities during on-shore flow conditions. Data collection techniques included traditional meteorological towers, balloon-tethered instrumentation, vertical atmospheric radar profilers and acoustical sounders.

Supervised a climatological study associated with closure activities at the West Valley Nuclear Demonstration Project Facility in western New York State.

United States Air Force – Active duty 1985-1988 (Honorable Discharge from Air Force Reserve at Rank of Captain - 1997)

1985-1987: Weather Officer, Military Airlift Command Headquarters, Scott AFB, Illinois - Weather Support Unit. Prepared operational aviation forecasts and briefed Senior Command Staff under routine and crisis scenarios. Provided meteorological guidance during high-profile incidents including space shuttle Challenger explosion and Chernobyl nuclear reactor disaster. Investigated weather-related aviation accidents. Position required top-secret security clearance.

1987- 1988: Readiness Systems Analyst, USAF Environmental Technical Applications Center, Scott AFB, Illinois. Responsible for preparing site-specific climatic briefs and major regional climatological studies for the Air Force, Army and Defense Department contractors.

Awarded Air Force Commendation Medal for Meritorious Service.

Project Experience Continued

Publications/Presentations

The Caribbean Basin - A Climatological Study, USAFETAC/TN-89/003, 1989, Mr. Kenneth R. Walters, Lieutenant Andrew G. Korik, Lieutenant Michael J. Vojtesak

Evaluation of the Potential Influences of Modeling Clay on Sub-slab Sampling Results., Co-Author with Nadine Weinberg, et al. Presented at the Air and Waste Management Association Conference, Denver, CO, September 2012.

Arcadis Quality Assurance Officer

Nicholas **Beyrle**

21+ YEARS EXPERIENCE

CORE SKILLS

- Technical Specialties
  - NAPL
  - Investigation
  - Remediation
- Project Management
- Teamwork

QUALIFICATIONS / MEMBERSHIPS

- Professional Geologist - NY
- New York State Council of Professional Geologists Member

SECTOR EXPERIENCE

- ENVIRONMENT
- SOIL & GROUNDWATER
- DEMOLITION
- RETAIL (PETROL STATION)
- MANUFACTURING
- MAJOR PROJECTS

"My primary goal is efficiency in every task. Efficiency leads to the most cost-effective solution in the shortest amount of time."

SUITABILITY TO THE ROLE

Mr. Beyrle has over 21 years of professional experience providing geologic services. He is well versed in leading and managing field operations for site investigations, remedial investigations, feasibility studies, air sparge/soil vapor extraction pilot tests and installations, routing system operations, monitoring, and maintenance, and routine sampling of air and groundwater. He has experience installing several types of wells, including traditional monitoring wells, NAPL-collection wells, reagent-delivery wells, soil vapor extraction wells, and air sparge wells using several types of drilling rigs (sonic, hollow-stem auger, mud-rotary, and direct-push). Mr. Beyrle has over nineteen years of experience characterizing overburden, bedrock, and wastes throughout New York State and understanding their role in contaminant transport and remediation. He frequently implements site characterization and remedial investigations in accordance with the New York State Department of Environmental Conservation (NYSDEC) Department of Environmental Remediation (DER-10) Technical Guidance for Site Investigation and Remediation and prepares final reports presenting the data, conclusions, and recommendations.

PROJECT EXPERIENCE

Former MGP Site – Southern New York

Iberdrola USA

Responsible for implementing an initial site characterization compliant with NYSDEC DER-10 at a former MGP site. The scope of work entailed installing approximately 40 soil borings and eight monitoring wells to develop the conceptual site model, determine whether former MGP operations impacted site media (surface soil, near surface soil, subsurface soil, bedrock, and groundwater), develop and understand contaminant transport through the site media, and analyze and interpret contaminant forensic data to understand the site contamination history. Implementing the site characterization work plan required managing rotating staff and subcontractors to work a 7-day work week for approximately 8 weeks with continuous regulatory and property owner oversight.

Outcomes Achieved:

- The regulator was very satisfied with our work, ability to adjust the work plan based on unforeseen and unexpected field conditions, and ability to meet the property owner demands for property access.
- The project was completed on time and under budget.
- The client was so satisfied that they retained Arcadis to prepare and implement the Remedial Investigation

Former MGP Site – Central New York

Iberdrola USA

Responsible for constructing a remedial design for the site which consisted of installing 34 wells for the delivery of oxygen-releasing material to reduce contaminant

mass in groundwater downgradient of the site. Managed field staff and contractors to keep project on schedule. Prepared and submitted required regulatory deliverables (weekly) and updated client frequently on progress. Currently drafting the Final Engineering Report and Site Management Plan that will transition the operable units of the site into the post-remedy monitoring phase.

Outcomes Achieved:

- Project was completed under budget and ahead of schedule.

Former MGP Site – Southern New York

Iberdrola USA

Responsible for coordinating and implementing an adaptive program to delineate the limits of subsurface NAPL in "real time". The effort involved drilling over 130 soil borings using a Sonic drilling rig. Collected geotechnical samples (Shelby tubes) and associated data to support remedial design efforts, as well as collected several samples for forensic "fingerprinting" analysis. Additional activities included installing monitoring wells and nested piezometers; conducting specific-capacity hydraulic conductivity tests, managing drilling subcontractors; interfacing with regulatory representatives, and securing subcontracts under contract. Currently responsible for overseeing the long-term semi-annual groundwater sampling program, coordinating field efforts, project staff, data management and drafting/submitting required Periodic Review Reports (PRR) to the regulatory agency.

Outcomes Achieved:

- Project deliverables to the client and regulator are submitted as required.

Former MGP Sites – Central New York

Iberdrola USA -Multiple Sites

Responsible for implementing pre-design investigations (PDIs) at three former MGP sites. Secured staffing and contractors to implement the multi-phase PDIs at each site within the confines of the extremely cost-efficient awarded proposal. Each project required several weeks' worth of work and included test-pitting, advancing soil borings, installing monitoring wells, collecting surface/subsurface soil, rock coring, wetland sediment sampling, and wetland delineation. Despite the size and complexity of each of the projects, kept cost over-run under control and identified efficiencies and cost savings within and among the three projects.

Outcomes Achieved:

- Met client deliverables and conducted all required work while controlling costs.

Retail Gas Station Portfolio – New York City Area (Queens, Manhattan, Long Island)

Confidential Client – Multiple Sites

Responsible for overseeing periodic (semi-annual/quarterly/monthly) sampling of site media (via wells or active remedial system), tabulating data, and reporting to comply with regulatory requirements. Responsible for coordinating field efforts, data management, and project staff. Analyze data trends to identify cost-effective actions (e.g., installation of oxygen-releasing compounds, well development/rehabilitation) to improve system performance and reduce contaminant mass in the subsurface. Identify sites that are good candidates for spill closure and work with the various regulatory case managers to identify reasonable closure requirements – often above standard regulatory criteria.

Outcomes Achieved:

- Since 2018, ten sites have attained a 'No Further Action' ruling from the regulator.

Goodman Yard – Upstate New York

CSX Transportation

Responsible for driving the site to spill closure. Responsibilities included initial site investigation, review of remedial options, implementation of the most efficient and cost-effective remedy, and request for 'No Further Action'. Conducted targeted in-situ chemical oxidation (ISCO) injections in source area and installed air sparge/soil vapor extraction (AS/SVE) system to remediate broader impacts in site media. Responsible for coordinating field staff, conducting field work, collecting data, generating reports, and discussing results and path forward with the regulator.

Outcomes Achieved:

- Targeted ISCO injections significantly reduced contaminant mass in subsurface advective transport zones.
- The AS/SVE system successfully remediated broader impacts at the site.
- 'No Further Action' for the Spill was approved by the regulator.

Car Shop – Upstate New York

CSX Transportation

Responsible for delineation and remediation of light non-aqueous phase liquid (LNAPL) and polychlorinated biphenyl (PCB) impacts in soil and groundwater. Conducted multi-phase investigation to complete delineation of subsurface impacts in soil and groundwater. Conducted LNAPL mobility study to determine if LNAPL plume migration was a concern. Data collected was summarized in a report indicating LNAPL is not mobile at the site and presenting source-area removal (excavation) as the most cost-effective remedy. The presence of PCBs required compliance with the US Environmental Protection Agency (USEPA) in addition to state regulators.

Outcomes Achieved:

- Phased investigations were used to reduce the size of excavations and break them up into smaller, targeted source-area removals.
- Excavation limits were modified in the field based on real-time input from the regulator. Reducing the possibility of additional remedial actions being required before the spill could be closed.
- 'No Further Action' for the Spill was approved by the regulator.

Buffalo Site – Western New York

Confidential Client

Responsible for driving the site to spill closure. Transitioned the site from a previous consultancy with the site in a routine groundwater monitoring phase. Reviewed historical site operations and remedial actions to identify modifications to the current trajectory for the site to expedite closure. Previous remedial efforts significantly reduced contaminant mass in the subsurface, however constituents were still above regulatory limits. Used professional relationship with the regulatory case manager to identify reasonable closure requirements.

Outcomes Achieved:

- Currently have a formal 'No Further Action' request submitted for review.

DENNIS CAPRIA

SENIOR TECHNICAL



EDUCATION

BS Biology (Minor in Chemistry)State University College at Plattsburgh 1988

YEARS OF EXPERIENCE

Total – 36 years

With Arcadis – 25 years

Mr. Capria has more than 36 years of analytical laboratory, quality assurance, data management, project chemistry experience, Quality Assurance Project Plans (QAPPs)both Uniform Federal Policy (UFP) and text based QAPPs and data verification/validation in the environmental field. Currently, he is the Regional Manager for the Information Management/Data Visualization& Communications (IM/DV&C) group which includes the following departments focused on: project chemistry/data validation, data management, GIS, CADD, 3D MVS, and Technical Communications services. Mr. Capria's responsibilities have ranged from overseeing the daily Quality Assurance requirements associated with large industrial sites of domestic and international clients to the operation and maintenance of volatile and semivolatile organic (GC, GC/MS instruments). His analytical chemistry experience includes various sample preparations, wet chemistry and inorganic/organic techniques, data generation and interpretation. His supervisory experience includes managing a team of Project Chemists, Data Managers and Visualization professionals as well as overseeing a QA/QC department at a laboratory.

Prior to joining Arcadis, Mr. Capria held a number of laboratory positions which included GC/MS Chemist and Analytical Quality Assurance/Quality Control Coordinator at laboratories in New York State. His prior responsibilities included client contact for industrial and consulting firms regarding analytical services for a major analytical services protocol (ASP) laboratory. He was responsible for the daily operation of the GC/MS department for an analytical laboratory. There, gaining extensive knowledge of USEPA acceptable methodologies. These are all associated with EPA-approved methods for the analysis of variety of contaminants (e.g., VOC, SVOCs, metals, dioxins, PCBs, PFAS, and pesticides). Mr. Capria worked to establish and implement the analytical guidelines for compliance with regulatory agency specifications. His responsibilities included: conducting sample analyses utilizing gas chromatography/ mass spectrometers; maintaining analytical instrumentation; scheduling analysis; peer reviewing and compiling analytical data packages; writing standard operating procedures (SOPs); training technicians; and streamlining the electronic data collection between lab instrumentation and QA/QC department, accelerating client results.

Mr. Capria's other accomplishments as laboratory Quality Control Officer: included maintaining laboratory certifications (such as New York State Department of Health [NYSDOH], New York State Department of Environmental Conservation [NYSDEC], New Jersey Department of Environmental Protection [NJDEP], and Pennsylvania Department of

Project Experience Continued

Environmental Resources [PADER]), preparing monthly control limits for QA/QC sample data, and providing a wealth of client services related to analytical program management.

Managerial/Technical Expertise

In addition to serving as the Co-Discipline Director for the Arcadis Preferred Laboratories, Mr. Capria is responsible for the overall resource management of the IM/DVC Department which consists of over 100 information technology, data quality, GIS, CADD, 3D MVS, Communications experts dedicated to improving the efficiency and effectiveness of business processes. He has also served as the quality assurance officer (QAO) for investigations of multiple hazardous waste sites in the Northeast and across the US. Sites include impacted aquatic systems, industrial facilities, landfills, and wastewater effluent discharges. As QAO, Mr. Capria serves as the primary communication link between analytical subcontractors and Arcadis, and is responsible for managing coordinating field managers and analytical subcontractors, and the direction of the IM/DV personnel. Further responsibilities include developing QAPPs that are consistent with federal and state guidelines to meet project data quality objectives (DQOs) related to sites Arcadis manages.

On a project-specific basis, he has been involved in developing analytical approaches to solve specific project requirements and regulatory needs; developing and reviewing bid documents for analytical services/master service agreements; and evaluating and auditing laboratory performance. Mr. Capria provides a wealth of data quality services for some of the largest industrial sites in the United States. He also provides this guidance to our international colleagues for our international clients.

Data Quality Usability Experience

As the QAO for many Arcadis project Mr. Capria is responsible for developing and reviewing project quality assurance documentation including project-specific DQOs, QAPPs, and field sampling plans (FSPs). These documents reference the most recent EPA quality system documents. He has written multiple Uniform Federal Policy (UFP) QAPPs covering all EPA regions. He oversees the data validation of mixed media (soil, sediment, water, biota, wipes, building material and air) data from investigations of multiple hazardous waste sites, including data validation pursuant to U.S. Environmental Protection Agency (USEPA) Functional Guidelines, and provides guidance on data usability. He manages and performs data validation efforts pursuant to USEPA regional and individual state guidelines, and has proficient knowledge of analytical methods including USEPA-CLP, USEPA-Regional, USEPA SW-846, 40 CFR Part 136, AK DEC, NJDEP, and NYSDEC ASP procedures.

Mr. Capria has been instrumental in the success of planning and implementing IM/DV solutions for the generation of hundreds of analytical presentations of data in various formats such as tables and figures, which are utilized by Arcadis and its clients in evaluating data for multiple projects.

Project Experience

Data Management/Validation (20140)

Confidential Client, Massachusetts

Project Chemist and providing project support, including data review, and determining data quality objectives and appropriate methods. Oversees staff performing data validation and database entries, and performs quality control checks throughout the project period of

Project Experience Continued

performance. Data management/validation in support of the off-site residential property investigations, pursuant to USEPA Region 1 guidelines.

Environmental Data Management
CSX Transportation, Inc., Painesville, Ohio

Served as Project Advisor/Project Chemist for a validation and chemistry project of an emergency response incident in Painesville, Ohio. Responsibilities included oversight and management of data validators for a derailment of approximately 30 train cars. Tasks included collection summary of data usability of analytical data for the presentation of results at meetings with the client, regulatory agencies and the general public.

Environmental Data Usability
CSX Transportation, Inc., Brooks, Kentucky

Served as Project Chemist to support for a data validation and chemistry support of an emergency response incident in Brooks, Kentucky. Responsibilities included oversight and management of data validators for a derailment of approximately 30 train cars. Tasks included summary of data usability of analytical data for the presentation of results at meetings with the client, regulatory agencies and the general public. 3,200 samples were collected and 210,000 sample results were verified/validated.

Project Chemistry Support (64432)
Confidential Client, Flint, Michigan

Served as the QAO/Project Chemist for this large automotive site, where responsibilities included coordinating with client and project personnel, validating the data from the numerous samples collected each year, supervising and approving the input validation, and updating the database for the project. Also performed laboratory audits in support of the RFI completed at this site.

QA/QC Coordinator and Project Chemistry
Confidential Client, Massachusetts

Served as the QA/QC coordinator and Project Chemist for a major industrial site. At this massive site, was responsible for the day-to-day management of data for thousands of samples collected on a regular basis in support of various investigation and remediation programs. In this role, provided daily technical support to the client, managed the entire analytical program, supervised the data management for the project and performed data validation for the numerous samples per year. In addition, performed laboratory audits in support of the pre-design investigation (PDI) program for this industrial facility.

Data Management/Validation (20159)
Confidential Client, Schenectady, New York

Data management/validation in support of the RI at Nott Street Industrial Park, pursuant to USEPA Region 2 guidelines.

Project Experience Continued

Data Management/Validation
CBS Corporation, Springfield, Massachusetts

Serves as the validator for the CBS site, where responsibilities included data management for the project, and performance of data validation for complete investigation.

Data Management/Validation
Confidential Client, Massachusetts

Served as the QAO and Project Chemist focusing on data management/validation in support of the Consent Decree (CD) pre-design investigations and on-site National Pollutant Discharge Elimination System (NPDES) program at a large industrial facility, pursuant to USEPA Region 1 guidelines. Managed and validated more than 30,000 samples which have been collected at this facility over the past six years.

Data Management/Validation
Confidential Industrial Client, Rio de Janeiro,

Served as the IM/DV program manager and as technical project chemist for the investigation site. Role required staffing of information management and data visualization professionals, traveling to Brazil to audit/assess laboratories and their ability to generate quality data. Also directed managing communications with laboratories for quality issues and assisting response team with planning and generating required tables/figures for submission to client and regulatory agencies.

Environmental Data Management
USCG, Region V and III

Serving as project chemist and QA manager for multiple USCG remediation projects. Responsibilities include overall data quality, QAPP development, and senior review of data validation. Responsibilities and duties include review of laboratory data packages; overseeing and interfacing with the analytical laboratory; coordinating field QA/QC procedures with Task Managers (including audits of field activities), concentrating on field analytical measurements and practices to meet data quality objectives; performing and reviewing audit reports; and preparing QA/QC reports, which include an evaluation of field and laboratory data and data usability reports, in accordance with EPA guidelines. Contract value: $13.5MM

USAEC PFAS Program

Senior program chemist responsible for guiding and developing the UFP-QAPP compliant QA plan and providing technical guidance to the project chemist for laboratory and method selection focused on PFAS, as well as interpreting environmental data for the project team. The work on this project included the evaluation of PFAS analysis in all matrices water, soil, sediments, and air. Development data validation procedure as the analytical method and agency QA/QC requirements evolves to assess analytical results to ensure results meet the Site DQOs. Contract value: $__

Project Experience Continued

Mayflower Pipeline

Confidential Oil & Gas Client, Mayflower, Arkansas

Served as the IM/DV Lead and overall project chemist for the incident response team. Role required staffing of information management and data visualization professionals, scheduling for round the clock coverage for data management, GIS, and chemistry tasks. Also managing communications with laboratories for quality issues and assisting response team with planning and generating required tables/figures for submission to client and regulatory agencies. The response also required large amount of data validation and many meetings with the laboratories and audits to assess the laboratories.

Silvertip Yellowstone River Oil Spill

Confidential Oil & Gas Client, Montana

Served as the IM/DV Lead and overall project chemist for the incident response team. Role required staffing of information management and data visualization professionals, scheduling for round the clock coverage for data management, GIS, and chemistry tasks. Also managing communications with laboratories for quality issues and assisting response team with planning and generating required tables/figures for submission to client and regulatory agencies. The response also required large amount of data validation and many meetings, and site visits at the laboratories to cover mythology and quality issues.

Education

Civil Engineering, Bachelors of Science, 2010
Clarkson University,
Potsdam, New York

Environmental Engineering, Bachelors of Science, 2010
Clarkson University,
Potsdam, New York

Years of Experience

Total – 15.0
With ARCADIS – 14.0

Certifications

40-Hour HAZWOPPER, per 29 CFR1910.120

8-hour OSHA HAZWOPER Refresher Training

OSHA HAZWOPER Site Supervisor

OSHA 30hr Construction Safety

DOT/IATA Hazardous materials Shipping and Transportation

RCRA Hazerdous Waste Manifesting

LPS Certification

American Heart Association Certified in CPR, AED, First Aid, and Bloodborne Pathogens

Professional Associations

American Society for Civil Engineers (ASCE)

Quinn R. Carnahan EIT

Project Environmental Engineer

Mr. Carnahan has over fourteen years of experience with environmental and civil projects for major industrial and municipal clients. He is an Environmental Engineer in ARCADIS' Rochester, New York office, specializing on vapor intrusion investigation, sub-slab depressurization system design and implementation, environmental compliance, remediation projects, site investigations, remediation oversight, construction oversight, site health and safety, industrial deconstruction projects, and cost estimate/proposal development. He has performed an active role on a variety of projects across multiple divisions in Arcadis, working closely with the water group, construction services, and remediation. He has a well-rounded, experienced with managing Arcadis staff and contractors on small to large projects, working closely with government agencies, clients and the public, performing material and environmental sampling, analysis, investigations, site assessments, contractor oversight, permitting and reporting.

Sub-slab Depressurization System

Residential SSD System Installation Livonia MI
Confidential Client, Livonia Michigan
2019 – 2024

Supported vapor intrusion investigation at over thirty residential properties based on historic groundwater VOC impacts from a neighboring active industrial facility. Supported vapor intrusion sampling at residential properties. Conducted a pre-design property inspection at residential properties. Completed SSD system pilot testing, SSD system designs, contractor oversight, and field engineering support at each residential property. Successfully completed construction of the SSD systems and system modifications where needed. Completed system startup, regulatory compliance sampling and annual system performance monitoring. Continued to support routine OMM and compliance sampling activities at the SSD systems. Providing on going engineering support for quarterly and annual agency reporting, developed OMM manual for homeowners.

Commercial SSD System Installations at Multiple Laundry Facilities
Confidential Client, Rockford and Schaumburg IL
2020 – 2024

Supported vapor intrusion investigation at three active commercial laundry facility based on historic dry-cleaning operations. At each facility, conducted sub-slab depressurization (SSD)

system pilot testing at the facility to determine the full-scale system design to cover impacted sub-slab soil. Completed SSD system calculations, designed SSD system with carbon treatment, finalized construction specification documents, and bidder packages. Construction management of contractors for centralized blower system fabrication and onsite piping network. Successfully completed construction of the SSD systems, completed system startup, and regulatory compliance sampling. Continued to support routine OMM and compliance sampling activities at the SSD systems.

Commercial SSD System Installation at Laundry Facility
Confidential Client, Manchester IL
2021 – 2024

Provided engineering oversight and construction management of contractors for the installation of an SSD system at an active commercial laundry facility. SSD system consisted of multiple suction points with inline fans installed on the roof of the facility. Conducted vapor intrusion pathway investigation and sealing off pathways throughout the facility. Successfully completed construction of the SSD system, completed system startup, and performance monitoring. Continued to support routine OMM and compliance performance monitoring at the SSD system.

Commercial SSD System Design and Installation
GTE Operational Support Incorporated, Seneca Falls New York
2014 – 2024

Contributed to the continued expansion of the existing Sub-slab Depressurization Systems (SSDS) at a commercial facility with historic VOC impacts. Provided engineering support, construction oversight and design verification to multiple contractors during multiple phases of expansion scope, including pilot testing, construction, start-up, and operation. The new SSDS include two large combined systems for a total of 22 extraction points, as well as single inline fans single extraction point systems. Activities involved with include electrical installation and upgrades, piping, and mechanical installation. Involvement in this project includes roles both in the field and office consisting of; project planning, system design, procurement, engineering oversight, VI investigation, utility investigation, health and safety, and agency reporting. Proficient at operating and troubleshooting SSD systems at this facility and vapor intrusion investigation.

Impacted Residential Investigations

Hoosick Falls NY
NYSDEC Region 4, New York State Department of Environmental Conservation, Hoosick Falls New York
May – August 2016

The Hoosick Falls investigation began with the collection of well water samples from residential properties in a rural county in NY. This large-scale investigation looked for the presence of PFOAs in private drinking water wells at over 1,000 private properties. Involvement in this project included the leading and management of sampling teams for residential, commercial, and agricultural property, coordinating Arcadis and contractor staff for the installation of water treatment systems at private properties. This investigation required close communication and cooperation with NYS agency staff, residents, and contractors working for Arcadis and the state.

Middleport NY Offsite Unit 6 and Eco Investigation
FMC, Middleport, New York
August – November 2016

The Middleport investigation consisted of a large scale two-phase investigation of residential property for the presence of RCRA metal, pesticides and herbicides from a nearby chemical manufacturing company. The investigation included the collection of soil borings from a slide-hammer macro core sampler. Preformed field management, coordination activities, and sampling during the investigation of over private residential properties, city right-of-ways, and NY state property. The investigation included working with the other project teams in the collection of environmental samples including food web organisms. Involved with the sample collection and tracking for each parcel, collected data and developed detailed maps and documentation for the investigation records.

Corning Offsite Unit 5 Investigation
NYSDEC Region 8, New York State Department of Environmental Conservation, Corning New York
2015

The Corning investigation consisted of a large scale residential neighborhood investigation to determine the presence and extent of subsurface target fill from historic glass and ash dumps. Subsurface boring and surface samples were collected for analysis of suspected constituents of concern. Frequent communications with the property owners was necessary for permission and access to the property as well as any historic information that could aid in the investigation and sampling efforts.

Preformed field management and coordination activities of drilling subcontractors during the investigation of over 100 private residential properties, city right-of-ways, and NY state DOT property. Involved with the sample collection and tracking for each parcel, collected GPS data and developed detailed maps and documentation for the investigation records. Worked closely with DEC field staff representative and DEC project manager during the entirety of the field investigation. Involvement continued with the development of site cross-section profiles and the

site characterization report for the NYSDEC.

Industrial Facility Remediation

Aviation ATF Facility
GE Aviation, General Electric Co., Cincinnati Ohio
2012 – 2014

Involvement on this project consisted of roles both in the field and the office consisting of: primary sampling investigation of a TSCA contaminate in an active industrial manufacturing facility, assisting with the design of a remedial action work plan, implementation of remediation and reconstruction activities of the manufacturing facility. Field activities included oversight and management of multiple companies working on site, project status monitoring, record keeping of site activities, and coordination of multiple contractor parties involved with different phases of demolition, remediation, and reconstruction of the facility. Tasked with the role of supervision and monitoring of remedial activities in accordance with TSCA regulations and agency agreements. Involved with continuously documenting project activities on behalf of the client, involvement with reporting and record keeping mandated by governing agency agreements.

Involved with the managing of project finances, executing contractor purchase orders, coordinating task budgets, and onsite health and safety of all workers. Coordinated with others for TSCA material management during removals and remediation; managed TSCA disposal and reducing health and environmental impacts. Frequently involved with client meetings, discussions, and project decision making.

Industrial Facility Remediation and Closure
Ashland-Hercules, Hattiesburg MS
2014 – 2016

Involved with the development of a proposal for additional investigation and sampling activities of a contaminated impoundment basin. Coordinated subcontractor bids for field investigation, drafted project documents. Conducted a subsurface instigation for historic infrastructure on the property to identify potential sources of chemicals or process wastes.

Through multiple phases of the remedial project, field involvement included the impoundment basin sludge dewatering, remediation, and disposal activities; remediation of chemical process tank liquids; and large waste water tank sludge remediation. Coordinated and managed the onsite air monitoring equipment and reporting roles. Assisted with construction monitoring and coordination of multiple site activities and contractors occurring on the industrial property. Tracking waste accumulation and shipments, whiling following PES regulations on hold times

and shipments for hazardous waste.

Construction Health & Safety Monitoring

Grove City UX Facility
GE Transportation, General Electric Co., Grove City PA
2015

Provided Environmental Health and Safety oversight, at an active industrial manufacturing facility during the construction of a new multi-million dollar clean room manufacturing assembly line. Responsible for waste coordination, construction monitoring, health & safety monitoring and inspections of multiple contractors through the entire renovation and construction project.

Remedial Investigation and Design

Former Philips Display Facility – Seneca Falls NY
GTEOSI, Seneca Falls NY
2014 - 2015

Contributed to the investigation and design of additional Sub Slab Depressurization Systems for the reduction of sub surface and indoor VOC levels. Provided onsite management and direction of contractor activities during the installation of the remedial design phase. Responsible for field implementation during construction and overall health and safety of the contractor. Conducted periodic O&M responsibilities of the sub slab depressurization system and quarterly sampling events.

Emergency Spill Response and Investigation

CSX Main Line - Bergen NY
CSX Transportation, Bergen NY
2014 - 2015

Responded to an emergency call of a diesel fuel release from a freight train. Assisted with the field investigation, monitoring of surface waterways, subsurface investigation with a Geoprobe rig, and installation of monitoring wells. Provided the client with continued periodic site inspections and monitoring for the diesel fuel. Coordinated the proposal of a surface treatment for the spill area, managed contractor bids and sourcing.

D4 Facility Demolition

Bridgeport Site & Seaview Avenue Site
General Electric Co., Bridgeport Connecticut
2012

Field assignment consisting of: oversight, contractor management, activity coordination, air and environmental monitoring/reporting, and energy impact recording/reporting. Daily oversight of multiple contractors performing deconstruction activities at multiple project stages between two sites. Primary site activities consisted of environmental removals, general deconstruction, and remediation. Inspections and deconstruction monitoring preformed on; contractor work progress, coordinated manifesting, and documenting of waste shipments. Supplied daily, weekly, and end of phase reporting and documentation of site activities, progress and proposed work plans to the client, agencies, and subcontractors.

Site air monitoring was conducted prior to site activities for background data and during deconstruction activities due to the close proximity of the site to residential homes. The air monitoring included coordinating particulate monitoring equipment up and down wind, adjusting locations with site activities and the prevailing weather. Provided data management and compiling from the air monitoring, dust generatoring activities, and the onsite weather station. Created daily logs and reports, archived all data for agency inspections to the site resulting from frequent community concerns.

Provided comprehensive daily, weekly, and monthly reporting of energy impact tracking relating to site activities. Reporting included: material usage, fuel consumption, deliveries, transportation, visitors and site employee commutes. Reports submitted to the client and government agencies.

Nile-Mahoning, Trumbull & Youngstown Ohio
General Electric Co., Youngstown Ohio
2011& 2013

2011: Pre demolition phase activities for the investigation and analysis of current condition and scope of removal activities of a vacant contaminated industrial manufacturing facility. Conducted entire building characterization sampling, universal waste, regulated materials (TSCA and RCRA materials), and building material quantity estimates for pre removal and pre demolition activities.

Coordinated and preformed field activities at three different facilities. Activities completed: TSCA and RCRA sampling, documentation, material estimates and reporting from the different sites

over a four month time frame. Modify and complete site specific health and safety documents. Daily, weekly and end of phase reporting and documentation of site activities, progress and proposed work plans. Contributed to the development of phase completion reports and submission of collected and analyzed data to the client. Satisfied the client by exceeding expectations with the amount and quality of data returned.

2013: Provided oversight and site management of multiple contractors during environmental removals phase prior to facility demolition of work activities on behalf of the client and property owner. Involved directly on site in the site health and safety role, project management, and reporting role directly from the field.

GE Canada - Building 18 Dismantlement
General Electric Canada, Toronto Ontario Canada
2010-2011

Pre dismantlement investigations of a vacant contaminated industrial manufacturing facility, TSCA sampling and delineation activities, organized and coordinate dismantlement phase between the client and subcontractors. Institute environmental, noise, and vibration protection for neighboring properties during active dismantlement work. Involved with the transition to active dismantlement site activities with environmental monitoring and protection policies in place. Post dismantlement site transition to the new owner and for reuse of the property.

Aided in the development of work plans, sequence-methodology plans, agency, regulatory permits and documentation for activities on site (Agencies: Ministry of Environment, Toronto Public Health). Preformed building material sampling for reduction of contaminated material disposal. Provided material estimates for waste stream analysis. Compiled reports and estimations for waste and removal contracts. Developed figures, price estimates, progress reports, and completion reports through various phases of the project. Satisfied the client by providing a methodology for reducing the amount of hazardous building material previously planned for disposal, which resulted in a decreased transportation and disposal cost.

National Pollution Discharge Elimination System (NPDES) Permit
General Electric – Pittsfield Massachusetts
2010-2013

Involvement consists of numerous phases of work required to comply with the clients NPDES Permit.
Remediation Oversight – Provided project oversight of on-site remediation efforts related to water treatment structures. Responsibilities included written and photo documentation of construction activities and working as a liaison between the client and contractors.
Facility Oversight – Performed sampling activities and subsequent monitoring activities associated with agency permits and consent decrees.

Agency Reporting – Assisted in development of studies and reports submitted to state and federal agencies to demonstrate permit compliance. Aided in developing plans for implementation to reduce the effect of discharges on surface water.

Providence Street Sewer Reconstruction
Ashland-Hercules – Hattiesburg Mississippi
2014

Involvement on this project consists of coordinating community air monitoring activities during active demolition of the existing sewer line, and construction of the new sewer line in contaminated soil and groundwater. Air monitoring preformed on the perimeter of construction activities in the residential neighborhood, as well as mobile monitoring positioned at the construction work. Due to the constituents of concern present in the subsurface and water table, air monitoring was necessary for the protection of the public and all staff during the construction work. Daily reports were created with the multiple sources of information and data from the day's activities and air monitoring.

Industrial Impoundment Basin Closure and Remediation
Ashland-Hercules – Hattiesburg Mississippi
2015

Involvement on this project consists of coordinating community air monitoring activities during the dewatering, solidification, and removal of contaminated and hazardous sludge from the impoundment basin. Air monitoring conducted at the perimeter of construction activities in the residential neighborhood, as well as mobile monitoring positioned at the construction work. Due to the constituents of concern present in the sludge, air monitoring was necessary for the protection of the public and all staff during the construction work. Daily reports were created with the multiple sources of information and data from the day's activities and air monitoring.

Conducted an investigation and documentation of the industrial sewer system and stormwater sewer system throughout the industrial facility. Collected sediment samples in various structures of the industrial sewer system prior to sediment removal, cleaning, and abandoning.

Additional Experience

Confidential Client (Tyler TX)
- SSD Pilot Test
- SSD System Construction Oversight
- SSD System Engineering Support

General Electric Co. (Pittsfield MA):
- NPDES: Dry/Wet Weather Sampling/Analysis/Reporting
- Discharge Wet Weather Sampling Events
- Development of Storm Water Pollution Prevention Plans (SWPPPs)
- Oil Water Separator Inspections/Cleaning Contractor Oversight
- Water Treatment Plant – Capability Study Reporting
- Water Treatment Plant – Optimization Study Reporting
- Water Treatment Plant – Method Detection Limit Study Reporting
- Yearly River/Outfall Sampling Events
- Bi-yearly Groundwater Sampling Events

General Electric Aviation (Cincinnati OH):
- Building 500 Cell 1 Interior Demolition – Final Completion Report
- Building 500 Cell 1 Build-out – Sampling, Contractor Monitoring, Project Reporting
- North Master Substation – Soil Investigation, sampling, and TSCA Excavation

General Electric Co. (Elkton MD) – Site Investigation, RCRA Material Sampling, and Reporting

General Electric Co. (Newcomerstown OH) – Site Investigation and TSCA Material/Building Sampling

UTC (Cromwell CT) – RFP and Construction Specification Development

3M Dynacolor (Brockport NY)
- Groundwater remediation through injections
- Treatment Solution Installation/Construction Oversight
- Groundwater Sampling Events

Lockheed Martin (Syracuse NY) – Waste Water/Oil Grease Treatment Analysis & Design

Impact Technologies (Rochester NY & State College PA)
- Environmental Audit
- Solid Waste Sampling & Analysis



Quinn R. Carnahan EIT

Project Environmental Engineer

CSX Goodman Yard (Rochester NY) – Historic Spill Investigation

NYSEG Dansville (Danville NY) – CAMP (Community Air Monitoring Program) & Construction Oversight

GTEOSI Seneca Falls NY

- OMM of subsurface vapor air systems (SSD)
- VMP and indoor air monitoring and sampling
- Indoor air investigation, VMP installation
- VOC screening and investigation of source pathways
- Groundwater sampling events

ADAM SVENSSON

GEOLOGIST II

EDUCATION

BS, Geological Sciences, State University at Buffalo, New York, 2018

YEARS OF EXPERIENCE

6

SPECIALIZED TRAINING

HAZWOPER 40-Hour Safety Training
OSHA 30-Hour Supervisor Training
OSHA 10-Hour Construction Industry Outreach Safety Training
APNGA Portable Nuclear Density Gauge Safety & USDOT HAZMAT Certification
NYSDOL Asbestos Project Monitor and Air Sampling Technician
GSSI Trained in the Theory and Practice of Applying GPR in Engineering and Geophysical Investigations

Mr. Svensson joined Arcadis with 2 years of professional experience as a geologist and technician at various locations in Western New York. He is competent at drilling oversight, well installation oversight, soil classification, well monitoring and sampling, remediation system OM&M and waste manifesting.

Project Experience

Geologist

Arcadis, Inc., Buffalo, NY

4 years' experience of drilling oversight, well installation oversight, soil logging, ground water sampling, sewer sampling, and remediation system OM&M on the following project sites:

Confidential Client

Northeast United States

Performed confirmation soil sampling and logging at a train derailment site. Led a team of field staff to assist with sampling procedures while under the scrutiny of the state environmental regulatory body.

Various Projects

Western New York

Performed drilling oversight, well installation oversight and soil logging for multiple projects in the Western New York region at various site locations.

Confidential Client

Upstate New York

Performed groundwater sampling and well gaging, assisted with packing and shipment of time sensitive samples to maintain compliance with analytical procedures.

CSX Train Yards

Buffalo, New York

Field lead for monthly, quarterly, semiannual and annual sampling events and inspections at four train yard locations in order for the client to remain in compliance with DEC regulations. Responsible for obtaining all equipment, analytical bottleware and independently conducted each event.

Project Experience Continued

Former MGP Site
Southern New York
Performed groundwater sampling and well gaging, assisted with packing and shipment of time sensitive samples to maintain compliance with analytical procedures.

Confidential Client
Jamestown, New York
Assistant of the field lead for collection of groundwater and vapor samples from site wells and remediation system influent and effluent. Routine OM&M performed monthly to ensure proper operation of the AS/SVE remediation system in place at this facility.

Confidential Client
Cheektowaga, New York
Assistant of the field lead for collection of groundwater and vapor samples from site wells and remediation system sample locations. Routine OM&M performed monthly to ensure proper operation of the AS/SVE remediation system in place at this facility.

DEC DOW Sewershed Characterization
Buffalo, New York
Assisted in the collection of sewer water samples at 12 sewer drains located around Buffalo, NY. These samples were to be used in a study conducted by the University of Buffalo and the Department of Health on the characteristics of the COVID-19 virus.

Confidential Client
Attica, New York
Field lead for monthly groundwater sampling events at a spill site on private agricultural land. Samples are taken monthly to delineate, assess and mitigate the extent of the affected area. Responsible for obtaining all equipment, analytical bottleware and independently conducted each event.

Confidential Client
Olean, NY
Oversight of a subsurface investigation project involving advancement of 40 boreholes using a sonic drilling rig in Olean, NY. Logged, characterized, and collected soil for analytical analysis from core-barrel samples. Managed field instrument calibration and sample shipping logistics where analytical test required less than 48-hour hold time to be compliant/valid.

Attachment 2

Analytical Method Detection and Reporting Limits

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Volatile Organic Compounds by GC/MS						
EPA 8260C	Soil	1,1,1-Trichloroethane	71-55-6	0.363	5.00	ug/Kg
EPA 8260C	Soil	1,1-Dichloroethane	75-34-3	0.610	5.00	ug/Kg
EPA 8260C	Soil	1,1-Dichloroethene	75-35-4	0.612	5.00	ug/Kg
EPA 8260C	Soil	1,2,4-Trimethylbenzene	95-63-6	0.960	5.00	ug/Kg
EPA 8260C	Soil	1,2-Dichlorobenzene	95-50-1	0.391	5.00	ug/Kg
EPA 8260C	Soil	1,2-Dichloroethane	107-06-2	0.251	5.00	ug/Kg
EPA 8260C	Soil	1,3,5-Trimethylbenzene	108-67-8	0.322	5.00	ug/Kg
EPA 8260C	Soil	1,3-Dichlorobenzene	541-73-1	0.257	5.00	ug/Kg
EPA 8260C	Soil	1,4-Dichlorobenzene	106-46-7	0.700	5.00	ug/Kg
EPA 8260C	Soil	1,4-Dioxane	123-91-1	21.8	100	ug/Kg
EPA 8260C	Soil	2-Butanone (MEK)	78-93-3	1.83	25.0	ug/Kg
EPA 8260C	Soil	Acetone	67-64-1	4.21	25.0	ug/Kg
EPA 8260C	Soil	Benzene	71-43-2	0.245	5.00	ug/Kg
EPA 8260C	Soil	Carbon tetrachloride	56-23-5	0.484	5.00	ug/Kg
EPA 8260C	Soil	Chlorobenzene	108-90-7	0.660	5.00	ug/Kg
EPA 8260C	Soil	Chloroform	67-66-3	0.309	5.00	ug/Kg
EPA 8260C	Soil	cis-1,2-Dichloroethene	156-59-2	0.640	5.00	ug/Kg
EPA 8260C	Soil	Ethylbenzene	100-41-4	0.345	5.00	ug/Kg
EPA 8260C	Soil	Methyl tert-butyl ether	1634-04-4	0.491	5.00	ug/Kg
EPA 8260C	Soil	Methylene Chloride	75-09-2	2.30	5.00	ug/Kg
EPA 8260C	Soil	n-Butylbenzene	104-51-8	0.435	5.00	ug/Kg
EPA 8260C	Soil	N-Propylbenzene	103-65-1	0.400	5.00	ug/Kg
EPA 8260C	Soil	sec-Butylbenzene	135-98-8	0.435	5.00	ug/Kg
EPA 8260C	Soil	tert-Butylbenzene	98-06-6	0.520	5.00	ug/Kg
EPA 8260C	Soil	Tetrachloroethene	127-18-4	0.671	5.00	ug/Kg
EPA 8260C	Soil	Toluene	108-88-3	0.378	5.00	ug/Kg
EPA 8260C	Soil	trans-1,2-Dichloroethene	156-60-5	0.516	5.00	ug/Kg
EPA 8260C	Soil	Trichloroethene	79-01-6	1.10	5.00	ug/Kg
EPA 8260C	Soil	Vinyl chloride	75-01-4	0.610	5.00	ug/Kg
EPA 8260C	Soil	Xylenes, Total	1330-20-7	0.840	10.0	ug/Kg

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Semivolatile Organic Compounds (GC/MS)						
EPA 8270D	Soil	1,4-Dioxane	123-91-1	55.0	100	ug/Kg
EPA 8270D	Soil	2-Methylphenol	95-48-7	20.0	170	ug/Kg
EPA 8270D	Soil	3-Methylphenol	108-39-4	26.0	330	ug/Kg
EPA 8270D	Soil	4-Methylphenol	106-44-5	20.0	330	ug/Kg
EPA 8270D	Soil	Acenaphthene	83-32-9	25.0	170	ug/Kg
EPA 8270D	Soil	Acenaphthylene	208-96-8	22.0	170	ug/Kg
EPA 8270D	Soil	Anthracene	120-12-7	42.0	170	ug/Kg
EPA 8270D	Soil	Benzo[a]anthracene	56-55-3	17.0	170	ug/Kg
EPA 8270D	Soil	Benzo[a]pyrene	50-32-8	25.0	170	ug/Kg
EPA 8270D	Soil	Benzo[b]fluoranthene	205-99-2	27.0	170	ug/Kg
EPA 8270D	Soil	Benzo[g,h,i]perylene	191-24-2	18.0	170	ug/Kg
EPA 8270D	Soil	Benzo[k]fluoranthene	207-08-9	22.0	170	ug/Kg
EPA 8270D	Soil	Chrysene	218-01-9	38.0	170	ug/Kg
EPA 8270D	Soil	Dibenz(a,h)anthracene	53-70-3	30.0	170	ug/Kg
EPA 8270D	Soil	Dibenzofuran	132-64-9	20.0	170	ug/Kg
EPA 8270D	Soil	Fluoranthene	206-44-0	18.0	170	ug/Kg
EPA 8270D	Soil	Fluorene	86-73-7	20.0	170	ug/Kg
EPA 8270D	Soil	Hexachlorobenzene	118-74-1	23.0	170	ug/Kg
EPA 8270D	Soil	Indeno[1,2,3-cd]pyrene	193-39-5	21.0	170	ug/Kg
EPA 8270D	Soil	Naphthalene	91-20-3	22.0	170	ug/Kg
EPA 8270D	Soil	Pentachlorophenol	87-86-5	170	330	ug/Kg
EPA 8270D	Soil	Phenanthrene	85-01-8	25.0	170	ug/Kg
EPA 8270D	Soil	Phenol	108-95-2	26.0	170	ug/Kg
EPA 8270D	Soil	Pyrene	129-00-0	20.0	170	ug/Kg
EPA 8270D	Soil	2,4,6-Tribromophenol (Surr)	118-79-6		0.000	ug/Kg
Metals (ICP)						
EPA 6010C	Soil	Arsenic	7440-38-2	0.880	2.00	mg/Kg
EPA 6010C	Soil	Barium	7440-39-3	0.140	0.500	mg/Kg
EPA 6010C	Soil	Beryllium	7440-41-7	0.0400	0.200	mg/Kg
EPA 6010C	Soil	Cadmium	7440-43-9	0.0700	0.200	mg/Kg
EPA 6010C	Soil	Chromium	7440-47-3	0.360	0.500	mg/Kg
EPA 6010C	Soil	Copper	7440-50-8	0.570	1.00	mg/Kg
EPA 6010C	Soil	Lead	7439-92-1	0.460	1.00	mg/Kg
EPA 6010C	Soil	Manganese	7439-96-5	0.280	1.00	mg/Kg

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Metals (ICP) (continued)						
EPA 6010C	Soil	Nickel	7440-02-0	0.250	5.00	mg/Kg
EPA 6010C	Soil	Selenium	7782-49-2	0.800	4.00	mg/Kg
EPA 6010C	Soil	Silver	7440-22-4	0.200	0.600	mg/Kg
EPA 6010C	Soil	Zinc	7440-66-6	1.02	2.00	mg/Kg
EPA 7196A	Soil	Cr (VI)	18540-29-9	0.848	2.00	mg/Kg
EPA 3500_CR3_D	Soil	Cr (III)	16065-83-1	0.630	1.50	mg/Kg
EPA 3500_CR3_D	Soil	Cr	7440-47-3	0.0900	0.500	mg/Kg
EPA 3500_CR3_D	Soil	Cr (VI)	18540-29-9	0.630	1.50	mg/Kg
EPA 9012B	Soil	Cyanide, Total	57-12-5	0.483	1.00	mg/Kg
EPA 7471B	Soil	Mercury	7439-97-6	0.00460	0.0200	mg/Kg
Organochlorine Pesticides (GC)						
EPA 8081B	Soil	4,4'-DDD	72-54-8	0.324	1.67	ug/Kg
EPA 8081B	Soil	4,4'-DDE	72-55-9	0.350	1.67	ug/Kg
EPA 8081B	Soil	4,4'-DDT	50-29-3	0.390	1.67	ug/Kg
EPA 8081B	Soil	Aldrin	309-00-2	0.410	1.67	ug/Kg
EPA 8081B	Soil	alpha-BHC	319-84-6	0.300	1.67	ug/Kg
EPA 8081B	Soil	beta-BHC	319-85-7	0.300	1.67	ug/Kg
EPA 8081B	Soil	cis-Chlordane	5103-71-9	0.830	1.67	ug/Kg
EPA 8081B	Soil	delta-BHC	319-86-8	0.310	1.67	ug/Kg
EPA 8081B	Soil	Dieldrin	60-57-1	0.400	1.67	ug/Kg
EPA 8081B	Soil	Endosulfan I	959-98-8	0.320	1.67	ug/Kg
EPA 8081B	Soil	Endosulfan II	33213-65-9	0.300	1.67	ug/Kg
EPA 8081B	Soil	Endosulfan sulfate	1031-07-8	0.311	1.67	ug/Kg
EPA 8081B	Soil	Endrin	72-20-8	0.330	1.67	ug/Kg
EPA 8081B	Soil	gamma-BHC (Lindane)	58-89-9	0.306	1.67	ug/Kg
EPA 8081B	Soil	Heptachlor	76-44-8	0.361	1.67	ug/Kg
Herbicides (GC)						
EPA 8151A	Soil	Silvex (2,4,5-TP)	93-72-1	6.00	16.7	ug/Kg
Polychlorinated Biphenyls (PCBs) by Gas Chromatography						
EPA 8082A	Soil	PCB-1016	12674-11-2	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1221	11104-28-2	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1232	11141-16-5	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1242	53469-21-9	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1248	12672-29-6	0.0489	0.250	mg/Kg

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Polychlorinated Biphenyls (PCBs) by Gas Chromatography (continued)						
EPA 8082A	Soil	PCB-1254	11097-69-1	0.117	0.250	mg/Kg
EPA 8082A	Soil	PCB-1260	11096-82-5	0.117	0.250	mg/Kg
Per- and Polyfluoroalkyl Substances by LC/MS/MS						
EPA 1633	Soil	13C2 PFTeDA	STL02116		0.313	ug/Kg
EPA 1633	Soil	13C2-PFDoDA	STL02703		0.313	ug/Kg
EPA 1633	Soil	13C3 HFPO-DA	STL02255		2.50	ug/Kg
EPA 1633	Soil	13C3 PFBS	STL02337		0.583	ug/Kg
EPA 1633	Soil	13C3 PFHxS	STL02581		0.593	ug/Kg
EPA 1633	Soil	13C4 PFBA	STL00992		2.50	ug/Kg
EPA 1633	Soil	13C4 PFHpA	STL01892		0.625	ug/Kg
EPA 1633	Soil	13C5 PFHxA	STL02577		0.625	ug/Kg
EPA 1633	Soil	13C5 PFPeA	STL01893		1.25	ug/Kg
EPA 1633	Soil	13C6 PFDA	STL02579		0.313	ug/Kg
EPA 1633	Soil	13C7 PFUnA	STL02580		0.313	ug/Kg
EPA 1633	Soil	13C8 PFOA	STL01052		0.625	ug/Kg
EPA 1633	Soil	13C8 PFOS	STL01054		0.600	ug/Kg
EPA 1633	Soil	13C8 PFOSA	STL01056		0.625	ug/Kg
EPA 1633	Soil	13C9 PFNA	STL02578		0.313	ug/Kg
EPA 1633	Soil	1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	0.200	0.800	ug/Kg
EPA 1633	Soil	1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	0.200	0.800	ug/Kg
EPA 1633	Soil	d3-NMeFOSAA	STL02118		1.25	ug/Kg
EPA 1633	Soil	d5-NEtFOSAA	STL02117		1.25	ug/Kg
EPA 1633	Soil	M2-4:2 FTS	STL02395		1.17	ug/Kg
EPA 1633	Soil	M2-6:2 FTS	STL02279		1.19	ug/Kg
EPA 1633	Soil	M2-8:2 FTS	STL02280		1.20	ug/Kg
EPA 1633	Soil	N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.0500	0.200	ug/Kg
EPA 1633	Soil	N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorobutanoic acid (PFBA)	375-22-4	0.200	0.800	ug/Kg
EPA 1633	Soil	Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorodecanoic acid (PFDA)	335-76-2	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorododecanoic acid (PFDoA)	307-55-1	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0500	0.200	ug/Kg

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Per- and Polyfluoroalkyl Substances by LC/MS/MS (continued)						
EPA 1633	Soil	Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorohexanoic acid (PFHxA)	307-24-4	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorononanoic acid (PFNA)	375-95-1	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorooctanesulfonamide (PFOSA)	754-91-6	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorooctanoic acid (PFOA)	335-67-1	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluoropentanoic acid (PFPeA)	2706-90-3	0.100	0.400	ug/Kg
EPA 1633	Soil	Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0500	0.200	ug/Kg
EPA 1633	Soil	Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.0500	0.200	ug/Kg
Volatile Organic Compounds by GC/MS						
EPA 8260C	Water	1,1,1-Trichloroethane	71-55-6	0.820	1.00	ug/L
EPA 8260C	Water	1,1-Dichloroethane	75-34-3	0.380	1.00	ug/L
EPA 8260C	Water	1,1-Dichloroethene	75-35-4	0.290	1.00	ug/L
EPA 8260C	Water	1,2,4-Trimethylbenzene	95-63-6	0.750	1.00	ug/L
EPA 8260C	Water	1,2-Dichlorobenzene	95-50-1	0.790	1.00	ug/L
EPA 8260C	Water	1,2-Dichloroethane	107-06-2	0.210	1.00	ug/L
EPA 8260C	Water	1,3,5-Trimethylbenzene	108-67-8	0.770	1.00	ug/L
EPA 8260C	Water	1,3-Dichlorobenzene	541-73-1	0.780	1.00	ug/L
EPA 8260C	Water	1,4-Dichlorobenzene	106-46-7	0.840	1.00	ug/L
EPA 8260C	Water	1,4-Dioxane	123-91-1	9.32	40.0	ug/L
EPA 8260C	Water	2-Butanone (MEK)	78-93-3	1.32	10.0	ug/L
EPA 8260C	Water	Acetone	67-64-1	3.00	10.0	ug/L
EPA 8260C	Water	Benzene	71-43-2	0.410	1.00	ug/L
EPA 8260C	Water	Carbon tetrachloride	56-23-5	0.270	1.00	ug/L
EPA 8260C	Water	Chlorobenzene	108-90-7	0.750	1.00	ug/L
EPA 8260C	Water	Chloroform	67-66-3	0.340	1.00	ug/L
EPA 8260C	Water	cis-1,2-Dichloroethene	156-59-2	0.810	1.00	ug/L
EPA 8260C	Water	Ethylbenzene	100-41-4	0.740	1.00	ug/L
EPA 8260C	Water	Methyl tert-butyl ether	1634-04-4	0.160	1.00	ug/L
EPA 8260C	Water	Methylene Chloride	75-09-2	0.440	1.00	ug/L
EPA 8260C	Water	n-Butylbenzene	104-51-8	0.640	1.00	ug/L
EPA 8260C	Water	N-Propylbenzene	103-65-1	0.690	1.00	ug/L
EPA 8260C	Water	sec-Butylbenzene	135-98-8	0.750	1.00	ug/L

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Volatile Organic Compounds by GC/MS (continued)						
EPA 8260C	Water	tert-Butylbenzene	98-06-6	0.810	1.00	ug/L
EPA 8260C	Water	Tetrachloroethene	127-18-4	0.360	1.00	ug/L
EPA 8260C	Water	Toluene	108-88-3	0.510	1.00	ug/L
EPA 8260C	Water	trans-1,2-Dichloroethene	156-60-5	0.900	1.00	ug/L
EPA 8260C	Water	Trichloroethene	79-01-6	0.460	1.00	ug/L
EPA 8260C	Water	Vinyl chloride	75-01-4	0.900	1.00	ug/L
EPA 8260C	Water	Xylenes, Total	1330-20-7	0.660	2.00	ug/L
EPA 8260C	Water	Dibromofluoromethane (Surr)	1868-53-7	0.100	5.00	ug/L
Semivolatile Organic Compounds (GC/MS)						
EPA 8270D	Water	1,4-Dioxane	123-91-1	1.10	10.0	ug/L
EPA 8270D	Water	2-Methylphenol	95-48-7	0.400	5.00	ug/L
EPA 8270D	Water	3-Methylphenol	108-39-4	0.400	10.0	ug/L
EPA 8270D	Water	4-Methylphenol	106-44-5	0.360	10.0	ug/L
EPA 8270D	Water	Acenaphthene	83-32-9	0.410	5.00	ug/L
EPA 8270D	Water	Acenaphthylene	208-96-8	0.380	5.00	ug/L
EPA 8270D	Water	Anthracene	120-12-7	0.280	5.00	ug/L
EPA 8270D	Water	Benzo[a]anthracene	56-55-3	0.360	5.00	ug/L
EPA 8270D	Water	Benzo[a]pyrene	50-32-8	0.470	5.00	ug/L
EPA 8270D	Water	Benzo[b]fluoranthene	205-99-2	0.340	5.00	ug/L
EPA 8270D	Water	Benzo[g,h,i]perylene	191-24-2	0.350	5.00	ug/L
EPA 8270D	Water	Benzo[k]fluoranthene	207-08-9	0.730	5.00	ug/L
EPA 8270D	Water	Chrysene	218-01-9	0.330	5.00	ug/L
EPA 8270D	Water	Dibenz(a,h)anthracene	53-70-3	0.420	5.00	ug/L
EPA 8270D	Water	Dibenzofuran	132-64-9	0.510	10.0	ug/L
EPA 8270D	Water	Fluoranthene	206-44-0	0.400	5.00	ug/L
EPA 8270D	Water	Fluorene	86-73-7	0.360	5.00	ug/L
EPA 8270D	Water	Hexachlorobenzene	118-74-1	0.510	5.00	ug/L
EPA 8270D	Water	Indeno[1,2,3-cd]pyrene	193-39-5	0.470	5.00	ug/L
EPA 8270D	Water	Naphthalene	91-20-3	0.760	5.00	ug/L
EPA 8270D	Water	Pentachlorophenol	87-86-5	2.20	10.0	ug/L
EPA 8270D	Water	Phenanthrene	85-01-8	0.440	5.00	ug/L
EPA 8270D	Water	Phenol	108-95-2	0.390	5.00	ug/L
EPA 8270D	Water	Pyrene	129-00-0	0.340	5.00	ug/L
Semivolatile Organic Compounds (GC/MS SIM / Isotope Dilution)						
EPA 8270D_SIM_MS_ID	Water	1,4-Dioxane	123-91-1	0.100	0.200	ug/L

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Metals (ICP)						
EPA 6010C	Water	Arsenic	7440-38-2	0.00555	0.0150	mg/L
EPA 6010C	Water	Barium	7440-39-3	0.000700	0.00200	mg/L
EPA 6010C	Water	Beryllium	7440-41-7	0.000300	0.00200	mg/L
EPA 6010C	Water	Cadmium	7440-43-9	0.000500	0.00200	mg/L
EPA 6010C	Water	Chromium	7440-47-3	0.00100	0.00400	mg/L
EPA 6010C	Water	Copper	7440-50-8	0.00160	0.0100	mg/L
EPA 6010C	Water	Lead	7439-92-1	0.00300	0.0100	mg/L
EPA 6010C	Water	Manganese	7439-96-5	0.000400	0.00300	mg/L
EPA 6010C	Water	Nickel	7440-02-0	0.00126	0.0100	mg/L
EPA 6010C	Water	Selenium	7782-49-2	0.00870	0.0250	mg/L
EPA 6010C	Water	Silver	7440-22-4	0.00170	0.00600	mg/L
EPA 6010C	Water	Zinc	7440-66-6	0.00150	0.0100	mg/L
EPA 9012B_NP	Water	Cyanide, Total	57-12-5	0.00410	0.0100	mg/L
EPA 7470A	Water	Mercury	7439-97-6	0.0000420	0.000200	mg/L
EPA 7196A	Water	Chromium, hexavalent	18540-29-9	0.00500	0.0100	mg/L
EPA 3500_CR3_D	Water	Cr (III)	16065-83-1	0.00600	0.0100	mg/L
EPA 3500_CR3_D	Water	Cr	7440-47-3	0.000870	0.00400	mg/L
EPA 3500_CR3_D	Water	Cr (VI)	18540-29-9	0.00600	0.0100	mg/L
Organochlorine Pesticides (GC)						
EPA 8081B	Water	4,4'-DDD	72-54-8	0.00920	0.0500	ug/L
EPA 8081B	Water	4,4'-DDE	72-55-9	0.0116	0.0500	ug/L
EPA 8081B	Water	4,4'-DDT	50-29-3	0.0110	0.0500	ug/L
EPA 8081B	Water	Aldrin	309-00-2	0.00810	0.0500	ug/L
EPA 8081B	Water	alpha-BHC	319-84-6	0.00770	0.0500	ug/L
EPA 8081B	Water	beta-BHC	319-85-7	0.0248	0.0500	ug/L
EPA 8081B	Water	cis-Chlordane	5103-71-9	0.0148	0.0500	ug/L
EPA 8081B	Water	delta-BHC	319-86-8	0.0100	0.0500	ug/L
EPA 8081B	Water	Dieldrin	60-57-1	0.00980	0.0500	ug/L
EPA 8081B	Water	Endosulfan I	959-98-8	0.0110	0.0500	ug/L
EPA 8081B	Water	Endosulfan II	33213-65-9	0.0120	0.0500	ug/L
EPA 8081B	Water	Endosulfan sulfate	1031-07-8	0.0157	0.0500	ug/L
EPA 8081B	Water	Endrin	72-20-8	0.0138	0.0500	ug/L
EPA 8081B	Water	gamma-BHC (Lindane)	58-89-9	0.00800	0.0500	ug/L
EPA 8081B	Water	Heptachlor	76-44-8	0.00850	0.0500	ug/L

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Herbicides (GC)						
EPA 8151A	Water	Silvex (2,4,5-TP)	93-72-1	0.0500	0.500	ug/L
Polychlorinated Biphenyls (PCBs) by Gas Chromatography						
EPA 8082A	Water	PCB-1016	12674-11-2	0.176	0.500	ug/L
EPA 8082A	Water	PCB-1221	11104-28-2	0.176	0.500	ug/L
EPA 8082A	Water	PCB-1232	11141-16-5	0.176	0.500	ug/L
EPA 8082A	Water	PCB-1242	53469-21-9	0.176	0.500	ug/L
EPA 8082A	Water	PCB-1248	12672-29-6	0.176	0.500	ug/L
EPA 8082A	Water	PCB-1254	11097-69-1	0.250	0.500	ug/L
EPA 8082A	Water	PCB-1260	11096-82-5	0.250	0.500	ug/L
Per- and Polyfluoroalkyl Substances by LC/MS/MS						
EPA 1633	Water	13C2 PFTeDA	STL02116		12.5	ng/L
EPA 1633	Water	13C2-PFDoDA	STL02703		12.5	ng/L
EPA 1633	Water	13C3 HFPO-DA	STL02255		100	ng/L
EPA 1633	Water	13C3 PFBS	STL02337		24.0	ng/L
EPA 1633	Water	13C3 PFHxS	STL02581		24.0	ng/L
EPA 1633	Water	13C4 PFBA	STL00992		100	ng/L
EPA 1633	Water	13C4 PFHpA	STL01892		25.0	ng/L
EPA 1633	Water	13C5 PFHxA	STL02577		25.0	ng/L
EPA 1633	Water	13C5 PFPeA	STL01893		5.00	ng/L
EPA 1633	Water	13C6 PFDA	STL02579		12.5	ng/L
EPA 1633	Water	13C7 PFUnA	STL02580		12.5	ng/L
EPA 1633	Water	13C8 PFOA	STL01052		25.0	ng/L
EPA 1633	Water	13C8 PFOS	STL01054		25.0	ng/L
EPA 1633	Water	13C8 PFOSA	STL01056		25.0	ng/L
EPA 1633	Water	13C9 PFNA	STL02578		12.5	ng/L
EPA 1633	Water	1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	2.00	8.00	ng/L
EPA 1633	Water	1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	2.00	8.00	ng/L
EPA 1633	Water	d3-NMeFOSAA	STL02118		50.0	ng/L
EPA 1633	Water	d5-NEtFOSAA	STL02117		50.0	ng/L
EPA 1633	Water	M2-4:2 FTS	STL02395		50.0	ng/L
EPA 1633	Water	M2-6:2 FTS	STL02279		50.0	ng/L
EPA 1633	Water	M2-8:2 FTS	STL02280		50.0	ng/L
EPA 1633	Water	N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.521	2.00	ng/L
EPA 1633	Water	N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.620	2.00	ng/L

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Per- and Polyfluoroalkyl Substances by LC/MS/MS (continued)						
EPA 1633	Water	Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.500	2.00	ng/L
EPA 1633	Water	Perfluorobutanoic acid (PFBA)	375-22-4	2.13	8.00	ng/L
EPA 1633	Water	Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.500	2.00	ng/L
EPA 1633	Water	Perfluorodecanoic acid (PFDA)	335-76-2	0.500	2.00	ng/L
EPA 1633	Water	Perfluorododecanoic acid (PFDoA)	307-55-1	0.500	2.00	ng/L
EPA 1633	Water	Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	0.500	2.00	ng/L
EPA 1633	Water	Perfluoroheptanoic acid (PFHpA)	375-85-9	0.500	2.00	ng/L
EPA 1633	Water	Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.517	2.00	ng/L
EPA 1633	Water	Perfluorohexanoic acid (PFHxA)	307-24-4	0.500	2.00	ng/L
EPA 1633	Water	Perfluorononanoic acid (PFNA)	375-95-1	0.500	2.00	ng/L
EPA 1633	Water	Perfluorooctanesulfonamide (PFOSA)	754-91-6	0.500	2.00	ng/L
EPA 1633	Water	Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.500	2.00	ng/L
EPA 1633	Water	Perfluorooctanoic acid (PFOA)	335-67-1	0.500	2.00	ng/L
EPA 1633	Water	Perfluoropentanoic acid (PFPeA)	2706-90-3	1.00	4.00	ng/L
EPA 1633	Water	Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.500	2.00	ng/L
EPA 1633	Water	Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.500	2.00	ng/L
EPA 1633	Water	Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.500	2.00	ng/L
EPA 1633_DRAFT_TSS	Water	Total Suspended Solids	STL00161	0.400	4.00	mg/L
Air						
TO15	Air	Dichlorodifluoromethane	75-71-8	0.544	2.47	ug/m3
TO15	Air	Chlorodifluoromethane	75-45-6	0.424	1.77	ug/m3
TO15	Air	1,2-Dichlorotetrafluoroethane	76-14-2	0.336	1.40	ug/m3
TO15	Air	Chloromethane	74-87-3	0.310	1.03	ug/m3
TO15	Air	n-Butane	106-97-8	0.475	1.19	ug/m3
TO15	Air	Vinyl chloride	75-01-4	0.0537	0.200	ug/m3
TO15	Air	1,3-Butadiene	106-99-0	0.0863	0.442	ug/m3
TO15	Air	Bromomethane	74-83-9	0.276	0.777	ug/m3
TO15	Air	Chloroethane	75-00-3	0.475	1.32	ug/m3
TO15	Air	Bromoethene(Vinyl Bromide)	593-60-2	0.219	0.875	ug/m3
TO15	Air	Trichlorofluoromethane	75-69-4	0.281	1.12	ug/m3
TO15	Air	1,1,2-Trichlorotrifluoroethane	76-13-1	0.406	1.53	ug/m3
TO15	Air	1,1-Dichloroethene	75-35-4	0.103	0.200	ug/m3
TO15	Air	Acetone	67-64-1	3.80	11.9	ug/m3
TO15	Air	Isopropyl alcohol	67-63-0	3.93	12.3	ug/m3

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Air (continued)						
TO15	Air	Carbon disulfide	75-15-0	0.405	1.56	ug/m3
TO15	Air	3-Chloropropene	107-05-1	0.376	1.57	ug/m3
TO15	Air	Methylene Chloride	75-09-2	0.625	1.74	ug/m3
TO15	Air	tert-Butyl alcohol	75-65-0	3.64	15.2	ug/m3
TO15	Air	Methyl tert-butyl ether	1634-04-4	0.130	0.721	ug/m3
TO15	Air	trans-1,2-Dichloroethene	156-60-5	0.0912	0.793	ug/m3
TO15	Air	n-Hexane	110-54-3	0.388	1.76	ug/m3
TO15	Air	1,1-Dichloroethane	75-34-3	0.101	0.809	ug/m3
TO15	Air	Methyl Ethyl Ketone (2-Butanone)	78-93-3	1.45	1.47	ug/m3
TO15	Air	cis-1,2-Dichloroethene	156-59-2	0.0833	0.200	ug/m3
TO15	Air	Bromochloromethane	74-97-5			ug/m3
TO15	Air	Chloroform	67-66-3	0.200	0.977	ug/m3
TO15	Air	Tetrahydrofuran	109-99-9	3.83	14.7	ug/m3
TO15	Air	1,1,1-Trichloroethane	71-55-6	0.240	1.09	ug/m3
TO15	Air	Cyclohexane	110-82-7	0.200	0.688	ug/m3
TO15	Air	Carbon tetrachloride	56-23-5	0.138	0.220	ug/m3
TO15	Air	2,2,4-Trimethylpentane	540-84-1	0.178	0.934	ug/m3
TO15	Air	Benzene	71-43-2	0.141	0.639	ug/m3
TO15	Air	1,2-Dichloroethane	107-06-2	0.376	0.809	ug/m3
TO15	Air	n-Heptane	142-82-5	0.225	0.820	ug/m3
TO15	Air	1,4-Difluorobenzene	540-36-3			ug/m3
TO15	Air	Trichloroethene	79-01-6	0.134	0.200	ug/m3
TO15	Air	Methyl methacrylate	80-62-6	0.573	2.05	ug/m3
TO15	Air	1,2-Dichloropropane	78-87-5	0.434	0.924	ug/m3
TO15	Air	1,4-Dioxane	123-91-1	0.296	18.0	ug/m3
TO15	Air	Bromodichloromethane	75-27-4	0.335	1.34	ug/m3
TO15	Air	cis-1,3-Dichloropropene	10061-01-5	0.204	0.908	ug/m3
TO15	Air	4-Methyl-2-pentanone (Methyl isobutyl ketone)	108-10-1	0.533	2.05	ug/m3
TO15	Air	Toluene	108-88-3	0.234	0.754	ug/m3
TO15	Air	trans-1,3-Dichloropropene	10061-02-6	0.245	0.908	ug/m3
TO15	Air	1,1,2-Trichloroethane	79-00-5	0.404	1.09	ug/m3
TO15	Air	Tetrachloroethene	127-18-4	0.142	1.36	ug/m3
TO15	Air	Methyl Butyl Ketone (2-Hexanone)	591-78-6	0.615	2.05	ug/m3
TO15	Air	Dibromochloromethane	124-48-1	0.537	1.70	ug/m3

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Air (continued)						
TO15	Air	1,2-Dibromoethane	106-93-4	0.323	1.54	ug/m3
TO15	Air	Chlorobenzene-d5	3114-55-4			ug/m3
TO15	Air	Chlorobenzene	108-90-7	0.203	0.921	ug/m3
TO15	Air	Ethylbenzene	100-41-4	0.300	0.868	ug/m3
TO15	Air	m,p-Xylene	179601-23-1	0.413	2.17	ug/m3
TO15	Air	o-Xylene	95-47-6	0.274	0.868	ug/m3
TO15	Air	Styrene	100-42-5	0.251	0.852	ug/m3
TO15	Air	Bromoform	75-25-2	1.24	2.07	ug/m3
TO15	Air	Cumene	98-82-8	0.202	0.983	ug/m3
TO15	Air	1,1,2,2-Tetrachloroethane	79-34-5	0.295	1.37	ug/m3
TO15	Air	n-Propylbenzene	103-65-1	0.231	0.983	ug/m3
TO15	Air	4-Ethyltoluene	622-96-8	0.241	0.983	ug/m3
TO15	Air	1,3,5-Trimethylbenzene	108-67-8	0.231	0.983	ug/m3
TO15	Air	2-Chlorotoluene	95-49-8	0.238	1.04	ug/m3
TO15	Air	tert-Butylbenzene	98-06-6	0.258	1.10	ug/m3
TO15	Air	1,2,4-Trimethylbenzene	95-63-6	0.393	0.983	ug/m3
TO15	Air	sec-Butylbenzene	135-98-8	0.247	1.10	ug/m3
TO15	Air	4-Isopropyltoluene	99-87-6	0.335	1.10	ug/m3
TO15	Air	1,3-Dichlorobenzene	541-73-1	0.445	1.20	ug/m3
TO15	Air	1,4-Dichlorobenzene	106-46-7	0.535	1.20	ug/m3
TO15	Air	Benzyl chloride	100-44-7	0.456	1.04	ug/m3
TO15	Air	n-Butylbenzene	104-51-8	0.604	1.10	ug/m3
TO15	Air	1,2-Dichlorobenzene	95-50-1	0.397	1.20	ug/m3
TO15	Air	1,2,4-Trichlorobenzene	120-82-1	2.45	3.71	ug/m3
TO15	Air	Hexachlorobutadiene	87-68-3	1.17	2.13	ug/m3
TO15	Air	Naphthalene	91-20-3	1.57	2.62	ug/m3
TO15	Air	BFB	460-00-4	1.43	1.43	ug/m3
Waste Characterization TCLP						
Volatile Organic Compounds by GC/MS						
EPA 8260C	Soil	Benzene	71-43-2	0.000410	0.00100	mg/L
EPA 8260C	Soil	Carbon tetrachloride	56-23-5	0.000270	0.00100	mg/L
EPA 8260C	Soil	Chlorobenzene	108-90-7	0.000750	0.00100	mg/L
EPA 8260C	Soil	Chloroform	67-66-3	0.000340	0.00100	mg/L
EPA 8260C	Soil	1,2-Dichloroethane	107-06-2	0.000210	0.00100	mg/L

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Waste Characterization TCLP						
Volatile Organic Compounds by GC/MS (continued)						
EPA 8260C	Soil	1,1-Dichloroethene	75-35-4	0.000290	0.00100	mg/L
EPA 8260C	Soil	2-Butanone (MEK)	78-93-3	0.00132	0.00500	mg/L
EPA 8260C	Soil	Tetrachloroethene	127-18-4	0.000360	0.00100	mg/L
EPA 8260C	Soil	Trichloroethene	79-01-6	0.000460	0.00100	mg/L
EPA 8260C	Soil	Vinyl chloride	75-01-4	0.000900	0.00100	mg/L
Semivolatile Organic Compounds (GC/MS)						
EPA 8270D	Soil	1,4-Dichlorobenzene	106-46-7	0.00180	0.0400	mg/L
EPA 8270D	Soil	2,4-Dinitrotoluene	121-14-2	0.00170	0.0200	mg/L
EPA 8270D	Soil	Hexachlorobenzene	118-74-1	0.00200	0.0200	mg/L
EPA 8270D	Soil	Hexachlorobutadiene	87-68-3	0.00270	0.0200	mg/L
EPA 8270D	Soil	Hexachloroethane	67-72-1	0.00230	0.0200	mg/L
EPA 8270D	Soil	3-Methylphenol	108-39-4	0.00160	0.0400	mg/L
EPA 8270D	Soil	2-Methylphenol	95-48-7	0.00160	0.0200	mg/L
EPA 8270D	Soil	4-Methylphenol	106-44-5	0.00140	0.0400	mg/L
EPA 8270D	Soil	Nitrobenzene	98-95-3	0.00110	0.0200	mg/L
EPA 8270D	Soil	Pentachlorophenol	87-86-5	0.00880	0.0400	mg/L
EPA 8270D	Soil	Pyridine	110-86-1	0.00160	0.100	mg/L
EPA 8270D	Soil	2,4,5-Trichlorophenol	95-95-4	0.00190	0.0200	mg/L
EPA 8270D	Soil	2,4,6-Trichlorophenol	88-06-2	0.00240	0.0200	mg/L
Metals (ICP)						
EPA 6010C	Soil	Arsenic	7440-38-2	0.00555	0.0150	mg/L
EPA 6010C	Soil	Barium	7440-39-3	0.100	1.00	mg/L
EPA 6010C	Soil	Cadmium	7440-43-9	0.000500	0.00200	mg/L
EPA 6010C	Soil	Chromium	7440-47-3	0.0100	0.0200	mg/L
EPA 6010C	Soil	Lead	7439-92-1	0.00300	0.0200	mg/L
EPA 6010C	Soil	Selenium	7782-49-2	0.00870	0.0250	mg/L
EPA 6010C	Soil	Silver	7440-22-4	0.00170	0.00600	mg/L
EPA 7470A	Soil	Mercury	7439-97-6	0.0000420	0.000200	mg/L
EPA 9012_ReactiveCN	Soil	Cyanide, Reactive	STL00045	10.0	10.0	mg/Kg

Attachment 2
Analytical Method Detection and Reporting Limits

Grand Central Plaza – 1020 Center Street
Horseheads, New York
NYSDEC Site No. 808053

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Waste Characterization TCLP						
Organochlorine Pesticides (GC)						
EPA 8081B	Soil	gamma-BHC (Lindane)	58-89-9	0.00000600	0.000200	mg/L
EPA 8081B	Soil	Chlordane (technical)	12789-03-6	0.0000290	0.00200	mg/L
EPA 8081B	Soil	Endrin	72-20-8	0.0000138	0.000200	mg/L
EPA 8081B	Soil	Heptachlor	76-44-8	0.00000850	0.000200	mg/L
EPA 8081B	Soil	Heptachlor epoxide	1024-57-3	0.00000530	0.000200	mg/L
EPA 8081B	Soil	Methoxychlor	72-43-5	0.0000141	0.000200	mg/L
EPA 8081B	Soil	Toxaphene	8001-35-2	0.000120	0.00200	mg/L
Herbicides (GC)						
EPA 8151A	Soil	Silvex (2,4,5-TP)	93-72-1	0.000360	0.00200	mg/L
EPA 8151A	Soil	2,4-D	94-75-7	0.000400	0.00200	mg/L
Polychlorinated Biphenyls (PCBs) by Gas Chromatography						
EPA 8082A	Soil	PCB-1016	12674-11-2	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1221	11104-28-2	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1232	11141-16-5	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1242	53469-21-9	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1248	12672-29-6	0.0489	0.250	mg/Kg
EPA 8082A	Soil	PCB-1254	11097-69-1	0.117	0.250	mg/Kg
EPA 8082A	Soil	PCB-1260	11096-82-5	0.117	0.250	mg/Kg
EPA 8082A	Soil	PCB-1262	37324-23-5	0.117	0.250	mg/Kg
EPA 8082A	Soil	PCB-1268	11100-14-4	0.117	0.250	mg/Kg
Sulfide, Reactive						
EPA 9034_Reactive	Soil	Sulfide, Reactive	STL00261	10.0	10.0	mg/Kg
Ignitability, Pensky-Martens Closed-Cup Method						
EPA 1010A	Soil	Flashpoint	STL00152		50.0	Degrees F
pH						
EPA 9045D	Soil	pH	STL00204	0.100	0.100	SU
		Temperature	STL00038	0.00100	0.00100	Degrees C
VOCs (Totals)						
EPA 8260C	Water	Benzene	71-43-2	0.410	1.00	ug/L
EPA 8260C	Water	Carbon tetrachloride	56-23-5	0.270	1.00	ug/L
EPA 8260C	Water	Chlorobenzene	108-90-7	0.750	1.00	ug/L
EPA 8260C	Water	Chloroform	67-66-3	0.340	1.00	ug/L

Method	Matrix	Analyte Description	CAS Number	MDL	RL	Units
Waste Characterization TCLP						
VOCs (Totals) (continued)						
EPA 8260C	Water	1,2-Dichloroethane	107-06-2	0.210	1.00	ug/L
EPA 8260C	Water	1,1-Dichloroethene	75-35-4	0.290	1.00	ug/L
EPA 8260C	Water	2-Butanone (MEK)	78-93-3	1.32	10.0	ug/L
EPA 8260C	Water	Tetrachloroethene	127-18-4	0.360	1.00	ug/L
EPA 8260C	Water	Trichloroethene	79-01-6	0.460	1.00	ug/L
EPA 8260C	Water	Vinyl chloride	75-01-4	0.900	1.00	ug/L
Ignitability, Pensky-Martens Closed-Cup Method						
EPA 1010A	Water	Flashpoint	STL00152		50.0	Degrees F
pH						
EPA 9040C	Water	pH	STL00204	0.100	0.100	SU
	Water	Temperature	STL00038	0.00100	0.00100	Degrees C

Attachment 3

Field Sampling Plan

GCP Boom, LLC

Field Sampling Plan

Grand Central Plaza – 1020 Center Street
Horseheads, New York
Site No. 808053

September 2024

Field Sampling Plan

Grand Central Plaza – 1020 Center Street
Horseheads, New York
Site No. 808053

September 2024

Prepared By:
Arcadis of New York, Inc.
One Lincoln Center, 110 West Fayette Street, Suite 300
Syracuse, NY 13202
United States
Phone: 315 446 9120
Fax: 315 449 0017

Prepared For:
GCP Boom, LLC.
C. Gershon Company, Inc.
244 W. 39th Street, 5th Floor
New York, NY 10018

Our Ref:
30147184

This document is intended only for the use of the individual or entity for which it was prepared and may contain information that is privileged, confidential and exempt from disclosure under applicable law. Any dissemination, distribution or copying of this document is strictly prohibited.

Contents

Acronyms and Abbreviations iii
1 Introduction 1
1.1 General 1
1.2 Overview of Investigation Field Activities 1
2 Field Activities 2
2.1 General Field Guidelines 2
2.1.1 Groundwater Sampling Equipment 2
2.1.2 Air Sampling Equipment 2
2.1.3 Field Logbooks 3
2.2 Measurement of Fluid levels 4
2.3 Groundwater Sampling Procedures 5
2.3.1 Low-Flow Groundwater Purging and Sampling 5
2.3.2 Waste Management 9
2.3.3 Data Recording and Management 9
2.3.4 Quality Assurance 9
2.4 Indoor and Ambient Air Sampling Procedures 10
2.5 Subslab Vapor Sampling Procedures 10
2.6 Sample Labeling, Packing, and Shipping 11
2.7 Equipment Decontamination 12
2.7.1 Sampling Equipment Decontamination 13
2.8 Investigation-Derived Waste and Storage 13
2.8.1 Drum Storage 15
2.8.2 Drum Container Labelling 15
2.8.3 Inspection and Documentation 16
2.8.4 Preparing Waste Shipment Documentation (Hazardous and Non-Hazardous) 16
2.9 Emergency Response and Notifications 16
3 Field Instruments 17
3.1 Portable Photoionization Analyzer 17
3.2 Water-Level Meter 17

Attachments

Attachment 1 Technical Guidance Instructions

- Groundwater and Soil Sampling Equipment Decontamination
- Installation of Permanent Soil Vapor Probes
- Investigation-Derived Waste Handling and Storage
- PFAS Field Sampling Guide
- Soil Drilling and Sample Collection
- Soil Description
- Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells
- NYSDEC PFAS Guidance April 2023
- Sub-Slab Vapor and Soil Vapor Sampling Using Whole Air Canisters
- Administering Helium Tracer Gas Leak Test
- Sub-Slab Soil Gas Sampling Point Installation Using Vapor PINTM Approach
- Indoor or Ambient Air Sampling and Analysis Via USEPA Method TO-15

Attachment 2 Product Inventory Form and Air Sampling Log

Attachment 3 Low-Flow Groundwater Sampling Form

Attachment 4 Chain-of-Custody Form

Attachment 5 PID Calibration Log

Acronyms and Abbreviations

%	Percent
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EWP	Excavation Work Plan
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HazMat	Hazardous Materials
IDW	Investigation-Derived Waste
NAPL	Non-Aqueous Phase Liquid
NYSDOH	New York State Department of Health
ORP	Oxidation Reduction
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
SCWP	Site Management Plan
CAMP	Community Air Monitoring Plan
TGI	Technical Guidance Instruction
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1 Introduction

1.1 General

This Field Sampling Plan (FSP) supports the September 2024 Site Characterization Work Plan (SCWP) and Quality Assurance Project Plan (QAPP) and provides guidance for data collection associated with the 20.60 acre, “Grand Central Plaza” site at 1020 Center Street, Horseheads, New York (the “Site”). The Site was P-listed by the New York State Department of Environmental Conservation (NYSDEC) on January 12, 2024 and assigned site number 808053.

This FSP provides field procedures and sample collection methods to be used to characterize environmental media, as needed, for future site maintenance. This FSP should be used in conjunction with the SCWP, the Quality Assurance Project Plan (QAPP), an approved Health and Safety Plan (HASP), and the Community Air Monitoring Plan (CAMP). The QAPP (included as Appendix B of the SCWP presents quality assurance (QA)/quality control (QC) procedures to be used during field activities described in the SCWP, as well as a description of the general field and laboratory procedures.

1.2 Overview of Investigation Field Activities

The following activities may be conducted at the site:

- Measuring water table elevations;
- Collecting soil samples;
- Collecting groundwater samples;
- Sampling ambient air;
- Collecting indoor air samples; and
- Collecting sub-slab vapor samples.

Sampling locations and the rationale for each field sampling activity are described in the SCWP. Note that subslab, indoor air and ambient air sampling will be conducted during a separate mobilization and under a modified SCWP to be submitted later.

2 Field Activities

This section describes field procedures and methods potentially used for site investigation work.

2.1 General Field Guidelines

The general field guidelines below will be modified to account for special requirements necessary to appropriately sample 1,4-dioxane and polyfluoroalkyl substances (PFAS). The latest edition of the NYSDEC's April 2023 Guidelines for Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC's Part 375 Remedial Program (**Attachment 1**) will be consulted along with Arcadis' January 26, 2022 TGI – Per- and Polyfluoroalkyl Substances (PFAS) Field Sampling Guide (**Attachment 1**).

2.1.1 Groundwater Sampling Equipment

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

- Appropriate sample containers provided by the laboratory (kept closed and in laboratory-supplied coolers until the samples are collected);
- Pre-preserved sample containers (as required) for aqueous samples;
- Chain-of-custody (COC) record forms;
- Logbooks, field sampling records, and indelible ink pens and markers;
- Laboratory-grade soap (such as Alconox®), reagent-grade solvents, and distilled water to be used for decontaminating equipment between sampling stations;
- Buckets, plastic wash bins, and scrub brushes for decontaminating equipment;
- A digital camera and extra batteries;
- Shipping labels and forms;
- A safety auto-retract knife;
- Packing/shipping material for sample bottles;
- Strapping tape;
- Clear plastic tape;
- Duct tape;
- Aluminum foil; and
- Portable field instruments, including a photoionization detector (PID) and a water-level indicator.

2.1.2 Air Sampling Equipment

Subslab, indoor air and ambient air will be collected using a Summa canister sampling train. The typical Summa canister sampling train consists of:

- Summa canister;
- Flow controller;

- Particulate filter;
- Pressure gauge; and
- Fittings and a sampling line.

The laboratory will evacuate the canister to a minimum vacuum of negative 28 inches (± 2 inches) of mercury (in. Hg) prior to sampling. After sampling, the final vacuum will be recorded on a chain of custody form to confirm sample integrity. A pressure gauge will be used to measure the vacuum before, during, and after sampling. A seven-micron particulate filter will be used upstream of the flow controller to prevent blockage of the flow controller. The sampling line will consist of new, unused, ¼-inch diameter flexible Teflon® or stainless-steel tubing. All parts of the sampling train coming into direct contact with the sample will be made of stainless steel or Teflon®. The following general set-up procedure will be followed for each sampling location:

1. Place the Summa canister at the sampling location.
2. Note the environmental conditions in the sample area on the air sampling form (**Attachment 2**).
3. Assemble the Summa canister sampling train. Follow the laboratory instructions for pressure measurement, particulate filter placement, and flow controller attachment.
4. Sample following the procedures described below.

2.1.3 Field Logbooks

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

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

- Author's name, date of entry, and physical/environmental conditions during field activity;
- Purpose of sampling activity;
- Location of sampling activity;
- Field crew members' names;
- Site visitors' names;
- Sample media (e.g., soil, groundwater);
- Sample collection method;
- Number and volume of sample(s) taken;
- Description of sampling point(s);
- Volume of groundwater removed before sampling (where appropriate);
- Preservatives used;
- Date and time of collection;
- Sample identification number(s);
- Field observations; and
- Any field measurements made, such as, but not limited to, pH, temperature, conductivity, and water level.

All original data recorded in field logbooks and COC records will be written with indelible ink. If an error is made on an original document assigned to one individual, that individual will make all corrections by simply crossing a single line through the error and entering the correct information. The erroneous information will not be erased. Any subsequent error discovered on an original document will be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

2.2 Measurement of Fluid levels

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

- Decontaminate the water-level probe or oil/water interface probe (for wells expected to contain non-aqueous phase liquid [NAPL]).
- Measure the static fluid level, fluid interfaces (i.e., NAPL/water interface), and the bottom of the well (if applicable) with reference to the surveyed elevation mark on the top of the well casing or surface-water gauge. Record all measurements, to the nearest hundredth of a foot, in the field logbook.

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

Fluid levels will be measured using an electronic fluid-level indicator (sounder), steel tape, pressure transducer, or stream gauge at established reference points (e.g., top of casing, stream gauge).

The following materials will be available, as required:

- Appropriate health and safety equipment, as specified in the HASP;
- Laboratory-type soap (Alconox® or equivalent);
- Electronic water-level indicator (sounder) or pressure transducer;
- PID;
- Analyte-free water;
- Indelible ink pen; and
- Six-foot engineer's rule.

The following procedures will be used to obtain fluid levels.

1. Measure the lengths between markers on the cable with a 6-foot engineer's rule or a fiberglass engineer's tape. The tape or cable associated with the electronic water-level probe should be checked for the length corresponding to the deepest total well depth to be monitored during the data collection event.

   Note: If the length designations on the tape or cable associated with the electronic water-level probe are found to be incorrect, the probe will not be used until it is repaired by the manufacturer.
2. Record the verification of this calibration process in the field logbook.
3. Obtain fluid level depth measurements.

   Note: Field notes on logs will be treated as secured documentation, and indelible ink will be used. As a general rule, the order of measuring should proceed from the least to most contaminated monitoring wells, based on available data.
4. Identify the site and well number in the field logbook using indelible ink, along with the date, time, personnel names, and weather conditions.

5. Avoid activities that may introduce contamination into monitoring wells. Activities such as dispensing gasoline into vehicles or generators should be accomplished well in advance of obtaining field measurements.
6. Use PPE, as required by the HASP.
7. Clean the water-level probe and cable in accordance with appropriate cleaning procedures. Down-hole instrumentation should be cleaned prior to obtaining readings at the first monitoring well and upon completion of readings at each well.
8. Clean the water-level probe and cable with a soapy (Alconox®) water rinse, followed by a solvent rinse (if appropriate, based on site-specific constituents of concern) and an analyte-free water rinse. Contain the rinse water in a portable container that will be transferred to an on-site container.
9. Put clean plastic sheeting on the ground next to the well.
10. Unlock and open the well cover while standing upwind from the well. Place the well cap on the plastic sheeting.
11. Locate a measuring reference point on the well casing. If one is not found, initiate a reference point at the highest discernable point on the inner casing (or outer casing if an inner casing is not present) by notching with a hacksaw or using an indelible marker. All down-hole measurements will be taken from the reference point established at each well on the inner casing (or on the outer casing, only if an inner casing is not present).
12. Measure to the nearest hundredth of a foot and record the height of the inner and outer casings (from the reference point, as appropriate) to ground level.
13. Record the inside diameter of the well casing in the field logbook.
14. Lower the probe until it emits a signal (tone and/or light) indicating the top of the water surface. Gently raise and lower the instrument through this interface to confirm its depth. Measure and record the depth of the water surface and the total well depth, to the nearest hundredth of a foot, from the reference point at the top of the well. Lower the probe to the bottom of the well to obtain a total depth measurement.
15. Clean the water-level probe and cable in accordance with appropriate cleaning procedures.
16. Compare the depth of the well to previous records and note if there is a discrepancy.
17. Lock the well when all activities are completed.

Fluid level measurement data will be recorded legibly in the field logbook in indelible pen. Field situations, such as apparent well damage or suspected tampering, or other observations of conditions that may result in compromised data collection, will be photographically documented where practicable.

2.3 Groundwater Sampling Procedures

The following procedures will be used to collect groundwater samples from monitoring wells.

2.3.1 Low-Flow Groundwater Purging and Sampling

This protocol has been developed in accordance with the United States Environmental Protection Agency (USEPA) Region I Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (USEPA Standard Operating Procedure No. GW0001; July 30, 1996). No wells will be sampled until well development has been performed. During heavy precipitation events, groundwater sampling will be discontinued until the precipitation ceases. Groundwater samples will not be collected within 1

week following well development. When one round of water levels is taken to generate water-elevation data, the water levels will be taken consecutively, at one time, prior to sampling or other activities.

The following equipment and materials will be available, as required, during groundwater sampling:

- Appropriate PPE, as required in the site HASP;
- Site map, well construction records, and prior groundwater sampling records (if available);
- Sample pump, which may consist of one or more of the following:
  - Submersible pump (e.g., Grundfos Redi-Flo 2),
  - Peristaltic pump (e.g., ISCO Model 150), and
  - Bladder pump (e.g., Marschalk System 1, QED Well Wizard, Geotech, etc.);
- Low-density polyethylene tubing of an appropriate size for the pump being used (high-density polyethylene tubing if sampling for 1,4-dioxane or Per- and Polyfluoralkyl Substances);
- Power source (i.e., generator, battery);
- PID;
- Water-level probe (PFAS-sampling-compliant if sampling for PFAS);
- Water-quality (temperature/pH/specific conductivity/oxidation reduction [ORP]/turbidity/dissolved oxygen [DO]) meter and flow-through measurement cell; several brands may be used, including:
  - YSI 6-series multi-parameter instrument,
  - Hydrolab Series 3 or Series 4a multiprobe and display, and
  - Horiba U-10 or U-22 water quality monitoring system;
- Supplemental turbidity meter (e.g., Horiba U-10, Hach 2100P, LaMotte 2020);
- Appropriate water sample containers;
- Appropriate blanks (trip blank supplied by the laboratory);
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Groundwater sampling logs;
- COC forms;
- Indelible ink pens;
- Decontamination equipment;
- Plastic sheeting (for each sampling location);
- Dedicated or disposable bailers;
- New disposable polypropylene rope;
- Buckets to measure purge water; and

To mitigate potential cross-contamination, groundwater samples will be collected in a pre-determined order, from least impacted to most impacted, based on previous analytical data (if available). If no analytical data are available, samples will be collected in order from the furthest upgradient to the furthest downgradient to the source area locations.

The following steps detail monitoring well sampling procedures:

1. Review the materials checklist to ensure that the appropriate equipment has been acquired.
2. Identify the site and the well to be sampled on the sampling log sheets, along with the date, arrival time, and weather conditions. Also identify the personnel, the equipment used, and other pertinent data requested on the Low-Flow Groundwater Sampling Form (**Attachment 3**).
3. Label all sample containers using an appropriate label.
4. Use safety equipment, as required in the HASP.
5. Calibrate the field instruments according to the manufacturer's procedures for calibration.
6. Place plastic sheeting adjacent to the well to use as a clean work area.
7. Establish the background reading with the PID and record the reading on the field log.
8. Remove the lock from the well. If the lock is rusted or broken, replace it with a new brass keyed-alike lock.
9. Unlock and open the well cover while standing upwind of the well. Remove the well cap and place it on the plastic sheeting. Insert the PID probe into the breathing zone above the well casing following instructions in the HASP.
10. Set out dedicated or disposable sampling devices and meters on plastic sheeting.
11. Prior to sampling, measure groundwater elevations at each monitoring well. Determine whether light NAPL or dense NAPL is present. Note the presence of either of these NAPLs on the sampling form. Obtain a water-level depth and bottom of well depth using an electric well probe and record the depths on the sampling log sheet. Clean the well probe after each use with a soapy (Alconox®) water wash and a tap water rinse. (Note: Water levels will be measured at all wells prior to initiating a sampling event.)
12. After the groundwater elevations are measured and NAPLs are determined to be not present, groundwater will be purged from the wells. If NAPLs are determined to be present, a groundwater sample will not be collected; rather, a representative NAPL sample may be collected (if required) using a peristaltic pump or other method determined by the Field Manager/Site Supervisor.
13. Prepare and install a pump in the well:
    a. For submersible and non-dedicated bladder pumps, decontaminate the pump according to site decontamination procedures. Attach the air line tubing to the air port on the top of the bladder pump. Attach the sample discharge tubing to the water port on the top of the bladder pump. Care should be taken not to reverse the air and discharge tubing lines during bladder pump set-up as this could result in bladder failure or rupture. Attach and secure a safety cable to the eyebolt on the top of bladder pump (if present, depending on the pump model used). Slowly lower the pump, safety cable, tubing, and electrical lines into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Take care to avoid twisting and tangling of the safety cable, tubing, and electrical lines while lowering the pump into the well; twisted and tangled lines could result in the pump becoming stuck in the well casing. Also, make sure to keep the tubing and lines from touching the ground or other surfaces while introducing them into the well as this could lead to well contamination.
    b. If using a bladder pump, connect the air line to the pump controller output port. The pump controller should then be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose. Take care to tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Once the air compressor or gas cylinder is connected to the pump controller, turn on the compressor or open the valve on the cylinder to begin the gas flow. Turn on the pump controller if an on/off switch is present and verify that all batteries are charged and fully operating before beginning to pump.

c. If using a peristaltic pump, slowly lower the sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. The pump intake or sampling tube must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

14. Connect the pump discharge water line to the bottom inlet port on the flowthrough cell connected to the water quality meter.
15. If the well diameter is 2 inches in diameter or larger, measure the water level again, with the pump in the well, before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. Ideally, the pump rate should cause little water-level drawdown in the well (less than 0.3 feet), and the water level should be stabilized. The water level should be monitored every 3 to 5 minutes (or as appropriate) during pumping. Care should be taken to avoid breaking the pump suction or entrainment of air in the sample. Record any pumping rate adjustments and the depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of the indicator parameters. If the recharge rate of the well is very low, purging should be interrupted to prevent drawdown within the well advancing below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit sample collection.
16. Containerize all purge and decontamination liquids per Section 2.3.2 below.
17. During well purging, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, DO, and ORP) every 3 to 5 minutes (or as appropriate). The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows:
    - ±0.1 for pH;
    - ±3 percent (%) for specific conductance (conductivity);
    - ±10 millivolts for ORP; and
    - ±10% for turbidity and DO.

    Note: Turbidity and DO usually require the longest time to achieve stabilization. If the field indicator parameters do not stabilize within 1 hour of the start of purging, but the groundwater turbidity is below the goal of 50 nephelometric turbidity units and the values for all other parameters are within 10%, the well can be sampled. If the parameters have stabilized but the turbidity is not in the 50 NTU range, the pump flow rate should be decreased to a minimum rate of 100 milliliters per minute to reduce turbidity levels as much as possible.
18. Fill in the sample label and cover the label with clear packing tape to secure it to the container.
19. After the indicator parameters have stabilized, collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriately labeled sample container. If a flow-through cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell. When the container is full, tightly screw on the cap.
20. Secure the sample containers with packing material and store at 4 degrees Celsius on wet ice in an insulated transport container provided by the laboratory.
21. Record the time the sampling procedures were completed on the field logs.
22. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to the next well and repeat Step 1 through Step 21 until all wells are sampled.
23. Complete the procedures for packaging, shipping, and handling samples with associated COC forms.

2.3.2 Waste Management

Materials generated during groundwater sampling activities, including disposable equipment, purge water, and decontamination liquids, will be stored on site in appropriately labeled containers and disposed of properly. Waste will be managed in accordance with the Technical Guidance Instruction (TGI) – Investigation-Derived Waste Handling and Storage (**Attachment 1**); the procedures identified in the SCWP or QAPP; and all state-, federal-, or client-specific requirements. Waste containers will be properly labeled and documented in the field logbook.

2.3.3 Data Recording and Management

The original documents from the field will be managed in accordance with the site-specific QAPP. In general, forms (e.g., Low-Flow Sampling Field Forms), logs/notes (including daily field and calibration logs), digital records, and COC records will be maintained by the field team lead.

Field logs and COC records will be transmitted to the Arcadis Project Manager and/or Task Manager, as appropriate, at the end of each day unless otherwise directed. Electronic data files will be sent to the project team and uploaded to the electronic project folder daily.

Records generated as a result of this FSP will be controlled and maintained in the project record files in accordance with project requirements.

2.3.4 Quality Assurance

QA procedures will be conducted in accordance with the Arcadis Quality Management System or the site-specific QAPP.

Unless described otherwise in the project-specific work plan or QAPP, QA/QC samples will be collected as follows:

- One duplicate for every 20 samples; and
- One laboratory matrix/matrix spike sample for every 20 samples.

In addition to the QC samples to be collected in accordance with this FSP, the following QC procedures will be observed in the field:

- Collect samples from the monitoring wells, in order of increasing concentration, to the extent known based on review of historical site information, if available.
- Collect equipment blanks after wells with higher concentrations (if known) have been sampled. Equipment blanks will include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well).
- Operate all monitoring instrumentation in accordance with manufacturers' instructions and calibration procedures—calibrate the instruments at the beginning of each day, verify the calibration at the end of each day, and record all calibration activities in the field logbook.
- Following the procedures for equipment decontamination, clean all groundwater sampling equipment prior to use in the first well and after each subsequent well.

2.4 Indoor and Ambient Air Sampling Procedures

Indoor and ambient air samples will be collected in accordance with the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (2006) and associated soil vapor intrusion updates. The procedures implemented for the collection of indoor and ambient air samples are summarized as follows:

1. Complete a product inventory form (**Attachment 2**).
2. Remove the brass plug fitting covering the stainless steel Summa canister sampling port using a wrench.
3. Connect the pressure gauge or flow controller with integral pressure gauge to the Summa canister sampling port. Open the valve on the canister and quickly measure the vacuum within the canister. If the vacuum is greater than negative 25 inches of mercury, then the canister is acceptable for sampling. Any canisters with a vacuum less than negative 25 inches of mercury should not be used for sampling. Close the valve and record the measurement on the sampling sheet.
4. Assemble the sampling train. Each fitting should be hand tightened and then tightened with a wrench approximately ¼ turn.
5. Confirm that the sampling train is air-tight by conducting a vacuum test. Place the brass cap at the end of the sampling train (particulate filter), quickly open and close the sampling valve and monitor the vacuum on the pressure gauge. If the vacuum decreases, there is a leak in the system. The fittings should be rechecked and the vacuum test redone.
6. Initiate sampling by opening the Summa canister valve. Record starting time on the sampling sheet.
7. During sampling, the pressure will be monitored periodically to ensure that the flow controller is operating properly.
8. When the time corresponding to the calibrated flow controller (for indoor air – 24 hours) has elapsed, close the canister valve. Disassemble the sampling train. Check the vacuum within the canister using the pressure gauge and record the measurement on the sampling sheet.
9. Since the flow rate into the canister can fluctuate because of variations in atmospheric conditions, the measured final vacuum may range from 4 to 12 in. Hg. If the measured vacuum is greater than 12 in. Hg or less than 3 in. Hg, the sample may be flagged and re-sampling may be needed.
10. Place the brass cap on the sampling port of the canister and tighten it. The air sampling is complete.
11. Place the air sample in the travel box and complete the chain-of-custody forms and identification tag on the canister.
12. Send the canister to the laboratory via next day airmail service for analysis of volatile organic compounds (VOCs) by USEPA Method TO-15.

2.5 Subslab Vapor Sampling Procedures

Subslab vapor sampling points will be from temporary or permanent sampling points.

To obtain representative samples that meet the data quality objectives, subslab vapor samples will be collected as follows:

- Pre-assemble the sample train for each sub-slab port to be sampled (Vapor Pin® with barb fitting). Cut three 10-inch pieces of 1/4- inch OD Teflon®, Teflon® lined, or Nylaflow tubing and 1 -6-inch piece of the same tubing.
- Connect one piece of the 10-inch tubing to the two opposite sides of the stainless-steel tee with compression nuts and ferrule sets. Install a compression nut and ferrule set to the other side of each tubing piece.

- Remove the cap from the canister and connecting the flow controller with in-line particulate filter and vacuum gauge. The flow controller attaches directly to the canister and the pre-set rate dictates the sample duration. The laboratory may have connected the canister and flow controller prior to shipping. Attach the canister and flow controller assembly to the tubing from one side of the stainless-steel tee.
- Unless the flow controller manifold came with a purge port and valve, one will need to be added. Cut a short length (-6-inches) of 1/4- inch OD Teflon®, Teflon® lined, or Nylaflow tubing. Connect to the open end of the tee fitting using a compression nut and ferrule set. This tee adds a leg to the sample train that will be used to purge "dead" air from the sample train.
- Connect the purge syringe with three-way valve and/or air pump to the free end tubing from the tee using a length short piece of 1/4-inch ID silicon tubing.
- Attach a two-way compression valve to the remaining free end of the tee tubing. Cut another 6-inch piece of 1/4-inch OD Teflon tubing and connect to the other side of the two-way valve with a compression nut and ferrule set. The two-way valve will be immediately adjacent to the sample point in the train assembly. This valve is used to isolate the sample train from the sample point prior to sampling in order to test the sample train's integrity. See Section 8.3 for purging details.
- When collecting duplicate or other quality assurance/quality control (QA/QC) samples as required by applicable regulations and guidance, couple two canisters using a stainless-steel compression duplicate sample tee-fitting supplied by the laboratory. Attach flow controller with in-line particulate filter and vacuum gauge to duplicate sample tee.
- Attach the terminal end of the two-way compression valve to the sample port as appropriate. This may be done using the options below:
    - Use a section of silicon tube to connect the Teflon sample tubing to the barbed fitting of a Vapor Pin® port.
    - Use Swagelok® or equivalent compression fittings to connect Teflon tubing to the sample port. Teflon tape should never be used on Swagelok® or equivalent compression fittings.
- To ensure samples collected are representative, one to three volumes (i.e., the volume of the tube) will be purged using disposable syringes prior to collecting the samples.
- Samples will be collected, using conventional sampling methods, in a laboratory-certified Summa canister consistent with the sampling and analytical methods.
- Summa canisters will be batch or individually certified as analyte free by the laboratory.

2.6 Sample Labeling, Packing, and Shipping

The analytical laboratory will provide the sample containers for all soil, groundwater, air, and soil vapor samples. Container closures for all samples, except air and soil vapor, will be screw-on type and made of inert materials. Sample containers are cleaned and prepared by the laboratory prior to being sent to the site. Trip blanks will be used to check for false positives from laboratory cleaning procedures or cross contamination during sample shipment.

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

Upon collection, samples will be promptly labeled with the following information:

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

Clear tape will be secured over the sample label and the COC will be initiated. A sample COC form is included as **Attachment 4**.

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

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

- A drain plug (if present) that has been sealed with duct tape;
- Bubble wrap on the bottom of the cooler (1 to 2 inches);
- Water ice packaged in re-sealable plastic bags;
- Sufficient bubble wrap to fill in the remaining area; and
- The completed COC form in a re-sealable plastic bag, taped in place on the inside cover of the cooler.

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

All samples, whether solids, liquids, or gases, being shipped by air or ground transport will be evaluated using a shipping determination process to determine if the material or equipment being shipped is hazardous for transport. All materials identified as Hazardous Materials (HazMat) will be shipped according to applicable United States Department of Transportation (USDOT) and International Air Transport Association regulations and requirements. All employees collecting samples, preparing HazMat packages, or offering HazMat to a third-party carrier, such as FedEx, will have current HazMat training.

2.7 Equipment Decontamination

The general equipment decontamination procedures below will be modified to account for special requirements necessary to appropriately decontaminate equipment for 1,4-dioxane and PFAS. The latest edition of the NYSDEC's April 2023 Guidelines for Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC's Part 375 Remedial Program (**Attachment 1**) will be consulted along with Arcadis' January 26, 2022 TGI – Per- and Polyfluoroalkyl Substances (PFAS) Field Sampling Guide (**Attachment 1**).

2.7.1 Sampling Equipment Decontamination

The following equipment will be required for use during sampling equipment cleaning procedures:

- Appropriate PPE, as required in the site HASP;
- Distilled water;
- PFAS-free water (if sampling for PFAS);
- Non-phosphate detergent, such as Alconox® (or equivalent);
- Tap water;
- Rinsate collection plastic containers;
- USDOT-approved waste shipping container(s);
- Brushes;
- Large, heavy-duty, garbage bags;
- Spray bottles;
- “Pesticide grade” methanol (optional);
- “Ultra-pure grade” nitric acid (optional);
- Hexane (optional);
- Re-sealable plastic bags; and
- Plastic sheeting.

Prior to collecting samples to be submitted for chemical analysis, if any, all non-dedicated bowls, spoons, hand augers, bailers, and filtering equipment will be washed with potable water and a detergent (such as Alconox®). Decontamination may take place at the sampling location, as long as all liquids are contained in pails and buckets. Sampling equipment will then be rinsed with a distilled water rinse. If sampling for PFAS, all distilled water rinses will be replaced with PFAS-free water rinses. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil, if necessary. At no time will washed equipment be placed directly on the ground. Equipment will either be used immediately or wrapped in plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location. If sampling for PFAS, decontaminated equipment will not come into contact with aluminum foil, LDPE, glass, or polytetrafluoroethylene (Teflon ®) materials.

2.8 Investigation-Derived Waste and Storage

Investigation-derived waste (IDW) will be generated during site activities, which include, but are not limited to, groundwater sampling and equipment decontamination. IDW may include decontamination liquids, PPE, sorbent materials, purge water, and disposable sampling materials that may have come in contact with potentially impacted materials. IDW will be collected and staged at the point of generation. Waste materials will be analyzed for constituents of concern to evaluate proper disposal methods. Anticipated IDW will be labeled and stored in 55-gallon drums with bolt-sealed lids. Disposable equipment (PPE and disposable sampling equipment) typically does not require laboratory analysis. All IDW will be disposed of off-site at a permitted facility in accordance with all applicable local, State, and Federal regulations.

Minimization of IDW will be considered and may include techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), and sampling techniques that generate little waste.

The procedures for handling IDW are based on the USEPA's 1992 Guide to Management of Investigation Derived Wastes. IDW is assumed to be contaminated with site residuals until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements, including, but not limited to, the following laws and regulations for hazardous waste management.

- 6 New York Codes, Rules, and Regulations Part 364 "Waste Transporter Permits," Part 371 "Identification and Listing of Hazardous Wastes," and Part 372 "Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities;"
- Resource Conservation and Recovery Act (RCRA) 42 United States Code Part 6901-6987;
- Comprehensive Environmental Response, Compensation, and Liability Act 42 United States Code Part 9601-9675;
- Superfund Amendments and Reauthorization Act; and
- USDOT Hazardous Materials Transportation.

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and state/federal requirements and following the laboratory requirements and methodologies outlined in the QAPP. IDW will be analyzed by methods appropriate for the known constituents that have been historically detected in the monitoring wells.

In the unexpected event that IDW is characterized as a hazardous waste (as defined in 6 New York Codes, Rules, and Regulations Part 371), RCRA and USDOT requirements must be followed for packaging, labeling, transporting, storing, and recordkeeping, as described in Title 40 of the Code of Federal Regulations (CFR) (40 CFR) Part 262 and Title 49 of the CFR Part 171-178. Waste material classified as RCRA non-hazardous may be handled and disposed of as an industrial waste.

These procedures may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports.

The following materials, as required, shall be available for IDW handling and storage:

- Appropriate PPE, as specified by the HASP;
- USDOT 1A2 or equivalent 55-gallon steel drums;
- Socket wrench (15/16-inch);
- Hammer;
- Leather gloves;
- Drum dolly;
- Appropriate drum labels (outdoor waterproof self-adhesive);
- Appropriate labeling, packing, COC forms, and shipping materials;
- Indelible ink and/or permanent marking pens;

- Plastic sheeting;
- Digital camera; and
- Field logbook.

2.8.1 Drum Storage

All 55-gallon drums will be stored at a secure, centralized, on-site location that is readily accessible for vehicular pick-up in accordance with local, State and Federal rules and regulations. Drums confirmed as containing, or believed to contain, hazardous waste will be stored over an impervious surface provided with secondary containment. For drums containing liquid, the storage location will have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and in good condition in accordance with the USEPA's 1992 Guide to Management of Investigation-Derived Wastes.

2.8.2 Drum Container Labelling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or "Testing in Progress" label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Testing in Progress, Hazardous, or Non-Hazardous);
- Waste generator's name (e.g., client name);
- Project name;
- Name and telephone number of Arcadis Project Manager;
- Composition of contents (e.g., used oil, acetone 40%, toluene 60%);
- Media (e.g., solid, liquid);
- Accumulation date (i.e., date the waste is first placed in the container); and
- Drum number of total drums as reconciled with the drum inventory maintained in the field logbook.

Immediately upon placing waste into the drum/container, an appropriate waste label will be filled out to include the information specified above and affixed to the container. Containers with waste determined to be non-hazardous will be labeled with a green and white "Non-Hazardous Waste" label over the "Waste Container" label. Containers with waste determined to be hazardous will be stored in an on-site storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label. USDOT hazardous class labels must be applied to all hazardous waste containers for shipment off site to an approved disposal or recycling facility. In addition, a proper USDOT shipping name shall be included on the hazardous waste label. The transporter should be equipped with the appropriate USDOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR Part 262.33.

2.8.3 Inspection and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field logbook. The Drum Inventory Log will record the generation date, type, quantity, matrix, and origin (e.g., MW-1 through MW-20) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with the labeling of drums. Digital photographs will be taken upon the initial generation and drumming/staging of waste and upon final labeling after characterization to document compliance with labeling and storage protocols and the condition of the containers. Two photographs of each drum, including one of the entire drum and a close-up photograph of the label, will be provided as part of the drum inventory log. An additional photograph of the drum storage location (including all drums) will also be included. Evidence of damage, tampering, or other discrepancies should be documented photographically.

2.8.4 Preparing Waste Shipment Documentation (Hazardous and Non-Hazardous)

Waste profiles will be prepared by Arcadis and forwarded, along with laboratory analytical data, to GCP Boom, LLC for approval/signature. GCP Boom, LLC will then return the profiles to Arcadis, who will then forward them to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to GCP Boom, LLC for approval. Upon approval of the manifest, GCP Boom, LLC will return the original signed manifest directly to the waste contractor.

Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for disposable equipment will be different than the profile number for soil cuttings. When there are multiple profiles, it is critical that the proper label, with the profile number appropriate to a specific material, be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

2.9 Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. In the event of a fire, explosion, or other release that could threaten human health outside of the site, or when GCP Boom, LLC or Arcadis has knowledge of a spill that has reached surface water, GCP Boom, LLC or Arcadis must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR Part 262.34. Other notifications to state agencies may also be necessary.

3 Field Instruments

All field-screening equipment will be calibrated immediately prior to each day's use or more frequently, if required. Additional calibration may be required if measurements appear erroneous. Calibration procedures will conform to the manufacturer's standard instructions. Records of all instrument calibration will be maintained by the field personnel.

3.1 Portable Photoionization Analyzer

If required, the PID will be a MiniRAE 3000 (or equivalent), equipped with a 10.6 electron volt lamp. The MiniRAE is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 electron volts. This accounts for up to 73% of the VOCs on the Target Compound List. Calibration will be performed according to the following procedures:

1. Turn on the MiniRAE 3000 and monitor the ambient air. If there is any doubt of the air quality, then zero grade gas will be obtained.
2. Connect the regulator to the span gas cylinder. Hand-tighten the fittings.
3. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
4. Attach the gas bag to the regulator. Hand-tighten the fittings.
5. Turn the regulator knob counterclockwise half a turn to start the gas flow.
6. Fill the gas bag half full and then close the regulator fully clockwise to turn off the flow of gas.
7. Fill the gas bag and then turn the valve clockwise.
8. Press “MODE” and “N” at the same time to enter the set-up screens. Press “MODE” to cycle through the screens. Press “Y” for span cal and “Y” again for zero point. Press “Y” to set the zero point.
9. When the screen displays “CAL GAS,” press “Y” and calibrate the unit with isobutylene calibration gas.
10. Press and hold “MODE” for a few seconds, and the display will return to normal screening mode.
11. After 7 hours of use, recharge the battery pack. Record the time the battery pack was charged.

The date, time, user’s initials, calibration gas, and concentration will be recorded on the PID Calibration Log (**Attachment 5**).

3.2 Water-Level Meter

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

Attachment 1

Technical Guidance Instructions

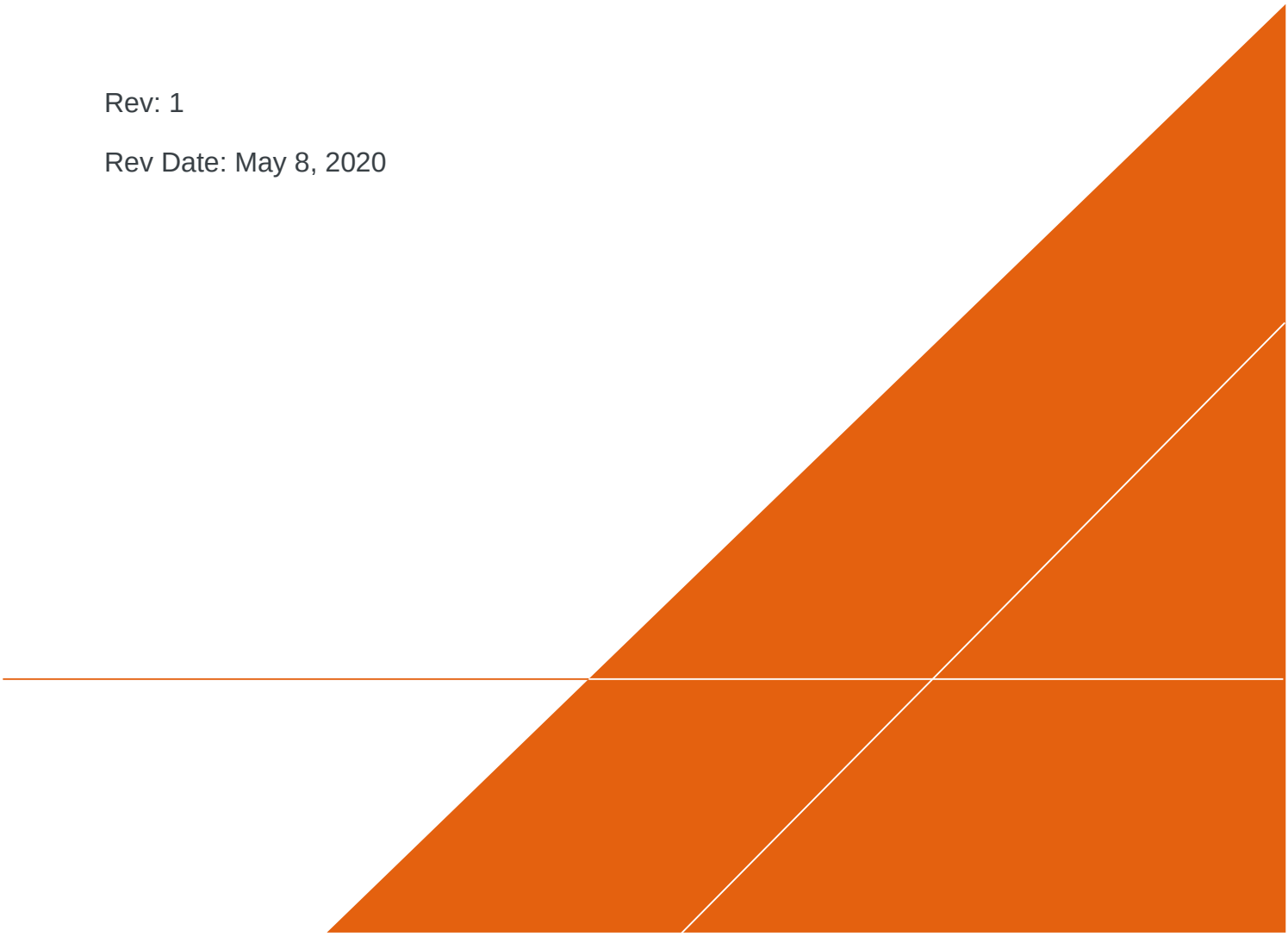
- Groundwater and Soil Sampling Equipment Decontamination
- Installation of Permanent Soil Vapor Probes
- Investigation-Derived Waste Handling and Storage
- PFAS Field Sampling Guide
- Soil Drilling and Sample Collection
- Soil Description
- Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells
- NYSDEC PFAS Guidance April 2023
- Sub-Slab Vapor and Soil Vapor Sampling Using Whole Air Canisters
- Administering Helium Tracer Gas Leak Test
- Sub-Slab Soil Gas Sampling Point Installation Using Vapor PIN™ Approach
- Indoor or Ambient Air Sampling and Analysis Via USEPA Method TO-15

ARCADIS Design & Consultancy for natural and built assets

TGI – GROUNDWATER AND SOIL SAMPLING EQUIPMENT DECONTAMINATION

Rev: 1

Rev Date: May 8, 2020



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Cassandra McCloud / Pete Frederick
1	May 8, 2020	4-5	Added note regarding use of Liquinox and 1,4-Dioxane	Marc Killingstad

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

APPROVAL SIGNATURES

Prepared by:  Date: 02/23/2017

Derrick Maurer

Technical Expert Reviewed by:  Date: May 8, 2020

Marc Killingstad (Technical Expert)

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

Decontamination is performed on sampling equipment prior to sample collection to ensure that the sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that could interfere with laboratory analysis for analytes of interest. Sampling equipment must be appropriately cleaned prior to use for sampling or coming into contact with environmental media to be sampled, and following completion of the sampling event prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The sampling equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling equipment which may be conducted at an established equipment decontamination area (EDA) on site, as appropriate and necessary. Sampling equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between each

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

sample collected, and prior to placing sampling equipment in protective cases, or containers for transport. Cleaning procedures for sampling equipment should be monitored by collecting equipment blank samples as required in project work plans, field sampling plans, quality assurance project plans (QAPP), or other pertinent project documents. Dedicated and/or single-use (i.e., not to be re-used) sampling equipment will not require decontamination.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as specified in the Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The equipment required for equipment decontamination is presented below:

- Health and safety equipment, including appropriate PPE, as required in the site Health and Safety Plan (HASP)
- Deionized water that meets that analytical criteria for deionized water with no detectable constituents above the reporting limits for the methods to be used and analytes being analyzed for. Deionized water is used for inorganics, and organic-free water for VOCs, SVOCs, pesticides, etc.
- Non-phosphate detergent such as Alconox or, if sampling for phosphorus or phosphorus-containing compounds, Liquinox (or equivalent). NOTE: *Liquinox has shown to provide false positives for 1,4-Dioxane and should not be used at sites where that may be a constituent of concern (COC).*
- Tap water
- Rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan, field sampling plan, or regulatory requirements if decontamination waste is to be shipped for disposal
- Brushes
- Large heavy-duty garbage bags
- Spray bottles

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

- (Optional) – Isopropyl alcohol (free of ketones) or methanol. These can be wipes or diluted with water (usually 1part isopropyl/methanol to 10 parts water) if a spray is needed.
- Airtight, sealable plastic baggies, such as Ziploc-type
- Plastic sheeting

5 CAUTIONS

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry. Ensure all rinsate materials do not adversely affect sample collection efficiency or analytical results.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts. Properly containerize equipment to ensure cross-contamination doesn't happen from other uncontaminated surfaces or equipment.

If equipment is damaged to the extent that decontamination is uncertain due to cracks, gouges, crevices, or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination regarding hazardous materials will be performed by a DOT-trained individual for cleaning materials shipped by Arcadis.

Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock.

6 HEALTH AND SAFETY CONSIDERATIONS

Review the safety data sheets (SDS) for the cleaning agents and materials used in decontamination. If solvent is used during decontamination, use appropriate PPE and work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers and bystanders. Follow health and safety procedures outlined in the HASP.

7 PROCEDURE

A designated area will be established to clean sampling equipment in the field prior to and following sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location that expose equipment to contamination (i.e. exposed to combustion engine exhaust). Detergent solutions will be prepared in clean containers for use in equipment decontamination. Decontaminated equipment should be handled by workers wearing clean gloves, properly changed to prevent cross-contamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease. NOTE: *Liquinox has shown to provide false positives for 1,4-Dioxane and should not be used at sites where that may be a constituent of concern (COC).*
3. If equipment is very dirty, precleaning gross debris with a brush and tap water may be necessary.
4. If non-aqueous phase liquids are present, the use of isopropyl alcohol (free of ketones) or methanol is recommended. Cloth wipes or diluted solution can be used to remove the non-aqueous phase liquids that are hard to remove with detergent solution in step 2. Consult with project manager if non-aqueous phase liquids are present onsite and design an appropriate decontamination procedure that includes step 4.
5. Rinse with deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps must be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another container filled with potable water. The pump should be flushed with deionized water as the last step prior to use. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

8 WASTE MANAGEMENT

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

9 DATA RECORDING AND MANAGEMENT

Equipment cleaning and decontamination will be noted in the field notebook for project documentation. Information will include the type of equipment cleaned, the decontamination location, specific procedures utilized, solvents and/or cleaning agents used, source of water, and deviations or omissions from this TGI.

Unusual field conditions should be noted if there is potential to impact the efficacy of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the project documentation. Records will be maintained for solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

10 QUALITY ASSURANCE

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water (or organic-free water, for organic analyses) over the clean and dry tools and collecting the water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned as specified in the sampling and analysis plan. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

11 REFERENCES

USEPA Region 9 - Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1 - Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

TGI: Installation of Permanent Soil Vapor Probes

Rev: 1

Rev Date: January 3, 2022

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
1	0	12/12/2017	All	Initial TGI Development	Eric Epple Daniel Zuck Mitch Wacksman
2	1	1/5/2021	All	Revisions, Update to new format for QMS	Lindsey Deschenes Robert Uppencamp

Approval Signatures

Prepared by:		12/12/2017
	Name (Preparer)	Date
Reviewed by:		1/5/2021
	Name (Subject Matter Expert)	Date

1 Introduction

This Technical Guidance Instruction (TGI) provides the methods and procedures for installing permanent soil vapor probes in subsurface geology. Additional TGIs should be reviewed for soil vapor probe sampling.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

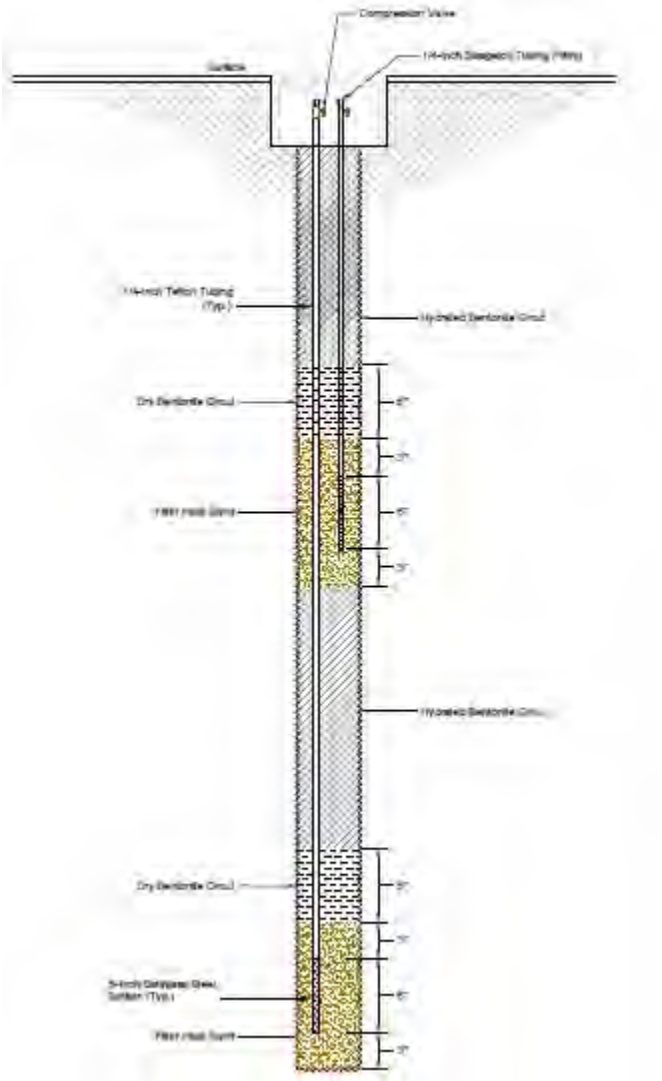
This TGI is recommended as a practical approach for the installation of permanent soil vapor sampling probes where the intent is to collect soil vapor samples over one or more sampling events. Nested sample soil vapor probes (i.e., multiple sample depths inside a single boring) can also be installed using these methods. Methods that can be used to advance the soil vapor probes installation include: hand auger, direct push, and hollow stem auger. Rotary sonic drilling is discouraged but may be necessary in certain circumstances. If rotary sonic drilling is necessary, discuss thoroughly with the project team. Soil vapor samples are often used during vapor intrusion investigations associated with subsurface impacts. Methods for soil vapor sample collection are described in Arcadis documents *TGI: Sub-Slab Soil Vapor or Soil Vapor Sampling Using Whole Air Canisters Analyzed Via USEPA Method TO-15* and *SOP: Soil-Gas Sampling and Analysis Using Sorbent Tubes*. The project team is responsible for ensuring this procedure meets all applicable guidance or regulations in the jurisdiction where work

is performed. Receiving approval/concurrence from the leading regulatory agency for the project is suggested prior to implementation.

Water level gauging, geotechnical sampling, soil sampling, and soil logging are often executed during soil vapor sampling or as part of a vapor intrusion investigation. These activities are outside the scope of this TGI.

The depth of each soil vapor probe should be discussed and determined by the project team prior to beginning installation procedures. Under normal circumstances soil vapor probe should not be shallower than 5’ below ground surface. Soil vapor probe placement is project specific and based on site objectives, however as a general consideration soil vapor probe are often placed approximately 2.5’ above the highest known groundwater elevation.

An example of a finished soil vapor probe is presented in the schematic below.



4 Personnel Qualifications

Soil vapor probe installation activities will be performed by persons who have been trained on proper installation procedures. If geotechnical sampling, soil sampling, or soil logging are required as part of the scope of work it is critical that field personnel are appropriately trained for these additional tasks as described in the appropriate Standard Operating Procedures (SOPs) and/or Technical Guidance Instructions (TGI)s for those activities.

5 Equipment List

The following materials will be available during soil vapor probe installation and soil logging activities, as required:

- Site Plan figure presenting proposed soil boring/well locations
- Work Plan (or equivalent)
- Site-specific Health and Safety Plan (HASP) with task specific Job Safety Analysis (JSAs)
- Personal protective equipment (PPE), as required by the HASP and JSA
- Traffic cones, delineators, caution tape, and/or fencing, as appropriate
- Probe tubing – new 1/4-inch or 3/8-inch outer diameter (OD) Teflon, Teflon-lined, or Nylon tubing. Be aware that some jurisdictions have requirements on the type of tubing to be used.
- Probe cap (to seal the tubing during equilibration) – Swagelok® part number SS-400.
- Probe screen and anchor point – ½-inch OD stainless steel screen, such as the Geoprobe Systems® implant, or similar. Several screen lengths are available (1-inch, 6-inch, 14-inch, 21-inch), for discrete intervals required in Vapor Intrusion investigations, a 6-inch screen is typically recommended. Make sure the diameter of the tubing connection (i.e., barbed, Swagelok®) on the top side of the screen matches the diameter of the sample tubing used for the installation.
- Hand tools including appropriate-sized open-end wrenches (typically 9/16-inch, 1/2-inch, and 3/4-inch), tubing cutters, etc.
- Drum labels as required for investigation derived waste (IDW) handling
- Labels for sample soil vapor probe tubing. Stamped metal tags affixed with zip ties are recommended. Do not use tape.
- MultiRae® four or five-gas meter (or equivalent) for health and safety monitoring during drilling. A photoionization detector (PID) capable of parts per billion (ppb) readings (e.g., ppbRAE); and/or Landtec® GEM 2000 landfill gas meter (or equivalent) may be used instead of the five-gas meter when only VOC hazards exist
- Particulate Dust Meter (PDR-1000) as required by HASP
- Decontamination equipment (bucket, distilled or deionized water, cleansers (Alconox®, TSP, or similar) appropriate for removing expected chemicals of concern, paper towels)
- Engineer's tape/measuring wheel
- Weighted tape
- Digital camera or phone with camera (confirm client approval)
- Field notebook and/or FieldNow® digital app (preferred)

- Appropriate field forms

If soil sampling or soil logging is required by the project additional materials may be required per the appropriate TGIs for these tasks.
Prior to mobilizing to the site, Arcadis personnel will contact the drilling subcontractor to confirm that appropriate equipment will be provided. Specifications of the installation equipment are expected to vary by project, and so communication with the driller is necessary to ensure that the materials provided will meet the project objectives. It is strongly recommended that Arcadis personnel provide sample tubing and fittings and not the drillers.

Equipment/materials typically provided by the driller could include:

- Disposable plastic liners (when drilling with direct-push equipment);
- Drums for investigation derived waste;
- Drilling decontamination materials;
- Decontamination pad materials, if required;
- Boring equipment: hand auger, air knife with vac-truck, and/or drill rig equipped with direct push or rotary auger capability;
- Clean filter silica sand (#2 or larger);
- Granular bentonite and bentonite powder;
- Hydraulic or non-shrink cement grout;
- Tremie pipe with funnel or manual grout pump (1-inch OD PVC Pipe);
- Applicable materials to install watertight protective casing (flush or stand-pipe) to be discussed with drilling contractor prior to mobilization.

6 Cautions

Pre-installation considerations:

- Underground utilities in the vicinity of the drilling areas must be delineated by the drilling contractor or an independent underground utility locator service prior to soil vapor probe installation. See AUS Utility Clearance HS Standard and HASP for detail. An AUS Utility Clearance Checklist must be completed and discussed with the project manager and team. There should be a clear understanding of subsurface conditions at the site, with a minimum of 3 good lines of evidence used.
- A field mobilization memo, work plan or scope of work should be reviewed and discussed with team members (office, field, and subcontractors) prior to implementation to ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all.
- Soil vapor probe installation should not be performed within 48 hours after a significant rain event (defined as >1 inch of rainfall), as saturated soils could present a false saturated soil interval which could lead to inaccurate screen settings.
- Field personnel should not handle substances that could contain VOCs and lead to cross-contamination. These include marking paint, hand sanitizers, fuels and solvents or oils prior to handling soil vapor

construction materials. Clean nitrile gloves should be used when handling any probe components (this include the drilling contractor). Field personnel should not use sharpie markers during installation or note taking.

- Gravel or dense clay may make direct push installation impracticable. Site geology should be discussed with the project technical lead and drilling contractor prior to field work.
- Ensure all soil vapor sampling probes are decontaminated and compatible with sample tubing prior to field mobilization. A two-stage decontamination process is preferred consisting of a soap wash that consists of distilled water detergent (Alconox®, TSP, or similar), then a final rinse with distilled water. The equipment should be allowed to air dry before use. When 1,4 dioxane is a site-specific constituent of concern, TSP (trisodium phosphate) should be used.
-
- **Installation Considerations:**
- Depth to Groundwater – soil vapor samples must be collected in the vadose zone (and above the capillary fringe). The bottom of the soil vapor probe must be above the capillary fringe. Depths of perched water zones should also be considered. Review historical groundwater data for seasonal high groundwater depths.
- If using an air knife for utility clearing, soils should be removed via hand auger or direct push beginning a minimum of 1 foot above the top of the sampling interval. An air knife is discouraged for utility clearance as it can rearrange the subsurface soil vapor profile. Some jurisdictions explicitly prohibit the use of an air knife for soil vapor probe installation.
- Vapor probes can be finished at the ground surface with a flush mount road box (preferred) or with a stand pipe protective casing, similar to groundwater monitoring wells.
- Soil permeability - It may not be feasible to collect soil vapor from finer-grained or tight soils with little pore volume, such as clays or dense dry silts; if there are known clay layers present in the subsurface, these intervals should be avoided when setting vapor probes. During the installation process, it is advisable to collect a soil core from the proposed sampling interval prior to installing the soil vapor probe to identify the exact depth of the capillary fringe and/or determine where the most permeable soil layers are located. For sampling in tighter soils, it is recommended that permanent soil vapor implants be installed with a wider borehole diameter.

7 Health and Safety Considerations

Field activities associated with soil vapor probe installation will be performed in accordance with a site-specific HASP and applicable JSA, a copy of which will be present on site during such activities.

8 Procedure

All drilling equipment must be decontaminated prior to use. Handle and store decontaminated soil vapor probes in a manner that prevents contamination, such as in a Ziploc® bag prior to use.

Inspect vapor probe parts and drilling equipment for wear and faulty parts. Have the driller replace probe tips, o-rings, adapters, and probe rods as appropriate.

The procedures below allow the installation of a soil vapor probe similar to that presented in the figure below. If multiple depths are to be installed, steps 3-6 are repeated, starting with the deepest sample interval.

1. Hand clear boring location as specified in HASP. If an air knife is used, discontinue use 1-foot above the top of the sample interval and finish boring using a hand auger or drill rig.
2. Record in the field log the soil type and any PID readings that were collected from soil cuttings removed during installation. If saturated soils are encountered, plug the interval(s) with granulated bentonite up through the last dry interval.
3. After reaching the desired depth, install sample screen and tubing. Place the screen and tubing into the open borehole or have the driller place inside the direct push drill pipe along with the push tip.
4. Once in place, install the required amount of clean silica sand (as specified in Step 3 based on soil type). Add clean silica sand to create an appropriate sand pack. Typically, there are 3 inches of clean silica sand both above and below a 6-inch sample screen, along with the clean silica sand surrounding the screen, creating a 12 inches total sampling interval.
5. Withdraw the drill pipe 6-inches and place 6 inches of dry granulated bentonite on top of the clean sand layer.
6. Add hydrated granular bentonite or bentonite slurry to 12-inches below the ground surface, or bottom of next sample interval (for nested installations). Install appropriate surface finish (i.e., bolting watertight road box, stick-up). If nested ports are not installed and the depth is greater than 10-feet below grade, a bentonite slurry grout may be placed above the granulated bentonite to 1-foot below grade.
    a. For permanent probe installation at California sites, add 6-inches of hydrated granular bentonite and let it set for a minimum of 30 minutes. After the bentonite is set, pour Portland Neat Cement Type I/II up to 12-inches below ground surface. For temporary probes, to be destroyed shortly after sampling, only use hydrated bentonite up to 12-inches below ground surface.
7. Fill the remaining annulus within the road box with non-shrink grout cement to approximately 0.5-foot below ground surface, or enough to seal the tubing to the protective casing. A small amount of sand may need to be placed on top of the cement to ensure that the tubing does not make contact with the cement during curing.
8. Cut sample tubing long enough to allow enough length to reach a sample container or sorbent tube in the future. For flush mounted casings, 2-3 feet of tubing is recommended. For stand-pipe casing, make sure there is at least 6-7-feet of tubing extending above grade. Terminate sample tubing using an airtight plug or valve. Swagelok® or similar stainless-steel fittings are recommended.
9. Clearly label sample probe and protective casing with ID and depth. Stamped metal tags affixed with stainless zip ties are recommended.
10. Allow at least 24-hours for soil vapor probe equilibration and cement curing prior to leak testing and sampling. See applicable TGIs for these procedures.

9 Waste Management

Investigation-derived wastes (IDW), including soil cuttings, decontamination liquids, and disposable materials (material packages, PPE, etc.), will be placed in clearly labeled, appropriate containers, or managed as otherwise specified in the Work Plan (or equivalent), field sampling plan (FSP), and/or IDW management guidance document.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

Drilling activities should be documented on appropriate field/log forms (see Attachment A) as well as in a proper field notebook and/or PDA. Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of installation activities, soil descriptions, construction specifications (backfill material and borehole diameter, tubing length, screen details, seal type), and quantities of materials used. In addition, the locations of newly-installed soil vapor probes will be documented photographically or in a site sketch. If appropriate, a measuring wheel or engineer's tape will be used to determine approximate distances between important site features. The well location will be surveyed using the method specified in the site Work Plan (or equivalent).

11 Quality Assurance

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate SOP. Soil vapor probe materials will also be cleaned prior to well installation.

12 References

California Environmental Protection Agency (CalEPA) – Department of Toxic Substances Control (DTSC). 2012. Advisory – Active Soil Gas Investigations (https://www.dtsc.ca.gov/SiteCleanup/upload/VI_ActiveSoilGasAdvisory_FINAL_043012.pdf). April.

Interstate Technology Regulatory Council (ITRC). 2007. Technical and Regulatory Guidance. Vapor Intrusion Pathway: A Practical Guideline (http://www.itrcweb.org/documents/VI-1.pdf). January.

New Jersey Department of Environmental Protection (NJDEP) – Site Remediation and Waste Management Program. 2016. Vapor Intrusion Technical Guidance (http://www.nj.gov/dep/srp/guidance/vaporintrusion/vig_main.pdf?version_4). August.

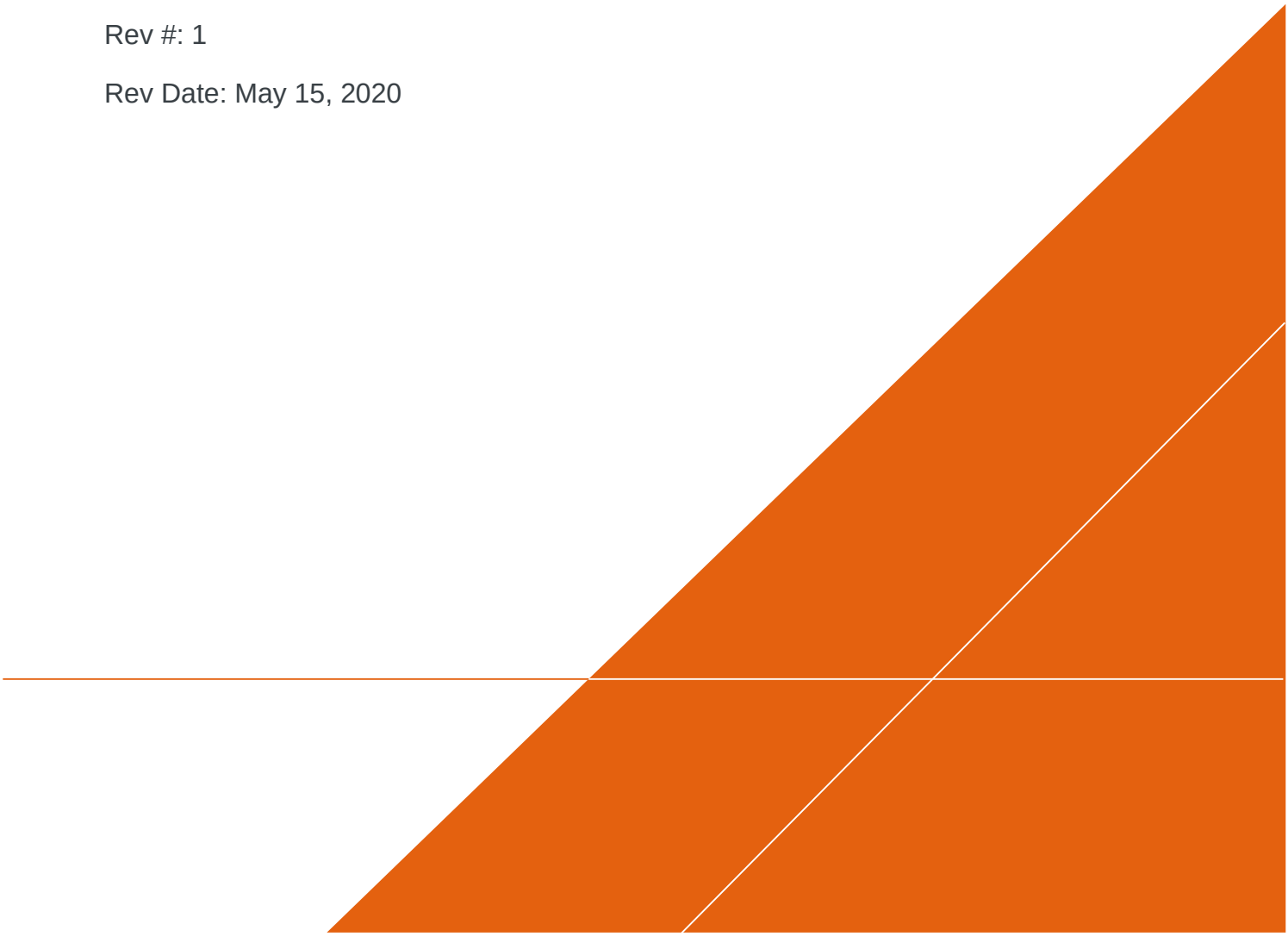
United States Environmental Protection Agency (USEPA) – Office of Solid Waste and Emergency Response (OSWER). 2015. Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf). June.

ARCADIS Design & Consultancy for natural and built assets

TGI - INVESTIGATION-DERIVED WASTE HANDLING AND STORAGE

Rev #: 1

Rev Date: May 15, 2020



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Ryan Mattson / Peter Frederick
1	May 15, 2020	ALL	Updated to reflect regulatory changes	

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

APPROVAL SIGNATURES

Prepared by:		02/23/2017
	Derrick Maurer	Date:
Technical Expert Reviewed by:		05/15/2020
	Ryan Mattson (Technical Expert)	Date:

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

The objective of this Technical Guidance Instruction (TGI) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and nonhazardous, generated during site activities, which may include, but are not limited to: drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. For the purposes of this TGI, IDW is considered to be discarded materials which are defined as solid waste by United States Environmental Protection Agency (EPA) standard 40 CFR § 261.2 (which may include liquids, solids, or sludges). IDW may include soil, groundwater, drilling fluids, decontamination liquids, as well as contaminated personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials. Hazardous or uncharacterized IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary onsite storage area (discussed in further detail under Drum Storage) pending characterization and disposal. IDW materials will be characterized using process knowledge and appropriate laboratory analyses to determine the waste classification and evaluate proper safe handling and disposal methods.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

This TGI describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly transported from the project site and disposed. The procedures included in this TGI for handling and temporary storage of IDW are based on the EPA's guidance document *Guide to Management of Investigation Derived Wastes* (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). Although not comprehensive, the following laws and regulations on Hazardous Waste Management should be considered as potential ARAR. It is the Arcadis Certified Project Manager (CPM) and/or designated Technical Expert to determine which laws and regulations, at all levels of government, are applicable to each project site and activity falling under this TGI.

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987.
- Federal Hazardous Waste Regulations 40 CFR § 260-265

Department of Transportation (DOT) Hazardous Materials Transportation 49 CFR

Occupational Safety and Health Administration (OSHA) Regulations 29 CFR

State Laws and Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Regional, County, Municipal, and Local Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Initial Storage

Pending characterization, IDW will be temporarily stored appropriately within each area of contamination (AOC). Under RCRA, "storage" is defined as the "holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Uncharacterized wastes are considered potentially hazardous wastes and must be stored in DOT approved packaging. Liquid wastes must be stored in DOT approved closed head drums or other approved containers (e.g., portable tank containers) that are compatible with the type of material stored therein. Solid materials must be stored in DOT approved open head drums where practicable. Larger quantities of solid IDW can be containerized in bulk containers (such as in a roll-off box). Soil from large excavation projects may be managed in stockpiles with within the AOC and does not need to be containerized until exiting the AOC.

Characterization

Waste characterization can either be based on generator knowledge, such as using historical process knowledge and safety data sheets (SDS), or can be based upon characterization sampling analytical results. IDW typically is not characterized using SDS as it is a mixture of aged chemicals and environmental media. Historical process knowledge should be used to determine if the IDW is a listed hazardous waste (40 CFR § 261.31-33). If the IDW is not a listed hazardous waste, waste

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

characterization can be completed by laboratory analysis of representative samples of the IDW. The laboratory used for waste characterization analysis must have the appropriate state and federal accreditations and may be required to be pre-approved by the Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization determination.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Waste material classified as RCRA nonhazardous may be handled and disposed of as nonhazardous waste in accordance with applicable federal, state, and local regulations.

Storage Time Limitations

Containerized hazardous wastes can be temporarily stored for a maximum of 90 calendar days from the accumulation start date for a large quantity generator or a maximum of 180 calendar days from the accumulation start date for a small quantity generator. Wastes classified as nonhazardous may be handled and disposed of as nonhazardous waste and are not subject to storage time limitations.

This is TGI may be modified by the CPM and/or Technical Expert for a specific project or client program, as required, dependent upon client requirements, site conditions, equipment limitations, or limitations imposed by the procedure. The resulting procedure employed to execute the work will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the CPM and/or Technical Expert as soon as practicable, and if approved to be performed, be documented.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current regulatory- and Arcadis-required health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Personnel handling and packaging hazardous waste and performing hazardous waste characterizations must have RCRA hazardous waste management training per 40 CFR § 264.16. Additional state-specific hazardous waste management training is required in certain states (i.e., California).

Although not common practice, in certain situations Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator. Arcadis personnel who sign waste profiles and/or waste manifests will have both current RCRA hazardous waste management training per 40 CFR § 264.16 and current DOT hazardous materials transportation training per 49 CFR § 172.704. Arcadis field personnel will also comply with client-specific training. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

4 EQUIPMENT LIST

The Following Materials, as required, will be available for IDW handling and Storage:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan (HASP)
- DOT approved containers
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Portable tank container
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as determined by the CPM and/or Technical Expert.
- Indelible ink and/or permanent marking pens
- Plastic sheeting
- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook

5 CAUTIONS

Filled drums can be very heavy, become unbalanced, or spill its contents. Therefore, use appropriate moving techniques and equipment for safe handling. Similar media (e.g. soils with other soils; or liquids with other liquids) will be stored in the same drums to aid in sample analysis and disposal. Drum lids must be secured to prevent rainwater from entering the drums and leakage during movement. Drums containing solid material may not contain any free liquids. Waste containers stored for extended periods of time may be subject to deterioration. Drum Over Packs may be used as secondary containment. All drums must be visually inspected for condition to ensure that they are in good condition without visible evidence of rusting, holes, breakage, etc., to prevent potential leakage and facilitate subsequent disposal. All drum lids must be verified as having a properly functioning secured lid prior to use.

6 HEALTH AND SAFETY CONSIDERATIONS

As determined by the site's known and suspected hazards, appropriate PPE must be worn by all field personnel within the designated work area. Exposure air monitoring may be required during certain field activities as required in the Site Health and Safety Plan. If soil excavation in areas with potentially hazardous contaminants is possible, contingency plans will be developed to address the potential for encountering gross contamination or non-aqueous phase liquids. All excavation activities shall be in compliance with OSHA standard 29 CFR 1926.651 Excavations, and any other applicable regulations.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

Arcadis field personnel and subcontractors will be trained in and perform their work in compliance with all applicable federal, state, and local health and safety regulations as well as Arcadis' HASP and applicable Client health and safety requirements.

7 PROCEDURE

Specific waste temporary storage and handling procedures to be used are dependent upon the type of generated waste, including type of media (e.g. soils or free liquids) and constituents of concern. For this reason, IDW can be stored in a secure location onsite in separate 55-gallon storage drums, where solids can be stockpiled onsite (if nonhazardous) and purge water may be stored in portable tank containers. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the project team during all phases of the project. Site managers may want to consider techniques such as replacing solvent based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be properly decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that minimize the generation of waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring.

Drum Storage

Drums containing hazardous waste will be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized onsite location that is readily accessible for vehicular pick-up. Drums confirmed as, or assumed to contain hazardous waste will be stored over an impervious surface provided with secondary spill containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific or local-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Very small quantity generators (VSQG) are generators who generate less than 100 kilograms of hazardous

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 calendar days or less without a permit and without having interim status, provided that such accumulation is in compliance with requirements in 40 CFR § 262.17. A SQG may accumulate hazardous waste on site for 180 calendar days or less without a permit or without having interim status, subject to the requirements of 40 CFR § 262.16. VSQG requirements are found in 40 CFR § 262.14. NOTE: The federal VSQG and SQG provisions may not be recognized by some states (e.g., California and Rhode Island). State-specific and local-specific regulations must be reviewed and understood prior to the generation of hazardous waste.

Satellite Accumulation of Hazardous Waste Satellite accumulation (SAA) will mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.15 and without any storage time limit, provided that the generator complies with 40 CFR § 262.15.

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable or reactive hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste should be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste).
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (e.g., polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or "Testing in Progress" label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Pending Analysis, Hazardous, or Nonhazardous)
- Waste generator's name (e.g., client name)
- Project Name
- Name and telephone number of Arcadis project manager
- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Pending Analysis” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied.

- Containers with waste determined to be non-hazardous will be labeled with a green and white "Nonhazardous Waste" label over the "Waste Container" label.
- Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label.

The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition, a DOT proper shipping name will be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g., Boring-1, Test Pit 3, etc.) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when Client or Arcadis has knowledge of a spill that has reached surface water, Client or Arcadis must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.265. Other notifications to state and/or other local regulatory agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

Excavated Solids

Excavated solids may include, but are not limited to: soil, fill, and construction and demolition debris. Prior to permitted treatment or offsite disposal, potentially hazardous excavated solids may be temporarily stockpiled onsite as long as the stockpile remains in the same AOC from where it was excavated. Potentially hazardous excavated solids removed from the AOC must be immediately containerized in labeled drums or closable top roll-offs lined with 9-mil polyvinyl chloride (PVC) sheeting and are subject to LQG storage time limits. Nonhazardous excavated solids can be stockpiled either inside or outside of the AOC, do not have to be containerized and are not subject to hazardous waste regulations. Potentially hazardous excavated solids must not be mixed with nonhazardous excavated solids. All classes of excavated solid stockpiles should be maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (USEPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner or sprayed dust control product. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in closed head drums compatible with the decontamination solution. Decontamination procedures, including personnel and field sampling equipment, must comply with applicable Arcadis procedural documents.

Disposable Equipment

Disposable equipment includes personal protective equipment (e.g., tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, contaminated disposable equipment will also be disposed of as a hazardous waste. If compatible with the original IDW waste stream (i.e., the IDW is a solid and the disposal equipment is a solid), the disposable equipment can be combined with the IDW. If these materials are not compatible (i.e., the IDW is a liquid and the disposal equipment is a solid), the disposable equipment will be stored onsite in separate labeled 55-gallon drums. Uncontaminated or decontaminated disposable equipment can be considered nonhazardous waste.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert plastic materials. The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are described in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any visible sediment and water before returning, a professional cleaning service may be required. Each specific vendor should be consulted concerning specific requirements for returning tanks.
- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

8 WASTE MANAGEMENT

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and local/state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific applicable regulatory agency thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 250 cubic yard basis for stockpiled soil or one per 55-gallon drum per different waste stream for containerized. A four-point composite sample will be collected per 250 cubic yards of stockpiled material and for each drum waste stream. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements and may be reduced for large volumes of waste with consistent properties. Waste characterization samples will be considered valid for consistent waste streams for a period of 1 year. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls (PCBs), as well as reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- or local-specific regulations may require a different or additional sampling approaches.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and local/state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility. Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- and/or local-specific regulations may require different or additional sampling approaches.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with current Arcadis sample chain of custody, handling, packing, and shipping procedures and guidance instructions.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please refer to the current Arcadis training requirements related to handling and shipping of samples, shipping determinations, and hazardous materials.

Preparing Waste Shipment Documentation (Hazardous and Nonhazardous)

Waste profiles will be prepared by the Arcadis CPM and forwarded, along with laboratory analytical data to the Client for approval/signature. The Client will then return the profile to Arcadis who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to the Client for approval. Upon approval of the manifest, the Client will return the original signed manifest directly to the waste contractor or to the Arcadis CPM for forwarding to the waste contractor. Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator.

Final drum labeling and pickup will be supervised by an Arcadis representative who is trained and experienced with applicable waste labeling procedures. The Arcadis representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

9 DATA RECORDING AND MANAGEMENT

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with relevant Arcadis procedures and guidance instructions as well as applicable client and/or project requirements, such as a Quality Assurance Project Plan or Sampling and Analysis Plan. Copies of the chain-of-custody forms will be maintained in the project file. Arcadis should photograph or maintain a copy of any hazardous waste manifest signed on behalf of Client in the corresponding office DOT record file.

10 QUALITY ASSURANCE

The CPM or APM will review all field documentation once per week for errors or omissions as compared to applicable project requirements including but not limited to: the proposal/scope of work, QAPP, SAP, HASP, etc. Deficiencies will be noted, tracked, and resolved. Upon correction, they will be noted for project documentation.

11 REFERENCES

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

TGI – Per- and Polyfluoroalkyl Substances (PFAS) Field Sampling Guide

Rev: 10

Rev Date: January 26, 2022

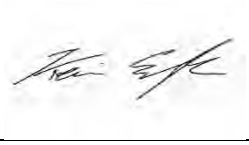
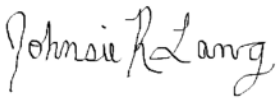
Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	0	April 27, 2017	All	Initial Release	Erica Kalve Erika Houtz Sue Tauro
	1	June 19, 2018	1 through 4 and 17	Updated Information on Sampling Materials	Erica Kalve Erika Houtz
	2	October 15, 2018	6 to 16	Minor updates on laboratory elements, updates to decontamination procedures, and clarification on equipment and reagent blank collection	Erika Houtz Erica Kalve
	3	December 17, 2018	4, 6, 17	Removed Sharpies from acceptable field writing implements; Changed language in Section 3.2 and Section 10.5 to provide stricter guidance for DoD projects.	Erika Houtz, Erica Kalve
	4	March 26, 2019	4,5	Removed Citranox from acceptable Decon solutions in Table 1a, added all fluoropolymer containing materials to prohibited items in Table 1b. Made a correction that Liquinox contains trace levels of 1,4 Dioxane, not Alconox.	Erika Houtz
	5	October 16, 2020	14	Added Air Force preference to sample surface water at surface for Air Force investigations.	Erika Houtz

	6	March 23, 2021	4, 5, 7, 12, 13, 14, 15, 16, 17	Made clarifications that fine/ultra-fine point Sharpies are allowed. Referenced 2018 MDEQ sampling guidance. Made updates to 'After Sample Collection' in Section 7.	Kevin Engle
	7	April 18, 2021	All	Changed title from Poly- and Perfluoroalkyl Substances to **"Per- and Polyfluoroalkyl Substances"** and changed PFASs to PFAS.	Rosario Varrella, Erika Houtz
	8	May 4, 2021	12, 13, 15, 16	Clarified that sample containers should have an HDPE lined screw cap and that LDPE plastic sheeting should be used.	Kevin Engle, Erika Houtz
	9	October 20, 2021	Note that numbers have shifted one page forward relative to prior versions. 5, 7, 9-12, 15, 16, 18-25.	Specific acceptable sunscreen and insect repellent brands were added to Table 1. Clarified language regarding footwear and H&S trainings. Laboratories section and Section 10.5 was updated to reflect new laboratory names and an updated version of the QSM. Sections 5 and 6 were updated to provide clearer language on health and safety protocols for sunscreen, insect repellent, and rain events. Added language to specify decontamination of reusable equipment prior to initial use in Section 7.1. Section 8 on Waste Management was updated to state that	Kevin Engle, Erika Houtz

				waste storage and disposal should be determined in the site specific workplan. Section 9 was updated to include Rite in the Rain® notebooks as approved for PFAS sampling. Changed the term "sample port" to "sample location" when describing where to place plastic sheeting. Section 10.1 was updated to indicate an equipment blank can be collected for unvetted hazard controls that contact a sample. References were updated to include the newer version of the DoD QSM, MDEQ Sampling Guidance, and California State Water Board PFAS Sampling Guidance.
	10	January 26, 2022	Various, Section 7	TGI formatted to comply with new QMS TGI template and Arcadis brand compliance. Indicated to avoid use of anti-fog spray on safety glasses due to possible presence of PFAS.

Approval Signatures

Prepared by:		1/26/2022
	Kevin Engle, PG Geologist (Preparer)	Date
Reviewed by:		1/26/2022
	Johnsie Lang, PhD (Subject Matter Expert)	Date

1 Introduction

This document is intended to provide guidance to field staff sampling for Per- and Polyfluoroalkyl Substances (PFAS). The content in this document describes the intended use, scope and application, personnel qualifications, equipment, cautions, health and safety considerations, procedures, waste management, data recording and management, and quality assurance of PFAS sampling.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

The purpose of this Technical Guidance Instructions (TGI) is to provide guidance on field sampling to be used for **Per- and Polyfluoroalkyl Substances** (PFAS). This protocol was adapted from various sources including Arcadis Australia, Transport Canada, and the U.S Army Corp of Engineers (USACE) Omaha. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. **Table 1a** provides a summary of materials that have been approved for site investigation; this list is expected to grow longer as industry experience increases. **Table 1b** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding

PFAS cross-contamination potential, and it is recommended that these materials be prohibited for sample collection; for materials that are suspected of containing PFAS and/or to retain PFAS, these recommendations are considered preliminary and subject to change. Further discussion of approved and prohibited materials is found throughout this document.

Table 1a: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Investigations

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves™	Low density polyethylene (LDPE) HydraSleeves™ are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to investigation	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Fine/Ultra-Fine point Sharpies®	Larger point Sharpies® should be avoided.	MDEQ 2018
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to investigation	DER 2016

Sampling Materials	Additional Considerations	References
Alconox® or Liquinox® followed by deionized water or PFAS-free water rinse	Liquinox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016
Sun and Biological Protection		
OFF Deep Woods, Sawyer Permethrin	Apply >10 m away from sampling area	MDEQ 2018
Banana Boat, Coppertone, Neutrogena, Meijer, and L'Oreal Sunscreens	Apply >10 m away from sampling area	MDEQ 2018

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 1b: Summary of Sampling Equipment and Materials Not Recommended for PFAS Site Investigations.

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFAS	References
Water Sampling Materials				
Teflon®, PTFE-containing or other fluoropolymer coated or containing field equipment (e.g., tubing, bailers, liners, tape, plumbing paste, pump parts)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFAS	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFAS	References
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Markers		x		NHDES 2016
Decontamination				
[Some] detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFAS, or have the potential to retain PFAS, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFAS, field personnel are advised to err on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFAS. A summary of other specific items related to field sampling for PFAS are discussed in the sections below.

This TGI applies to all Arcadis and subcontractor personnel involved in field sampling for PFAS.

4 Personnel Qualifications

4.1 Sampling Personnel

Field personnel must have current health and safety training, including 40-hour HAZWOPER training, up to date 8-hour refresher, site supervisor training, and site-specific training, as needed. In addition, field personnel will be versed in the other relevant SOPs (e.g., low flow sampling) and will possess the skills and experience necessary

to successfully complete the desired field work. The site Health and Safety Plan (HASP) and other documents will identify any other training requirements such as site-specific safety training or access control requirements.

4.2 Laboratories

These laboratories are example laboratories that could be used to analyze environmental media for PFAS, pending project approval:

- United States: Pace, SGS, Vista, ALS, and Eurofins
- Canada: AXYS-SGS and Bureau Veritas

Other laboratories may be used if they are appropriately accredited for PFAS analysis according to any project requirements. It is recommended that a laboratory is Environmental Laboratory Accreditation Program (ELAP)-accredited for PFAS analysis in accordance with the Department of Defense (DoD) Quality Systems Manual (QSM) 5.3 Table B-15 or any subsequent updates. **For all data collection efforts at DoD sites, PFAS data must be obtained using a method that is DoD ELAP-accredited under QSM 5.3 or later.**

5 Equipment List

The following equipment and materials must be available for sampling:

- Site plan of sampling locations, relevant work plan (or equivalent), and this TGI;
- Appropriate health and safety equipment, as specified in the site HASP;
- Dedicated plastic sheeting (preferably high-density polyethylene [HDPE]) or other clean surface to prevent sample contact with the ground;
- Conductivity/temperature/pH meter;
- Dissolved oxygen meter, oxidation reduction potential meter, and turbidity meter;
- Depth to water meter;
- If using low-flow groundwater sampling techniques, peristaltic pump (groundwater sampling)/bladder pump (with PFAS free bladder/ HDPE bladder), flow through cell, and accompanying HDPE and silicone tubing;
- Hydrasleeves™, if using Hydrasleeves™ for groundwater sampling;
- Metal trowel for soil samples; specialized soil/sediment sampling equipment as required;
- Brushes for scrubbing sampling equipment;
- Pens, pencils, and/or fine/ultra-fine point Sharpies® for writing;
- Clipboards, field binders, and field note pages that are not waterproof;
- Labeled sample bottles:
    - Water: HDPE bottles fitted with polypropylene screw cap only; some types of PFAS samples (primarily drinking water) may require preservative, which will be indicated by the laboratory conducting the analysis. The laboratory will specify the sample bottle volume.

  - Soil and sediment: HDPE bottles fitted with polypropylene screw cap only; no preservatives. The laboratory will specify the sample bottle volume.
- If high concentrations of PFAS related to class B firefighting foams are expected, bring additional small vials to conduct field-based shaker tests for foaming;
- Ziploc® bags to hold ice and samples;
- Bottles containing “PFAS-free” water used for reagent blanks;
- Labeled, thoroughly decontaminated coolers for samples with ice; Blue ice is not permitted;
- Deionized or distilled water for initial decontamination rinsing;
- “PFAS-free” water provided by the laboratory for final decontamination rinsing;
- Methanol, isopropanol, or acetone if able to be brought safely to field site; especially important for decontamination during soil sampling;
- Alconox or Liquinox®;
- Packing and shipping materials;
- Groundwater and/or Sampling Log; and
- Chain-of-Custody (COC) Forms.

6 Cautions

6.1 Food Packaging

Some food packaging may be treated with PFAS-containing chemicals to prevent permeation of oil and water in the food outside of the packaging. To avoid potential food packaging-related PFAS contact:

- Do not bring any food outside of the field vehicles onsite and eat snacks and meals offsite.
- Wash hands after eating.
- Remove any field garments or outer layers prior to eating. Do not put them back on until done eating and hands are washed.

6.2 Field Gear

6.2.1 Clothing

Many types of clothing are treated with PFAS for stain and water resistance, in particular outdoor performance wear under brand names such as Gore-Tex®. To avoid potential clothing-related PFAS contact:

- Do not wear any outdoor performance wear that is water or stain resistant, or appears to be. Err on the side of caution.

- Wear pre-laundered (multiple washings, i.e., 6+) clothing that is not stain resistant or waterproof (unless made from the materials listed in Section 5.3.1).
- Natural fabrics such as cotton are preferred. Synthetic fabrics may also be acceptable if there is no indication on the label that the fabric is water and stain resistant.
- Most importantly, avoid contacting your clothing with sampling equipment, bottles, and samples.

6.2.2 Personal Protective Equipment

Safety Footwear

Some safety footwear has been treated to provide a degree of waterproofing and increased durability and may represent a source of trace PFAS. If at all possible, Gore-Tex footwear should not be worn and safety footwear without waterproofing should be worn; footwear that provides adequate safety from physical hazards is required and takes precedence over potential PFAS concerns. To avoid any PFAS cross contamination to samples from footwear:

- Do not contact your footwear with equipment, bottles, or samples in any way.
- Do not allow gloves used for sampling to come in contact with safety footwear.

Nitrile Gloves

Wear disposable nitrile gloves at all times. Don a new pair of nitrile gloves **before** the following activities at each sample location:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or “PFAS-free” water bottles;
- Insertion of anything into the sample ports (e.g., HDPE tubing); and
- Handling of any quality assurance/quality control (QA/QC) samples including field blanks and equipment blanks.

Don a new pair of nitrile gloves **after** the following activities:

- Handling of any non-dedicated sampling equipment;
- Contact with contaminated surfaces; or
- When judged necessary by field personnel.

6.3 Personal Hygiene

- Shower at night.
- Do not use personal care products after showering such as lotions, makeup, and perfumes, UNLESS medically necessary.
- Use sunscreen and insect repellent as necessary for health and safety, i.e., if sampling is to occur outdoors in direct sunlight and/or if insect hazards may be present. Specific products that are acceptable for PFAS

sampling are listed in Table 1 and in Section 6.1. Apply sunscreen and insect repellant prior to initiating field sampling. If sunscreen and/or repellant need to be reapplied, ensure a safe distance away from the sampling locations and equipment (i.e., more than 10 meters (m) away). Wash hands after application and don new gloves following hand washing.

6.4 Visitors

Visitors to the site are asked to remain at least 10 m from sampling areas.

7 Health and Safety Considerations

7.1 Biological and Environmental Hazard Controls

7.1.1 Sunscreens and Insect Repellents

When site conditions warrant, insect repellent and sunscreen should be applied. Some insect repellents and sunscreen have been approved for PFAS sampling by individual states. According to Michigan Department of Environmental Quality (MDEQ; now known as Michigan Department of Environment, Great Lakes, and Energy [EGLE]), the products below are allowable (MDEQ 2018). Note that California State Water Quality Control Board's PFAS sampling guidance refers to MDEQ/EGLE's allowable list of sunscreens and insect repellents (California State Water Quality Control Board 2020).

Insect Repellents

- OFF Deep Woods
- Sawyer Permethrin

Sunscreen

- Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30
- Meijer Sunscreen Lotion Broad Spectrum SPF 30
- Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30
- Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30
- Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30
- Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30
- Banana Boat Sport Performance Sunscreen Stick SPF 50
- Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50
- Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30
- Coppertone Sunscreen Stick Kids SPF 55
- L'Oréal Silky Sheer Face Lotion 50+
- Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50
- Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70
- Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70
- Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30
- Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+

Please plan for sampling events and purchase these products ahead of time. For any sunscreens and bug sprays, including those listed above, always follow these instructions for application:

- Insect repellents and sunscreen should be applied away from the work area prior to initiating sampling.
- When re-applying, stay at least 10 m away from the sampling locations and equipment.
- Wash hands after application and don new nitrile gloves.

7.1.2 Rain Event

Special care should be taken when rain is falling at the project site:

- Field sampling during extreme rainfall should be avoided if possible. If sampling needs to take place during a rain event (or other extreme weather condition), ensure the rain gear or other safety clothing is appropriate. For example, rain gear made from the following materials is allowable: polyurethane, PVC, wax coated fabrics, rubber/neoprene, uncoated Tyvek® (MDEQ 2018).
- If project timelines are tight, consider the use of a gazebo tent that can be erected over the top of the monitoring well to provide shelter from the rain. The canopy material is possibly a PFAS-treated surface and should be managed as such; therefore, wear gloves when moving the tent, change them immediately after moving the tent, and avoid further contact with the tent until all sampling activities have been finished and the team is ready to move on to the next site.

7.1.3 Other H&S Considerations

- ***If an unapproved or potentially suspect hazard control is needed for health and safety, apply or keep that control away from the samples, document its use in field notes, and, if it does contact a sample, take an equipment blank with that material.***
- The ability to safely access the surface water sampling locations must be verified before sampling.
- Field activities must be performed in accordance with the site HASP, a copy of which will be present onsite during such activities.
- Safety hazards associated with sampling surface water include fast-moving water, deep water, and steep slopes close to sampling sites. Use extreme caution when approaching sampling sites.
- If thunder or lighting is present, discontinue sampling and take cover until 30 minutes have passed after the last occurrence of thunder or lighting.
- Use caution when removing well caps as well may be under pressure, cap can dislodge forcefully and cause injury.
- Avoid the use of anti-fog sprays on glasses, which may contain PFAS. It's recommended to instead purchase pre-treated anti-fog safety glasses.

8 Procedure

8.1 Field Equipment Cleaning

Reusable field sampling equipment will require cleaning before initial use and between uses. For groundwater sampling, between uses, decontaminate the flow-through cell and any non-dedicated equipment (i.e., interface probe of depth to water meter) that comes into contact with well water. Trowels and other materials used to sample soil samples will also require decontamination, although dedicated, single use equipment such as liners should be used where possible.

After donning a new pair of nitrile gloves:

- Rinse sampling equipment with Alconox or Liquinox® cleaning solution; Scrub equipment with a plastic brush if needed;
- Rinse two times with distilled water or deionized water;
- Rinse one time with “PFAS-free” water or once with methanol/isopropanol/acetone, if it is available, and once with “PFAS-free” water; organic solvents are especially useful for decontaminating soil sampling equipment. If organic cleaning solvents cannot be brought to site, scrub equipment a second time after a single distilled or deionized water rinse, then rinse two times with distilled or deionized water and once with “PFAS-free” water (i.e., two scrubbings and four water rinsings total).
- Collect all rinsate in a sealed pail for disposal. Do not reuse decontamination solutions between sampling locations.

8.2 Borehole/Monitoring Well Development

If a drill rig is being used to drill for soil cores or to install monitoring wells, wear clean nitrile gloves before collecting each continuous soil sample. Additional requirements include the following:

- Verify in writing with the manufacturer that single-use liners used to collect each sample are made of a material that does not contain PFAS;
- Collect soil samples in laboratory-supplied HDPE bottles.
- Store the sample bottles in coolers and keep at a temperature of 0 to 6ºC until transported to the laboratory.

8.2.1 Well Condition Survey/ Water Level Monitoring

Using equipment that has been thoroughly decontaminated according to the procedures in Section 7.1, conduct the well condition surveys and water level monitoring:

- Conduct monitoring well inspections and record water levels.
- Use an interface probe to evaluate presence/absence of non-aqueous phase liquid (NAPL).
- Measure the depth to water from the top of the polyvinyl chloride (PVC) riser and the total depth of the well.
- Record information in the field notes.

8.2.2 Monitoring Well Development and Purging

Follow these requirements for monitoring well development and purging:

- Do not use Teflon™ tubing for purging or sample collection. HDPE tubing is acceptable.
- Do not re-use materials between wells. Upon completion of use, remove all disposable materials (such as HDPE and/or silicone tubing) and place in heavy duty garbage bags for disposal.
- During development of the well, create sufficient energy to agitate the water column and create flow reversals in the well screen, filter pack and formation to loosen fine-grained materials and draw them into the well. The pumping or bailing action should then draw all drilling fluids and fine-grained material out of the borehole and adjacent formation and then out of the well. Review the Arcadis Monitoring Well Development guidance (Arcadis 2010) for more detailed information.
- Follow the low-flow purge and sampling techniques per the U.S. Protection Agency's (EPA's) guidance document titled *Low Stress (Low Flow) purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells* (2010) and ASTM's standard titled *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations* (2002). Also available for review is the Arcadis Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells (Arcadis 2011).
- To purge the well, if using HDPE tubing and a peristaltic pump, insert the end of the tubing to the approximate depth of the midpoint of the screened section of the monitoring wells. Measure the length of HDPE tubing to be inserted into each monitoring well and pre-cut it to approximate lengths (such as the previously measured arm span of a field technician) to avoid contact with any materials other than the monitoring well and peristaltic pump. Flow rates should be as low as can be reasonably achieved. Collect and appropriately dispose of purge water.
- Silicone tubing should direct the purge water through a flow-through cell for field parameter measurements of pH, conductivity, temperature, dissolved oxygen, and turbidity. Calibrate the instrument in the field prior to use. Decontaminate the instrument and flow-through cell at each monitoring well location before purging.
- Record field parameters in intervals (generally of 3-minute duration) to ensure purge water has cycled through the flow-through cell. Sample the wells after field parameter measurements indicate stabilization, which allows collection of representative formation water (generally acceptable standards are three consecutive pH readings to within ±0.1 units, and three consecutive conductivity, temperature and dissolved oxygen measurements to within 3%). Turbidity must be monitored, but does not need to be used as a stabilization indicator of purge completion. Record field parameter measurements at each well. Drawdown should be monitored throughout the purge.
- If wells are suspected to be dewatering throughout the purge (i.e., reduced flow rate/difficulty pumping water or bubbles begin to come through the flow through cell), turn off the pump and allow the water level to recover for ½ hour, followed by sample collection. Document these activities in the field notes.

8.3 Sample Collection

Different laboratories may supply sample collection bottles of varying sizes depending on the type of media to be sampled.

8.3.1 Sample Containers

- Collect samples in HDPE bottles fitted with a HDPE lined (no Teflon™) screw cap.
- Complete bottle labels after the caps have been placed back on each bottle.
- Do not use glass bottles due to potential loss of analyte through adsorption. This is particularly important for aqueous samples.
- Review with analytical lab the sample size, sample container, etc. depending upon the type of PFAS analysis that is being requested.

8.3.2 Soil Sampling

Before Sample Collection

- Place LDPE plastic sheeting adjacent to the sample location for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Trowels or drilling equipment that will come into contact with a sample should be decontaminated prior to sample collection, preferably with methanol/isopropanol/acetone;
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.

During Sample Collection

- Collect soil samples using a clean stainless-steel trowel or with single-use PFAS-free liners;
- Place soil samples in labeled HDPE bottles supplied by the laboratory.
- Note the time on the sample label.
- Collect any necessary duplicates/co-located samples and matrix spikes – verify with laboratory whether they need to be collected in separate sample bottles.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFAS, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

After Sample Collection

- Place each sample bottle in two sealed Ziploc® bags. Another brand of LDPE bag is acceptable.
- Record the label information and time of sampling in the field notes.
- Place soil sample bottles in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. Do not use blue ice.

8.3.3 Groundwater Sampling

Before Sample Collection

- Place LDPE plastic sheeting adjacent to the sample location for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the labeled HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.
- Measure depth to water and field parameters. Turbidity and the physical appearance of the purged water should be noted on the Groundwater Sampling Log.

During Sample Collection

- Start groundwater sample collection upon stabilization of field parameters.
- If low-flow groundwater sampling techniques are being used, disconnect the silicone tubing from the flow-through cell, enabling collection of groundwater samples without passing through the cell.
- Hydrasleeves are also considered acceptable for sampling of PFAS in groundwater – consult the project manager to determine which technique should be used. In general, low flow sampling is preferable.
- Collect groundwater samples (to the neck of the bottle, some headspace is acceptable) from the dedicated sampling ports at the center of the well screen. While collecting the sample, make sure the bottle cap remains in the other hand of the sampler, until replaced on the bottle.
- To mitigate cross contamination, collect groundwater samples in a pre-determined order from least impacted to greater impacted based on previous analytical data or knowledge about past activities at the site. If no analytical data are available, samples are to be collected in the following order:
    1. First sample the upgradient well(s).
    2. Next, sample the well located furthest downgradient of the interpreted or known source.
    3. The remaining wells should be progressively sampled in order from downgradient to upgradient, such that the wells closest to the interpreted or known source are sampled last.
- NOTE: If high concentrations of PFAS related to class B firefighting foams are expected in a groundwater sample, conduct a Shaker test by collecting and shaking a small portion of the sample (~10 to 25 mL) on site in a small disposable vial. If foaming is noted within the sample, document the foaming when samples are

submitted for analysis; the 'shaker test' vial can then be disposed. This shaker test provides information about how each of the samples should be handled analytically.

- After collecting the sample, tightly screw on the polypropylene cap (snug, but not too tight). This will minimize leaking or cross contamination of the sample. Most PFAS, including all analytes measured by USEPA Method 537, are not volatile at environmental pH.
- Note the time on the sample label.
- Collect any necessary duplicates and matrix spikes. As the laboratory should be analyzing the entire aqueous sample rather than sub-sampling, separate bottles will be required for these samples.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFAS, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.
- Do not rinse PFAS sample bottles during sampling. Do not filter samples.

After Sample Collection

- Place each sample bottle in two sealed Ziploc® bags. Another brand of LDPE bag is acceptable.
- Record the label information and time of sampling in the field notes and COC. Note ‘shake test’ results if appropriate.
- Place groundwater samples in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

  Treat all disposable sampling materials as single use and dispose of them appropriately after sampling at each monitoring well.

8.3.4 Sediment Sampling

Before Sample Collection

- Place LDPE plastic sheeting adjacent to the sample location for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.

During Sample Collection

- Where surface water samples and sediment samples are collected at the same location, collect surface water samples first to minimize siltation.

- Collect sediment samples either manually using a stainless-steel trowel or using a petite ponar grab sampler, depending on field conditions at each sampling location during sampling program.
- Collect sediment samples from the upper 10 cm of sediment.
- For a sample to be acceptable overlying, low turbidity water must be present.
- Decant the overlying water and use a stainless-steel trowel to collect only the upper 5 centimeters (cm) of sediment.
- Collect sediment samples directly into laboratory-supplied bottles that are suitable in both material and size.
- Do not overfill the sample bottle.
- Make sure that the sample does not contain vegetation, that the sediment is undisturbed, and that the sampler shows no signs of winnowing or leaking.
- Make sure bottle caps remain in the gloved hand of the sampler until sampling is complete and caps are replaced on the bottle.
- Note the time on the sample label.
- Collect any necessary duplicates and matrix spikes.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFAS, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

After Sample Collection

- Place each sample bottle in two sealed Ziploc® bags. Another brand of LDPE bag is acceptable.
- Record the label information and time of sampling in the field notes.
- Place samples in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**
- Measure surface water pH, conductivity, temperature, and total dissolved solids (TDS) at each location **after** both surface water and sediment sampling is completed.

8.3.5 Surface Water Sampling

Before Sample Collection

- Place LDPE plastic sheeting adjacent to the sample location for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.

- Use the HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.

During Sample Collection

- Avoid sampling the surface, in general.
- However, for Air Force investigations, collect samples from the water surface.
- Where surface water samples and sediment samples are collected at the same location, collect surface water samples first to minimize siltation.
- Collect surface water samples directly into laboratory-supplied bottles; wide-mouth bottles may be preferable to narrow mouth bottles for ease of surface water collection.
- Make sure bottle caps remain in the gloved hand of the sampler until sampling is complete and caps are replaced on the bottle.
- Note the time on the sample bottle.
- Collect any necessary duplicates and matrix spikes. As the laboratory should be analyzing the entire aqueous sample rather than sub-sampling, separate bottles will be required for these samples.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFAS, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

After Sample Collection

- Place each sample bottle in two sealed Ziploc® bags. Another brand of LDPE bag is acceptable.
- Record the label information and time of sampling in the field notes.
- Place samples in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**
- Measure surface water pH, conductivity, temperature, and TDS at each location **after** both surface water and sediment sampling.

8.4 Shipping

- If samples cannot be shipped the same day as collected, arrange an appropriate means of keeping the samples cool overnight and maintain the temperature between 0 and 10°C for the first 48 hours after collection, and then between 0 and 6°C thereafter.
- Store samples in appropriate transport bottles (coolers) with ice (Ziploc© bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

- Complete the appropriate procedures for COC, handling, packing, and shipping.
- Fill out and check COC Forms against the labels on the sample bottles progressively after each sample is collected.
- Place all disposable sampling materials (such as plastic sheeting, and health and safety equipment) in appropriate containers.
- Ship samples via courier service with priority overnight delivery. Tracking numbers for all shipments should be provided and recorded after they have been sent out to ensure their timely delivery.
- Do not ship samples via Fed Ex for Saturday delivery.

9 Waste Management

All rinsate should be collected in a sealed pail for disposal. Drill cuttings and purge water will be managed as specified in the Field Sampling Plan (FSP) or Work Plan, and according to state and/or federal requirements. PPE and decontaminated fluids will be contained separately and staged at the sampling location. Containers must be labeled at the time of collection. Labels will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, groundwater, PPE). General guidelines for investigation derived waste (IDW) handling and storage are set forth in a separate IDW guidance document (Arcadis 2009).

Typical waste characterization procedures include collection of a composite sample of the drill cutting material and a composite sample of the purge water for laboratory analysis. Samples are typically analyzed for disposal toxicity characteristic leaching procedure (TCLP) analysis for metals and VOCs. For PFAS, a simple leach test with neutral pH water may be more indicative of actual risk. Additionally, generators of waste are required to include analysis of other constituents that are reasonably believed to be present including (in this case) PFAS.

Waste storage and final waste disposition should be determined in the site specific workplan.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

If digital data collection isn't possible, waterproof field books should be avoided for field notes. Instead, field notes on loose paper on Masonite, plastic, or aluminum clip boards is preferred. Please note that newer Rite in the Rain® notebooks are approved for PFAS sampling. Other requirements for field notes include:

- Pens, pencils, and fine/ultra-fine point Sharpies® may be used.
- Keep field notes and writing implements away from samples and sampling materials.
- One person should conduct sampling while another records field notes.

- Do not write on sampling bottles unless they are closed.

10.1 Other Project Documentation

- Complete groundwater and/or soil sampling logs.
- Make sure COC Forms are properly completed. Verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the 537 list, etc.) are required for analysis and note on the COC.

11 Quality Assurance

Refer to quality control requirements for the project to ensure that appropriate quality assurance and quality control (QA/QC) samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles;
- Bottle caps must remain in the hand of the sampler until replaced on the bottle;
- Labels must be completed after the caps have been placed back on each bottle; and
- Samples must be stored in appropriate transport bottles (coolers) with ice (Ziploc© bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

11.1 Equipment Blanks (if relevant)

QA/QC sampling typically includes daily collection of equipment blanks using the laboratory-supplied “PFAS-free” water. For peristaltic pump tubing, laboratory supplied “PFAS-free” water should be poured into a clean HDPE sample bottle and then pumped through new HDPE tubing using the peristaltic pump (with new silicone tubing). The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFAS, after the sampling equipment has been appropriately decontaminated. Note that an equipment blank can also be collected if an unapproved or potentially suspect hazard control is needed for health and safety and it contacts a sample, i.e., that material would be exposed to PFAS free water then the water would be collected in a separate sample container.

11.2 Field Duplicates

QA/QC sampling typically includes the collection of one field duplicate for every 10 or 20 samples collected. Each duplicate sample will be collected immediately after the initial sample of which it is a duplicate into a separate laboratory-provided sample bottle. Do not indicate to the laboratory which sample the duplicate replicates, i.e., it should be given a blind reference on the COC and sample name such as “duplicate”.

11.3 Field Reagent Blanks

QA/QC sampling for PFAS typically includes the submission of one laboratory supplied field reagent blank per day. The field reagent blank sample is brought to the site in a laboratory-supplied sample bottle. Field staff

transfer the laboratory-supplied reagent blank to an empty sample bottle. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel and should be placed in the same cooler as the other PFAS samples.

11.4 Matrix Spikes (optional in some cases)

QA/QC sampling includes submitting a sample to be used as a matrix spike if the project requires it. If a separate sample bottle is required, an additional sample will be collected immediately after the initial sample of which it is a duplicate into a separate laboratory-supplied sample bottle.

11.5 Laboratory Analytical QA/QC

- Arcadis recommends that any request for PFAS analysis in groundwater or soil should be conducted by an ELAP-accredited method compliant with QSM 5.3 Table B-15. Requirements laid out in Table B-15 strictly govern acceptable laboratory data quality for PFAS analysis in environmental samples. **For all data collection efforts at DoD sites, PFAS data must be obtained using a method that is DoD ELAP-accredited under QSM 5.3 or later.**
- Laboratory QA/QC should consist of one laboratory blank and one laboratory control sample (or blank spike) per batch of samples, and additional QA/QCs as indicated by the laboratory QA/QC procedures.
- Isotope dilution should be used for quantification with isotope-labeled surrogate standards, as available, according to the guidelines of QSM 5.3 Table B-15. The USEPA has two drinking water methods (USEPA Method 537.1 and USEPA Method 533). Method 537.1 does not allow for isotope dilution but USEPA Method 533 requires isotope dilution.
- For drinking water, groundwater, and surface water samples, laboratories must extract the entire sample and include a solvent rinse of the bottle for analysis. Aqueous samples should generally not be sub-sampled prior to analysis, unless they are high concentration and require serial dilution (US DoD 2017).
- Soil samples should be analyzed in their entirety or thoroughly homogenized before extraction and analysis.
- As part of the internal QA/QC of laboratory results, relative percent difference (RPD) should be calculated between samples and corresponding field or laboratory duplicates. The laboratory quality assurance portion of the laboratory certificates should be reviewed to verify that all calculations/recoveries were within acceptable limits as established by the laboratory method and guidelines in Table B-15 of QSM 5.3 or later (USDoD 2019).

12 References

Arcadis Australia. 2017. Soil and Concrete Sampling for PFAS. April.

Arcadis. 2010. Monitoring Well Development, Rev. #2.2. March 22.

Arcadis. 2009. Investigation-Derived Waste Handling and Storage, Rev. #2. March 6.

Arcadis. 2011. Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells, Rev. #4. February 2.

ASTM. 2002. ASTM D6771-02 - Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations (Withdrawn 2011). Available at: https://www.astm.org/Standards/D6771.htm.

California State Water Quality Control Board. 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines for Non-Drinking Water. September. https://www.waterboards.ca.gov/pfas/docs/sept_2020_pfas_sampling_guidelines.pdf

Department of Environment Regulation (DER). Government of Western Australia. 2016. Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS). Contaminated Sites Guidelines. February.

Michigan Department of Environmental Quality (MDEQ). 2018. General PFAS Sampling Guidance. October. https://www.michigan.gov/documents/pfasresponse/General_PFAS_Sampling_Guidance_634597_7.pdf

Massachusetts Department of Environmental Protection (MassDEP). 2017. DRAFT Fact Sheet, Guidance on Sampling and Analysis for PFAS at Disposal Sites Regulated under the Massachusetts Contingency Plan. January.

New Hampshire Department of Environmental Services (NHDES). 2016. Perfluorinated Compound (PFC) Sample Collection Guidance. November.

United Nations Environment Programme (UNEP). 2015. PFAS analysis in water for the Global Monitoring Plan of the Stockholm Convention, Set-up and guidelines for monitoring. Jana Weiss, Jacob de Boer, Urs Berger, Derek Muir, Ting Ruan, Alejandra Torre, Foppe Smedes, Branislav Vrana, Fabrice Clavient, and Heidelore Fiedler. Division of Technology, Industry and Economics. Geneva. April.

United States Army Corps of Engineers (USACE). 2016. DRAFT – Standard Operating Procedure 047: Per/Poly Fluorinated Alkyl Substances (PFAS) Field Sampling. Revision: 1. March.

U.S. Army Corps of Engineers – Omaha District. 2016. Chemistry Requirements – PFAS.

U.S. Department of Defense (DoD). 2019. Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3. In conjunction with the U.S. Department of Energy. May.

U.S. Environmental Protection Agency. 2009. USEPA Method 537: Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), version 1.1, September. National Exposure Research Laboratory, Office of Research and Development.

U.S. Environmental Protection Agency. 2010. Low Stress (Low Flow) purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells. Available at: https://www.epa.gov/quality/low-stress-low-flow-purging-and-sampling-procedure-collection-groundwater-samples-monitoring.

Transport Canada. February 2016, Per-and Polyfluorinated Alkyl Substances (PFAS) Field Sampling Guidance.

TGI – Soil Drilling and Sample Collection

Rev: #3

Rev Date: April 5, 2023

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	0	October 11, 2018	All	Updated and re-written as a TGI	Marc Killingstad
	1	May 12, 2020	None	Review – no changes necessary	Marc Killingstad
	2	April 8, 2022	All	Updated to new format and minor content (e.g., PFAS)	Chris Shepherd/Marc Killingstad
	3	April 5, 2023	All	Annual review completed by Marc Killingstad. Updated document revision number, document date; version control and signature page.	Marc Killingstad

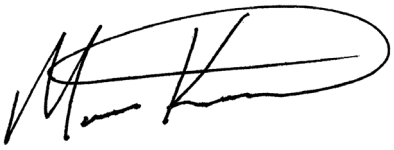
Approval Signatures

Prepared by: 4/5/2023



Chris Shepherd (Preparer) Date

Reviewed by: 4/5/2023



Marc Killingstad (Subject Matter Expert) Date

1 Introduction

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM. All deviations or omissions should be documented.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

This Technical Guidance Instruction (TGI) describes general drilling procedures and the methods to be used to field screen and collect soil samples for laboratory analysis in unconsolidated or weakly consolidated sediments. For soil description procedures, please refer to the *TGI - Soil Description*. For monitoring well installation in granular aquifers, please refer to the *TGI - Monitoring Well Installation*. For per- and polyfluoroalkyl substances (PFASs) drilling and soil sampling procedures, please refer to: *TGI – PFAS-Specific Drilling and Monitoring Well Installation, TGI – Per- and Polyfluoroalkyl Substances (PFAS) Field Sampling Guide*, and *TGI – Equipment and Reagent Blank Sample Collection for PFAS Analysis*.

Overburden (unconsolidated sediments) drilling is commonly performed using the hollow-stem auger drilling method. Other drilling methods suitable for overburden drilling, which are sometimes necessary due to site-specific geologic conditions, include: direct-push, drive-and-wash, spun casing, rotasonic, dual-rotary (Barber Rig), and fluid/mud rotary with core barrel or roller bit. Direct-push techniques (e.g., Geoprobe or cone penetrometer) and hand tools may also be used. Drilling within consolidated materials such as fractured rock is commonly performed using water-rotary (coring or tri-cone roller bit), air rotary or rotasonic methods. For guidance when drilling in consolidated materials (i.e., bedrock), please refer to *the TGI – Bedrock Core Collection and Description.*

The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling depths, targeted chemicals, site or regional geologic knowledge, types of sampling to be conducted, required sample quality and volume, and cost.

Field screening of soil samples is commonly performed using a photoionization detector (PID) and/or a flame ionization detector (FID). These instruments are used to measure relative concentrations of volatile organic compounds (VOCs) for the selection of samples for further laboratory or field analysis. Field screening for dense non-aqueous phase liquids (DNAPL) may be performed using hydrophobic dye (Oil Red O or Sudan IV), which is pertinent at chlorinated solvent sites.

Collection of soil samples for laboratory analysis may be performed using a variety of techniques including grab samples, undisturbed cores, and composite or homogenized samples. Samples may require homogenization across a given depth interval, or several discrete grabs (usually five) may be combined into a composite sample. Samples for VOC analysis will not be homogenized or composited and are collected as discrete grab samples.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools). Some lubricants (e.g., vegetable oil-based lubricants) may be acceptable, if the constituents won't interfere with the analyses.

4 Personnel Qualifications

Arcadis field personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or state/federal regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as identified in the site-specific Health and Safety Plan (HASP) which may include first aid,

cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. The HASP will also identify any access control requirements.

Prior to mobilizing to the field, Arcadis field personnel will review and be thoroughly familiar with relevant site-specific documents including but not limited to the task-specific work plan or field implementation plan (FIP), Quality Assurance Project Plan (QAPP), HASP, historical information, and other relevant site documents.

Arcadis field personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. Personnel responsible for overseeing drilling operations will have at least 16 hours of prior training overseeing drilling activities with an experienced geologist, environmental scientist, or engineer with at least 2 years of prior experience.

Arcadis personnel directing, supervising, or leading soil sampling activities will have a minimum of 1 year of previous environmental soil sampling experience. Field employees with less than 6 months of experience will be accompanied by a supervisor (as described above) to ensure that proper sample collection techniques are employed.

Additionally, the Arcadis field team will review and be thoroughly familiar with documentation provided by equipment manufacturers and become familiar with the operation of (i.e., hands-on experience) all equipment that will be used in the field prior to mobilization.

5 Equipment List

The following materials will be available, as required, during soil boring drilling, field screening, andsampling activities:

- Site-specific HASP and health and safety documents identified in the HASP
- FIP/work plan that includes site map with proposed boring locations, fieldsampling plan (with corresponding depths, sample analyses, sample volume required, and sample holding time), and previous boring logs (as available)
- Appropriate personal protective equipment (PPE), as specified in the HASP
- Including but not limited to disposable chemical resistant gloves and Level D PPE
- Traffic cones, delineators, and caution tape as appropriate for securing the work area as specified in the Traffic Safety Plan (TSP)
- Photoionization detector (PID), flame ionization detector (FID) or other air/soil screening equipment, asneeded, in accordance with the HASP or workplan
- Sampling equipment:
- Drilling equipment required by *ASTM D1586*, when performing split-spoon sampling including clean sample sleeves
- Disposable plastic liners, when drilling with direct-push equipment
- Stainless steel hand auger and stainless-steel spade if using manual methods
- Appropriate soil sampling equipment (e.g., stainless steel spatulas/spoons/bowls, knife)
- Sealable plastic bags (e.g., Ziploc®)

- Air-tight sample containers and 8-oz. glass Mason jars or driller's jars
- Aluminum foil
- Appropriate sample blanks (trip blank supplied by the laboratory), as specified in the FSP
- Soil sample containers and labels (supplied by the laboratory) appropriate for the analytical method(s) with preservative, as needed (parameter-specific)
- Sample labels
- Indelible ink pens
- Engineer's ruler or survey rod
- Plastic sheeting (e.g., Weatherall Visqueen)
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials
- Decontamination equipment (buckets, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern, paper towels) in accordance with the *TGI for Groundwater and Soil Sampling Equipment Decontamination*
- Forms/notes:
    - Tablet with digital forms, etc., if appropriate
    - Appropriate soil boring log (**Attachment 1**)
    - Chain-of-custody forms
    - Field notebook
    - Digital camera (or smart phone with camera)
- Drums or other containers appropriate for soil and decontamination water, as specified by the site investigation-derived waste (IDW) management plan, and appropriate drum labels

6 Cautions

Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be delineated by the drilling contractor or an independent underground utility locator service in accordance with the work plan, client requirements, and Arcadis guidance. See appropriate guidance forproper utility clearance protocol. Work will be performed in accordance with the Arcadis *Utility Location and Clearance Health and Safety Standard* and the *Utilities and Structures Checklist* will be completed before beginning any intrusive work.

Prior to beginning field work, the project technical team will ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all team members. An internal call with the project technical team to review the FIP/work plan scope and objectives is strongly recommended prior to mobilization to ensure that the field work will be effectively and efficiently executed.

Some regulatory agencies have specific requirements regarding borehole abandonment and grout mixtures. Determine whether the oversight agency has any such requirements prior to finalizing the

drilling plan.

If DNAPL is known or expected to exist at the site, refer to the project specific documents (e.g., DNAPL Contingency Plan) for additional details regarding drilling to reduce the potential for inadvertent DNAPL remobilization.

Similarly, if light non-aqueous phase liquid (LNAPL) is known or expected to be present as "perched" layers above the water table, refer to the DNAPL Contingency Plan. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions. Water used for drilling, decontamination of drilling/sampling equipment, or grouting boreholes uponcompletion will be of a quality acceptable for project objectives. Testing of water supply will be considered.

Specifications of materials used for backfilling the borehole will be obtained, reviewed and approved to meet project quality objectives. Bentonite is not recommended where DNAPL is likely to be present or in groundwater with high salinity. In these situations, neat cement grout is preferred.

Store and/or stage empty and full sample containers and coolers out of direct sunlight. Sample container threads should be wiped down with a clean, nonabrasive material (e.g., paper towels) to better ensure the sample container is properly sealed. Be careful not to over-tighten lids with Teflon® liners or septa. Over-tightening can impair the integrity of the seal and cancause the glass to shatter and create a risk for hand injuries.

NOTE: *Field logs and some forms are considered to be legal documents. All field logs and forms will therefore be filled out in indelible ink. Do not use permanent marker or felt-tipped pens for labels on sample container or sample coolers. Permanent markers could introduce volatile constituents into the samples.*

NOTE: *An Arcadis employee that is appropriately trained at the correct level of internal hazardous materials/DOT (Department of Transportation) shipping must complete an Arcadis shipping determination to address applicable DOT and IATA (International Air Transport Association) shipping requirements. Review the applicable Arcadis procedures and guidance instructions for sample packaging and labeling. Prior to using air transportation, confirm air shipment is acceptable under DOT and IATA regulations.*

7 Health and Safety Considerations

The HASP will be followed, as appropriate, to ensure the safety of field personnel. Review all site-specific and procedural hazards as they are provided in the HASP, and review Job SafetyAnalysis (JSA) documents in the field each day prior to beginning work.

Prior to drilling, utility clearance must be performed (see Section 5). Appropriate personal protective equipment (PPE) will be worn at all times in line with the task and thesite-specific HASP.

Working outside at sites with suspected contamination may expose field personnel to hazardous materials such as contaminated groundwater or NAPL (e.g., oil). Other potential hazards include biological hazards (e.g., stinging insects, ticks in long grass/weeds, etc.), and potentially the use of sharp cutting tools (scissors, knife). Only use non-toxic peppermint oil spray for stinging insect nests. Review client-specific health and safety requirements, which may preclude the useof fixed/folding-blade knives

and use appropriate hand protection.

If thunder or lightning is present, discontinue drilling and sampling until 30 minutes have passed after the last occurrence of thunder or lightning.

8 Procedure

The procedures for drilling and the methods to be used to field screen and collect soil samples for laboratory analysis are presented below:

8.1 Drilling Procedures

8.1.1 Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods

1. Find/identify boring location, establish work zone, and set up sampling equipment decontamination area.
    a. Verify utilities were cleared (see Section 5) and use soft dig technique to clear borehole, if applicable
    b. Clean sampling equipment in accordance with the FIP/work plan prior to drilling
2. Advance boring to target depth:
    a. Collect soil samples at appropriate interval as specified in the FIP/work plan (or equivalent) using the appropriate tooling (e.g., split-barrel sampler) and sample containers
        i. Split-barrel or drive-ahead samples are obtained during drilling
        ii. A common sampling method that produces high-quality soil samples with relatively littlesoil disturbance is described in *ASTM D1586 – Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils* (ASTM D1586).
    b. Always change disposable gloves before handling the sampling equipment
    c. Collect, document, and store samples for laboratory analysis as specified in the FIP/work plan (or equivalent; see below for additional details on sample collection procedures)
    d. Field screen samples as specified in the FIP/work plan (or equivalent; see below for additional details on field screening procedures)
    e. Rotasonic drilling produces soil cores that, for the most part, are relatively undisturbed, but note that when drilling in consolidated or finer-grained sediment the vibratory action during core barrel advancement may create secondary fractures or breaks. The core is retrieved by vibrating the soil/rock into a separate core bag, typically in 5-foot or 10-foot increments. The soil cores may consolidate or expand during retrieval, depending on soils, etc.
    f. Dual-rotary removes cuttings by compressed air or water/mud and allow only a

generalassessment of geology unless separate coring tools and techniques are used

g. Decontaminate equipment between samples in accordance with the FIP/work plan (or equivalent)

3. Describe each soil sample as outlined in the appropriate project records (refer to the description procedures outlined in the *TGI - Soil Description*)

    a. Record descriptions on the soil boring log (**Attachment 1**) and/or field notebook

    b. When possible, photo document the samples (e.g., soil cores, split-barrels)

    c. During soil boring advancement, document all drilling events in field notebook, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments) and work stoppages

    d. Blow counts will not be available if rotasonic, dual-rotary, or direct-push methods are used; however, if standard penetration testing is required during rotasonic drilling, an automatic drop hammer may be used in conjunction with the method to switch from core barrel advancement to standard penetration testing

    e. If soils are screened with a PID/FID or another instrument, document the measurement in accordance with the work plan

4. The drilling contractor will be responsible for obtaining accurate and representative samples, informing the supervising Arcadis geologist of changes in drilling pressure, drilling penetration rates, and keeping a separategeneral log of soils encountered, including blow counts

    a. The term “samples” means soil materials from particular depth intervals, whether or not portions of these materials are submitted for laboratory analyses

    b. Records will also be kept of occurrences of premature refusal due to boulders, construction materials that may have been used as fill, etc.

    c. Where a boring cannot be advanced to the desired depth, the boring will be abandoned, and an additional boring will be advanced at an adjacent location to obtain the required sample in accordance with the work plan

    d. Where it is desirable to avoid leaving vertical connections between depth intervals (e.g., if DNAPL or perched LNAPL are known or expected to exist at the site), the borehole will be sealed using cement and/or bentonite (see **Section 5** above)

    e. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location

8.1.2 Direct-Push Method

The direct-push drilling method may also be used to complete soil borings. Examples of this technique include Geoprobe®, Diedrich Environmental Soil Probe (ESP) System, or AMS PowerProbe.

Environmental probe systems typically use a hydraulically operated percussion hammer.

Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow. The hammer provides the force needed to penetrate very stiff to medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual tube liner for samplingsoil

(dual tube sampling system).

The outside diameter (OD) of the outer casing ranges from 2.25 to 6 inches and the OD of the inner sampling tube diameter ranges from 1.4 to 4.5 inches. The outer casing isolates overlying soil and permits the unit to continue to probe at depth. The dual tube sampling system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, a single rod system may be used that does notprovide a cased boring and which limits tremie-grouting from the bottom up.

Direct-push drilling can generally achieve target depths 100 feet or less depending on the site geology. The known or expected site conditions (e.g., presence of NAPL) will be evaluated when selecting the typeof direct-push sampling system to be employed.

1. Find/identify boring location, establish work zone, and set up sampling equipment decontamination area
    a. Verify utilities were cleared (see Section 5) and use soft dig technique to clear borehole, if applicable
    b. Clean sampling equipment in accordance with the FIP/work plan prior to drilling
2. Advance soil boring to target depth.
    a. Collect soil samples at appropriate interval as specified in the FIP/work plan (or equivalent) using clean/disposable sampling equipment (plastic liners)
    b. Always change disposable gloves before handling the sampling equipment
    c. Collect, document, and store samples for laboratory analysis as specified in theFIP/work plan (or equivalent; see below for additional details on sample collection procedures)
    d. Field screen samples as specified in the FIP/work plan (or equivalent; see below for additional details on field screening procedures)
3. Decontaminate equipment between samples in accordance with the FIP/work plan (or equivalent)
4. Describe samples in accordance with the procedures outlined in **Step 3** under ***Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods*** above (refer to the description procedures outlined in the *TGI - Soil Description*)

8.1.3 Manual Methods

Manual methods may also be used to complete shallow soil borings. Examples of this technique include using a spade, spoon, scoop, hand auger, or slide hammer. Manual methods are typically used to collect surface soil samples (0 to 6 inches) or to complete soil borings/collect soil samples from a depth of 5 feet or less.

1. Find/identify boring location, establish work zone, and set up sampling equipment decontamination area
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris
3. Use a spade, spoon, scoop, hand auger, or slide hammer to collect a sample of the required depth interval
4. Use an engineer's ruler or survey rod to verify that the sample is collected to the correct depth and

record the top and bottom depths from the ground surface

5. To collect samples below the surface interval, remove the surface interval first; then collect the deeper interval
    a. To prevent the hole from collapsing, it may be necessary to remove a wider section from the surface or use cut polyvinyl chloride (PVC) pipe to maintain the opening
    b. Collect soil samples at appropriate interval as specified in the FIP/work plan (or equivalent) and transfer to the appropriate, laboratory-supplied container
    c. Collect, document, and store samples for laboratory analysis as specified in the FIP/work plan (or equivalent; see below for additional details on sample collection procedures)
    d. Field screen samples as specified in the FIP/work plan (or equivalent; see below for additional details on field screening procedures)
6. Decontaminate equipment between samples in accordance with the FIP/work plan (orequivalent)
7. Describe samples in accordance with the procedures outlined in **Step 3** under ***Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods*** above (refer to the description procedures outlined in the *TGI - Soil Description*)

8.2 Field Screening Procedures

8.2.1 PID and FID Screening

Soils are typically field screened with a PID or FID for a relative measure of the total VOCs at sites where VOCs are known or suspected to exist. PIDs and FIDs require calibration in accordance with the work plan(s) and manufacturer's specifications and PIDs should be calibrated based on the target chemicals. The PID employs an ultraviolet lamp to measure VOCs and the ionizationenergy (IE) of the site constituents need to be considered when selecting the type of lamp (e.g., 10.6 eV, 11.7 eV) that will be used. In general, any compound with an IE lower than that of the lamp photons canbe measured. The FID has a wide linear range and responds to almost all VOCs.

Field screening is performed using one (or both) of the following two methods:

1. Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a clean, gloved hand. Such readings will be obtained at several locations along the lengthof the sample.
2. A portion of the collected soil is placed in a jar, which is covered with aluminum foil, sealed, and allowed to warm to room temperature (see below). After warming, the cover is removed, the foil is pierced withthe PID or FID probe, and a reading is obtained.

Prior to usage, the PID or FID must be calibrated according to the manufacturer's specifications at a minimum frequencyof once per day prior to collecting PID or FID readings. The PID will be calibrated to a benzene-related compound (isobutylene) or other appropriate gas, while the FID will be calibrated to methane. The time, date, and calibration procedure must be clearly documented in the field notebook and/or the calibration form.

If at any time the PID or FID results appear erratic or inconsistent with field observations, then the instrument will be recalibrated.

If calibration is difficult to achieve, then the PID's lamp will be checked for dirt or moisture and cleaned, or technical assistance will be required. Maintenance and calibration records will be kept as part of the field quality assurance program.

Initial PID readings will be recorded on the soil boring log (**Attachment 1**) and/or in the field notes. The soil sample will be separated from the slough material (if any) by using disposable gloves and a pre-cleaned stainless-steel spoon or tool.

For the second method, a representative portion of the sample will be placed in a pre-cleaned air-tight container (as quickly as possible to avoid loss of VOCs), filling the container half full to allow for the accumulation of vapors above the soil. An aluminum foil seal will be placed between the glass and cap and the cap will be screwed on tightly. Unless the screening will be performed immediately after the sample is placed in the container, the sample containers will be stored in a cooler chilled to approximately4ºC until screening can be performed.

The headspace of the container will be measured using a PID or FID as follows:

1. Samples will be taken to a warm workspace and allowed to equilibrate to room temperature for atleast one hour.
2. Prior to measuring the soil vapor headspace concentration, the container will be shaken.
3. The headspace of the sample will then be measured directly from the container by piercingthe aluminum foil seal with the probe of the PID or FID and measuring the relative concentration of VOCs in the headspace of the soil sample. The initial (peak) reading must be recorded.

8.2.2 NAPL Screening

To screen for the potential presence of non-aqueous phase liquid (NAPL) in soil, drilling procedures must allow for high-quality porous media samples to be taken. Split-barrel samplers or direct-push samplers will be collected continuously ahead of the auger, drill casing/rods, or probe rods. Upon opening each split-barrel sampler or direct-push plastic liner sleeve, the soil will immediately be evaluated for the presence of visible NAPL and odors. If suspected NAPL is immediately visible in the sample, its depth will benoted.

Additionally, the soil will be screened for the presence of organic vapors using a PID or FID, in accordance with the work plan, if applicable. During screening, the soil will be split open using a clean spatula or knife and the PID or FID probe will be placedin the opening and covered with a clean, gloved hand (**Method 1** above). Such readings will be obtained along the entire length of the sample. Alternatively, **Method 2** for PID/FID screening (outlined above) may also be performed. If the PID or FID examination reveals the presence of organic vapors above 100 parts permillion (ppm), the sample will undergo further detailed evaluation for visible NAPL.

The assessment for NAPL will include the following tests/observations:

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

with oils may appear brown

- Particular care will be taken to fully describe any sheens observed, staining, discoloration, droplets (blebs), or NAPL saturation

- Soil-Water Pan Test
  - A portion of the selected soil interval with the highest PID or FID reading above 100 ppm will be placed in a disposable polyethylene dish along with a small volume of potable or distilled water
  - The dish will be gently tilted back and forth to mix the soil and water, and the surface of the water will be viewed in natural light to observe the development of a sheen, if any
  - A small quantity of Oil Red O or Sudan IV hydrophobic dye powder should be added in accordance with the work plan, and the soil and dye will be manually mixed for approximately 30 to 60 seconds and smeared in the dish tocreate a paste-like consistency
  - A positive test result will be indicated by a sheen on the surface of the water and/or a bright red color imparted to the soil following mixing with dye
- Soil-Water Shake Test
  - A small quantity of soil (up to 15 cc) will be placed in a clear, colorless, jar containing an equal volume of potable or distilled water (40-mL vials are well suited to this purpose, but not required)
  - After the soil settles into the water, the surface of the water will be evaluated for a visible sheen under natural light
  - The jar will be closed and gently shaken for approximately 10 to 20 seconds
  - Again, the surface of the water will be evaluated for a visible sheen or a temporary layer of foam
  - A small quantity (approximately 0.5 to 1 cc) of Oil Red O or Sudan IV powder will be placed in the jar in accordance with the work plan
  - The sheen layer, if present, will be evaluated for a reaction to the dye (change to bright red color)
  - The jar will be closed and gently shaken for approximately 10 to 20 seconds
  - The contents in the closed jar will be examined under natural light for visible bright red dyed liquid inside the jar

- A positive test result will be indicated by the presence of a visible sheen or foam on the surface ofwater, a reaction between the dye and the sheen layer upon first addition of the dye powder, a bright red coating on the inside of the vial (particularly above the water line), or red-dyed droplets within the soil

NOTE: *If NAPL is obviously present upon opening the soil sampler or evaluating the soil sample within the split-spoon sampler or direct-push liner sleeve, it is not necessary to perform a soil-water pan test or soil-water shake test. In addition, it is not necessary to perform both a soil-water pan test and a soil-water shake test; either test method is acceptable. The pan test may be preferred in some circumstances because the presence of a sheen may be easier to see on a wider surface. Further, these tests will only be performed if specified in the work plan(s).*

NOTE: *When using hydrophobic dye in the tests above, color will be assessed outdoors under natural light during the period between sunrise and sunset, regardless of the degree of cloud cover. The hydrophobic dye Safety Data Sheets (SDS) will be incorporated into the HASP and reviewed prior to use and the dyes will be carefully handled and disposed in accordance with regulations, if applicable*.

8.3 Soil Sample Collection for Laboratory Procedures

If not specifically identified in the FIP/work plan, soil samples will be selected for laboratory analysis based on:

1. Their position in relation to identified source areas
2. The visual presence of source residues (e.g., NAPL or staining)
3. The relative levels of total VOCs based on field screening measurements
4. The judgment of the field coordinator
5. Moisture content or relative position with regard to apparent groundwater table/saturation

Samples designated for laboratory analysis will be placed in the appropriate containers.

Sample containers for VOC analysis will be filled first immediately following soil core retrieval to reduce loss of VOCs.

If samples will be collected for other analyses, a sufficient amount of the remaining soil willthen be homogenized as described below and sample containers will be filled for other parameters.

VOC samples will be collected as discrete samples using a small diameter core sampler (e.g., En Core® Sampler, Terra Core™ Sampler).

The En Core® Sampler is a disposable volumetric sampling device that collects, stores and delivers soil samples without in-field chemical preservation. The En Core® Sampler requires the use of a reusable T-handle.

The Terra Core™ Sampler is a one-time use transfer tool, designed to collect soil samples and transfer them to the appropriate containers for in-field chemical preservation (e.g., methanol).

The small diameter core samplers will be used according to the manufacturer's instructions (e.g., En Novative Technologies). Some regulatory agencies have specific requirements regarding VOC sample

collection. Determine whether the oversight agency has specific requirements prior to commencing sampling and collect samples at appropriate interval as specified in the FIP/work plan (or equivalent). Samples may require homogenization across a given depth interval, or several discrete grabs (usually five) may be combined into a composite sample.

NOTE: *Samples for VOC and PFAS analysis will NOT be homogenized or composited and will be collected asdiscrete samples as described above*.

The procedure for mixing samples is provided below.

1. Mix the materials in a stainless steel (or appropriate non-reactive material) bowl using a stainless-steel spoon (or disposable equivalents)

a. When dealing with large sample quantities, use disposable plastic sheeting and a shovelor trowel

b. NOTE: *When preparing samples for metals analyses, do not use disposable aluminum(or metal tools or trays other than stainless steel), as it may influence the analytical results*

2. Flatten the pile by pressing the top without further mixing

3. Divide the circular pile by into four equal quarters by dividing out two diameters at right angles

4. Mix each quarter individually using appropriate non-reactive bowls, spoons and/or sheeting

5. Mix two quarters (as described above) to form halves, then mix the two halves to form a composite orhomogenized sample

6. Place composite or homogenized sample into specified containers

7. Remaining material will be disposed of in accordance with project requirements and applicableregulations

8. Sample containers will be labeled with sample identification number, date, and time of collection andplaced on ice in a cooler (target 4° Celsius)

9. Samples selected for laboratory analysis will be documented (chain-of-custody forms), handled, packed, and shipped in accordance with the procedures outlined in the FIP/work plan (or equivalent).

8.4 Soil Boring Abandonment

All soil borings need to be abandoned in accordance with ***TGI for Monitoring Well and Soil Boring Decommissioning***. See Attachment E of the TGI for specifics.

9 Waste Management

Investigative-Derived Waste (IDW) generated during drilling activities, including soil and excess drilling fluids (if used), and decontamination liquids, will be stored on site in appropriately labeled containers and disposed of properly. Disposable materials will be stored and disposed of separately. Containers must be labeled at the time of collection and will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, PPE). Waste will be managed in accordance with the *TGI – Investigation-Derived Waste Handling and Storage,* the procedures identified in the FIP/work plan or QAPP as well as

state-, federal- or client-specific requirements. Be certain that waste containers are properly labeled and documented in the field log.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

Management of the original documents from the field will be completed in accordance with the site- specific QAPP.

In general, drilling activities will be documented on appropriate field/log forms as well as in a proper field notebook. All field data will be recorded digitally or with indelible ink. Field forms, logs/notes (including daily field and calibration logs), digital records, and chain-of-custody records will be maintained by the field team lead. Any deviations or omissions from this TGI should be documented.

Initial field logs and chain-of-custody records will be transmitted to the Arcadis CPM and Technical Lead at the end of each day unless otherwise directed by the CPM. The field teamleader retains copies of the field documentation.

Additionally, all documents (and photographs) will be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of drilling activities, soil descriptions, soil boring information, and quantities of materials used.

In addition, the locations of soil borings will be documented photographically and in a site sketch. If appropriate, a measuring wheel or engineer's tape will be used to determine approximate distances between important site features.

Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements.

11 Quality Assurance

Quality assurance procedures shall be conducted in accordance with the Arcadis Quality Management System or the site-specific QAPP.

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate TGI.

Field-derived quality assurance blanks will be collected as specified in the FIP/work plan and/or site- specific QAPP, depending on the project quality objectives. Typically, field rinse blanks (equipment blanks) will be collected when non-dedicated equipment (e.g., split-spoon sampler, stainless steel spoon) is used during soil sampling. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site conditions. Trip blanks for VOCs, which aid in the detection of contaminants from other media, sources, or the container itself, will be kept with the coolers and the sample containers throughout the sampling activities and during transport to the laboratory.

Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities in the field notebook.

12 References

ASTM D1586 - *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*. ASTM International. West Conshohocken, Pennsylvania.

13 Attachments

Attachment 1. Soil Boring Log Form

Attachment 1

Soil Boring Log Form

BORING LOG

ARCADIS

Boring ID:		**Project Name:**		**Page:**	
Permit ID:		**Date Started:**		**Ground Elevation:**	
Site Address:		**Date Completed:**		**Vertical Datum:**	
City, State:		**Total Depth:**		**Northing:**	
Drilling Co:		**Depth to Water:**		**Easting:**	
Driller:		**Hole Diameter:**		**Horizontal Datum:**	
Drilling Method:		**Core Device:**		**Prepared by:**	
Boring Status:		**Drilling Fluid:**		**Reviewed by:**	

Drilling Information				Primary Texture											Soil Description (Udden-Wentworth System)	Field Notes
				Fines		Sand					Gravel					
Drilling Depth (ft bgs)	Core Interval (ft)	Core Recovery (inches)	PID Reading (ppm)	clay	silt	very fine	fine	medium	coarse	very coarse	granule	pebble	cobble	boulder	Depth interval (ft), Moisture, PRIMARY TEXTURE, Modifier/Minor Texture, Sorting, Angularity, Consistency, Plasticity, Color - Only Record Sand Density with Standard Penetration Tests Minor Texture Modifiers: Trace (<10%), Little (10 to 20%), Some (21 to 35%), And (36 to 50%)	Driller's Observations, Particle Size Percentages, Geologic Formation, Field Screening Results, Sample Interval etc.

BORING LOG

ARCADIS

Boring ID: _____ **Project Name:** _____ **Page:** / _____

Drilling Information				Primary Texture											Soil Description (Udden-Wentworth System)	Field Notes
				Fines		Sand					Gravel					
Drilling Depth (ft bgs)	Core Interval (ft)	Core Recovery (inches)	PID Reading (ppm)	clay	silt	very fine	fine	medium	coarse	very coarse	granule	pebble	cobble	boulder	Depth interval (ft), Moisture, PRIMARY TEXTURE, Modifier/Minor Texture, Sorting, Angularity, Consistency, Plasticity, Color - Only Record Sand Density with Standard Penetration Tests Minor Texture Modifiers: Trace (<10%), Little (10 to 20%), Some (21 to 35%), And (36 to 50%)	Driller's Observations, Particle Size Percentages, Geologic Formation, Field Screening Results, Sample Interval etc.

BORING LOG

ARCADIS

Boring ID: _____ **Project Name:** _____ **Page:** ____/____

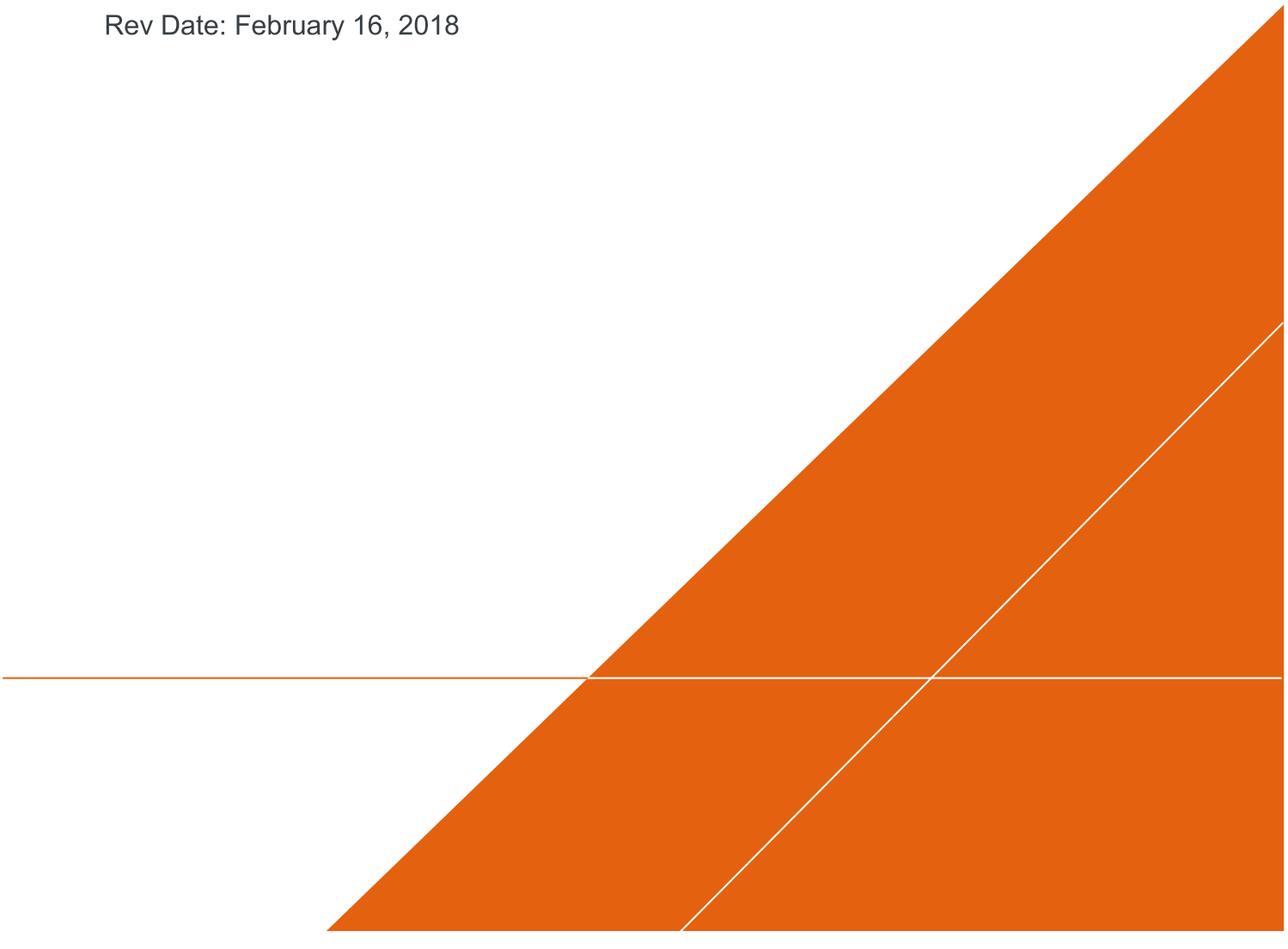
Drilling Information				Primary Texture											Soil Description (Udden-Wentworth System)	Field Notes
				Fines		Sand					Gravel					
Drilling Depth (ft bgs)	Core Interval (ft)	Core Recovery (inches)	PID Reading (ppm)	clay	silt	very fine	fine	medium	coarse	very coarse	granule	pebble	cobble	boulder	Depth interval (ft), Moisture, PRIMARY TEXTURE, Modifier/Minor Texture, Sorting, Angularity, Consistency, Plasticity, Color - Only Record Sand Density with Standard Penetration Tests Minor Texture Modifiers: Trace (<10%), Little (10 to 20%), Some (21 to 35%), And (36 to 50%)	Driller's Observations, Particle Size Percentages, Geologic Formation, Field Screening Results, Sample Interval etc.

ARCADIS Design & Consultancy for natural and built assets

TGI - SOIL DESCRIPTION

Rev: #2

Rev Date: February 16, 2018



VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	May 20, 2008	17	Original SOP	Joe Quinnan Joel Hunt
1	September 2016	15	Updated to TGI	Nick Welty Patrick Curry
2	February 16, 2018	15	Updated descriptions, attachments and references in text	Nick Welty Patrick Curry

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

APPROVAL SIGNATURES

Prepared by:		June 30, 2017
	Patrick Curry, PG	Date:
Technical Expert Reviewed by:		June 30, 2017
	Nicklaus Welty, PG	Date:

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

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

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

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

This TGI incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

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

3 PERSONNEL QUALIFICATIONS

Soil descriptions should only be performed by Arcadis personnel or authorized sub-contractors with a degree in geology or a geology-related discipline. Field personnel will complete training on the Arcadis soil description TGI in the office and/or in the field under the guidance of an experienced field geologist with at least 2 years of prior experience applying the Arcadis soil description method.

4 EQUIPMENT LIST

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

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

5 CAUTIONS

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

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

6 HEALTH AND SAFETY CONSIDERATIONS

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

7 PROCEDURE

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, acetate sleeves for direct push, bagged core for sonic drilling, etc.
2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.
3. Set up boring log field sheet.
    - Drillers in both the US and Canada generally work in feet due to equipment specifications. Use the Arcadis standard boring log form (**Attachment A**).
    - The preferred boring log includes a graphic log of the principal soil component to support quick visual evaluation of grain size. The purpose of the graphic log is to quickly assess relative soil permeability. Note, for poorly sorted soils (e.g. glacial till), the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability. For example, for a dense sand/silt/clay till, the graphic log would reflect the silt/clay, rather than sand.
    - Record depths along the left-hand side at a standard scale to aid in the use of this tool. See an example completed boring log (**Attachment B**).
4. Examine each soil core (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:
    - depth interval;
    - principal component with descriptors, as appropriate;
    - amount and identification of minor component(s) with descriptors as appropriate;
    - moisture;
    - consistency/density;
    - color; and
    - additional description or comments (recorded as notes).
5. At the end of the boring, record the amount of drilling fluid used (if applicable) and the total depth logged.

The above is described more fully below.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

DEPTH

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

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.
2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).
3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.
4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

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

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

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

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

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

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

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

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be "Pebbles"; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be "Sand, fine to coarse" or for a sample that was 40% silt and 45% clay the principal component would be "Clay and Silt". Shade the boxes on the graphic log (**Attachment A**) up to and including the box with the principal component. The purpose of the graphical log is to provide a relative estimate of permeability. As noted above, for poorly sorted soils such as glacial till, the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability.

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

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

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

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

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

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

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

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

Note that silt and silt-sand mixtures will be non-plastic and display dilatancy. Clay mixtures will have some degree of plasticity but do not typically react to dilatancy testing. Therefore, the tests outlined above can be used to differentiate between silt dominated and clay dominated soils.

MINOR COMPONENT(S)

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

Include a standard modifier to indicate percentage of minor components (see Table on Page 6) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for clay and clay mixtures. Dilatancy should be provided for silt and silt mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

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

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

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

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

MOISTURE

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

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. When drilling with hollow-stem augers and split-spoon sampling, the SPT blow counts and N-value is used to estimate density. The N-value is the blows per foot for the 6" to 18" interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6" to12", the third interval is 12" to 18", the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal. In recent years, more common drilling methods include rotary-sonic or direct push. When blow counts are not available, density is determined using a thumb test. Note however, the thumb test only applies to fine-grained soils.

Fine-grained soil – Consistency

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

Coarse-grained soil – Density

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

COLOR

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

ADDITIONAL COMMENTS (NOTES)

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

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

EXAMPLE DESCRIPTIONS



51.4 to 54.0’ CLAY, some silt, medium to high plasticity; trace small to large pebbles, sub-round to sub-angular up to 2” diameter; moist, stiff, dark grayish brown (10 YR 4/2) NOTE: Lacustrine; laminated 0.1 to 0.2” thick, laminations brownish yellow (10 YR 4/3).



Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

32.5 to 38.0' SAND, medium to very coarse, sub-round to sub-angular; little granule and pebble, trace silt; poorly sorted, wet, grayish brown (10 YR 5/2).

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

The standard generic description order is presented below.

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

8 WASTE MANAGEMENT

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

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

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

9 DATA RECORDING AND MANAGEMENT

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. The preferred standard boring log is presented below and is included as **Attachment A**.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

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

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

10 QUALITY ASSURANCE

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

11 REFERENCES

Arcadis Soil Description Field Guide, 2008.

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

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

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

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

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

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

NIOSH Pocket Guide to Chemical Hazards.

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

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

ATTACHMENT A

Arcadis Standard Soil Boring Log Form

ARCADIS

SOIL BORING LOG

Boring/Well _____ Project _____ Page ____ of ____

Site Location _____ Drilling Started _____

Total Depth Drilled _____ Feet Hole Diameter _____ inches Drilling Completed _____

Type of Sample or Coring Device _____ Length and Diameter of Coring Device _____ Sampling Interval _____ feet

Drilling Method _____ Drilling Fluid Used _____

Drilling Contractor _____ Driller _____

Prepared By _____ Helper _____

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				**Udden-Wentworth Description:** principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

ARCADIS

SOIL BORING LOG (CONT'D)

Boring/Well _____ Prepared By _____ Page ___ of ___

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, addtl. Comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

ARCADIS Design & Consultancy for natural and built assets

ATTACHMENT B

Example of Completed Arcadis Soil Boring Log

ARCADIS Design & Consultancy for natural and built assets

SOIL BORING LOG

Boring/Well SB-01 Project Example Page 1 of 1

Site Location Anytown, North America Drilling Started 6/26/17

Total Depth Drilled 20 Feet Hole Diameter 4.5 inches Drilling Completed 6/26/17

Type of Sample or Coring Device Continuous Length and Diameter of Coring Device 5', 2.25" macrocore Sampling Interval 5 feet

Drilling Method Geoprobe Drilling Fluid Used NA

Drilling Contractor Fibertec Driller Ryan Brown

Prepared By A. DeGrandis Helper Grant Berger

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD: clay	MUD: silt	SAND: very fine	SAND: fine	SAND: medium	SAND: coarse	SAND: very coarse	GRAVEL: granular	GRAVEL: pebble	GRAVEL: cobble	GRAVEL: boulder	Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
	0.3	1	X	X	X	X	X							(0.0-4.0) SAND, fine to medium, sub-rounded;
	0.1	2	X	X	X	X	X							little granules to small pebbles, sub-rounded
60"	0.0	3	X	X	X	X	X							to sub-angular; trace silt; poorly sorted, dry
(HA)	0.0	4	X	X	X	X	X							to moist, dark grayish brown (10YR 4/2).
↓	1.4	5	X	X										NOTE: Ablation till.
	1.7	6	X	X										
	0.9	7	X	X										(4.0-10.0) SILT, non-plastic, rapid dilatancy;
52"	1.2	8	X	X										dry to moist, soft to medium stiff,
	0.6	9	X	X										gray (10YR 5/1).
↓	0.2	10	X	X										
	0.0	11	X	X	X	X								(10.0-15.5) SAND, fine, sub-rounded; trace
	0.0	12	X	X	X	X								silt; well sorted, moist to wet, pale
60"	0.1	13	X	X	X	X								brown (10YR 6/3).
	0.0	14	X	X	X	X								
↓	0.0	15	X	X	X	X								NOTE: wet at 12.0'
	0.2	16	X	X	X	X								
	0.0	17	X											(15.5-20.0) CLAY, high plasticity, no dilatancy;
58"	0.0	18	X											little silt; moist, soft to medium stiff,
	0.0	19	X											light gray (10YR 7/1) to dark gray (10YR 4/1).
↓	0.0	20	X											NOTE: Lacustrine, minor 0.1-0.25" lamination.
														End of boring - 20.0'

ARCADIS Design & Consultancy for natural and built assets

ATTACHMENT C

Arcadis Soil Description Field Guide

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)

ARCADIS

FINE-GRAINED SOILS

Description	Criteria
	Descriptor - Plasticity
Nonplastic	A 1/8-inch (3mm) thread cannot be rolled at any moisture content.
Low	Thread can barely be rolled, and lump cannot be formed when drier than plastic limit.
Medium	Takes considerable time and rolling to reach plastic limit. Thread cannot be rolled after reaching plastic limit. Lump crumbles when drier than plastic limit.
High	Thread is easy to roll and quickly reaches plastic limit. Thread can be rerolled several times after reaching plastic limit. Lump can be formed without crumbling when drier than plastic limit.
	Descriptor - Dilatancy
No Dilatancy	No visible change when shaken or squeezed.
Slow	Water appears slowly on the surface of soil during shaking and does not disappear or disappears slowly when squeezed.
Rapid	Water appears quickly on surface of soil during shaking and disappears quickly when squeezed.
Minor Components with Descriptors	
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Consistency
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated 1 inch by thumb.
Medium stiff	N-value 5-8 or indented about 1/2 inch by thumb with great effort.
Stiff	N-value 9-15 or indented about 1/4 inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty.
Color using Munsell	
Geologic Origin (if known)	
Other	

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10-15 feet CLAY, medium to high plasticity; trace silt; trace small to very large pebbles, subround to subangular up to 2" diameter; moist, stiff, dark grayish brown (10YR 4/2). NOTE: Lacustrine; laminated 0.1 to 0.2" thick, laminations brownish yellow (10YR 4/3).



DESCRIPTION ORDER

Depth Interval
Principal Components with Descriptors
Minor Components with Descriptors
Sorting
Field Moisture Condition
Density/Consistency
Color using Munsell
Geologic Origin (if known)
Other descriptions as NOTES:
- Odor
- Stratigraphy
- Structure
- Sphericity
- Cementation
- Reaction to acid

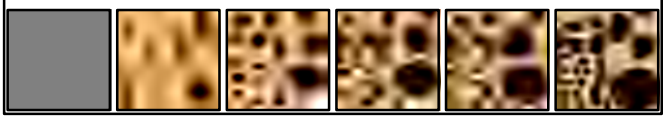
MINOR COMPONENTS % MODIFIERS

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

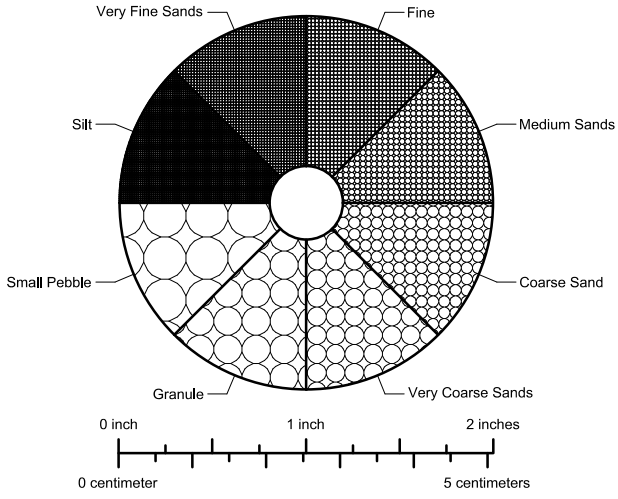
UDDEN-WENTWORTH SCALE

Fraction	Sieve Size	Grain Size	Approximate Scale
Boulder		256 - 4096 mm	Larger than volleyball
Large Cobble		128 - 256 mm	Softball to volleyball
Small Cobble		64 - 128 mm	Pool ball to softball
Very Large Pebble		32 - 64 mm	Pinball to pool ball
Large Pebble		16 - 32 mm	Dime size to pinball
Medium Pebble		8 - 16 mm	Pencil eraser to dime size
Small Pebble	No. 5+	4 - 8 mm	Pea size to pencil eraser
Granule	No. 10 - 5	2 - 4 mm	Rock salt to pea size
Very Coarse Sand	No. 18 - 10	1 - 2 mm	See field gauge card
Coarse Sand	No. 35 -18	0.5 - 1 mm	See field gauge card
Medium Sand	No. 60 - 35	0.25 - 0.5 mm	See field gauge card
Fine Sand	No. 120 - 60	0.125 - 0.25 mm	See field gauge card
Very Fine Sand	No. 230 - 120	0.0625 - 0.125 mm	See field gauge card
Silt and Clay. See SOP for description of fines	Not Applicable	<0.0625 mm	Analyze by pipette or hydrometer

PARTICLE PERCENT COMPOSITION ESTIMATION



GRAPH FOR DETERMINING SIZE OF PARTICLES



FOR COARSE-GRAINED SOILS

Description	Criteria
	Descriptor - Angularity
Angular	Particles have sharp edges and relatively planar sides withunpolished surfaces.
Subangular	Particles are similar to angular but have rounded edges.
Subround	Particles have nearly planar sides but have well-roundedcorners and edges.
Round	Particles have smoothly curved sides and no edges.
Minor Components with Descriptors	
	Sorting Cu= d60/d10
Well Sorted	Near uniform grain-size distribution Cu= 1 to 3.
Poorly Sorted	Wide range of grain size Cu= 4 to 6.
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Density
Very loose	N-value 1 - 4
Loose	N-value 5 - 10
Medium Dense	N-value 11 - 30
Dense	N-value 31 - 50
Very dense	N-value >50
Color using Munsell	
Geologic Origin (if known)	
Other	
	Cementation
Weak Cementation	Crumbles or breaks with handling or little finger pressure.
Moderate Cementation	Crumbles or breaks with considerable finger pressure.
Strong Cementation	Will not crumble with finger pressure.
	Reaction with Dilute HCl Solution (10%)
No Reaction	No visible reaction.
Weak Reaction	Some reaction, with bubbles forming slowly.
Strong Reaction	Violent reaction, with bubbles forming immediately.

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10 -15 feet SAND, medium to very coarse; little granules to medium pebbles, subround to subangular; trace silt; poorly sorted, wet, grayish brown (10YR5/2).



ARCADIS

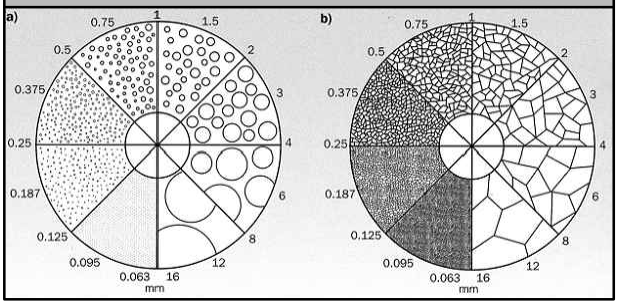
VARIATIONS IN SOIL STRATIGRAPHY

Term	Thickness of Configuration
Parting	0 - to 1/16-inch thickness.
Seam	1/16 - to 1/2-inch thickness.
Layer	1/2 - to 12-inch thickness.
Stratum	> 12-inch thickness.
Pocket	Small erratic deposit, usually less than 1 foot in size.
Varved Clay	Alternating seams or layers of sand, silt, and clay (laminated).
Occasional	≤ 1 foot thick.
Frequent	> 1 foot thick.

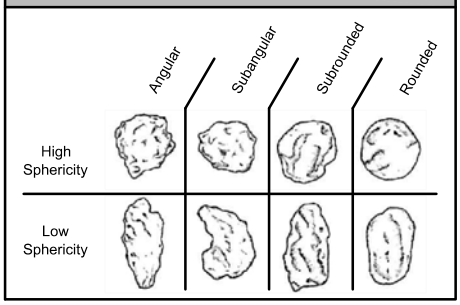
SOIL STRUCTURE DESCRIPTIONS

Term	Description
Homogeneous	Same color and appearance throughout.
Laminated	Alternating layers < 1/4 inch thick.
Stratified	Alternating layers ≥ 1/4 inch thick.
Lensed	Inclusions of small pockets of different materials, such as lenses of sand scattered through a mass of clay; note thickness.
Blocky	Cohesive soil can be broken down into small angular lumps, which resist further breakdown.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear to be polished or glossy, sometimes striated.

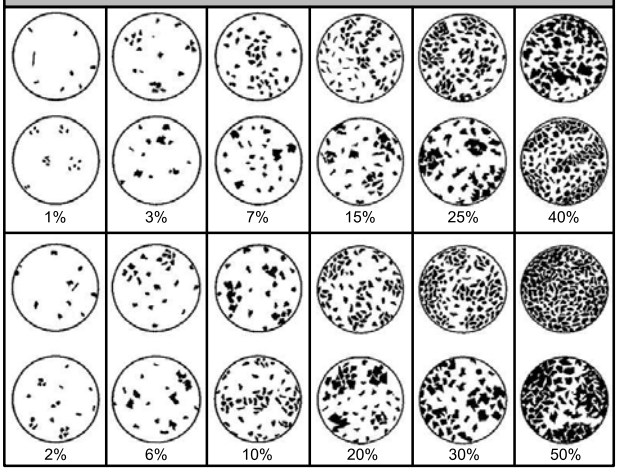
GRAPH FOR DETERMINING SIZE OF PARTICLES



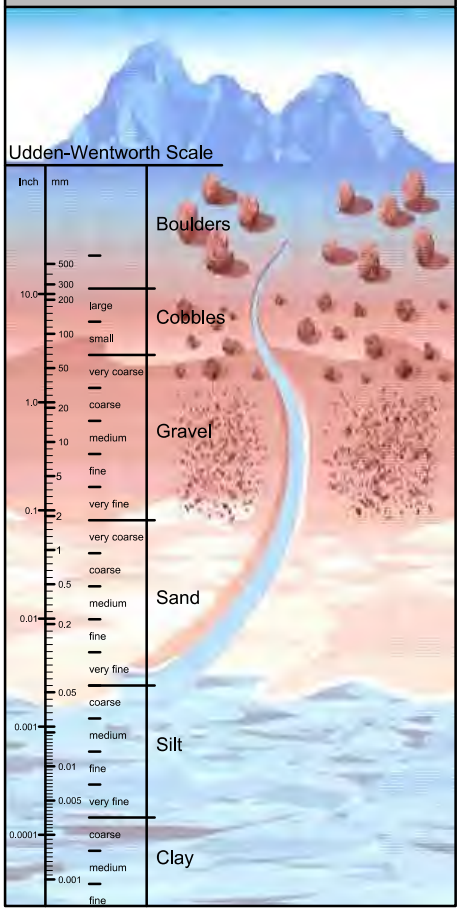
ANGULARITY CHART



PARTICLE PERCENT COMPOSITION ESTIMATION



SORTING



SETTLING TABLE (SILT/CLAY)

Diameter of Particle (mm)	<0.625	<0.031	<0.016	<0.008	<0.004	<0.002	<0.0005
Depth of Withdrawal (cm)	10	10	10	10	5	5	3
Time of Withdrawal	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec
Temperature (Celsius)							
20	00:00:29	00:01:55	00:07:40	00:30:40	00:61:19	04:05:00	37:21:00
21	00:00:28	00:01:52	00:07:29	00:29:58	00:59:50	04:00:00	
22	00:00:27	00:01:50	00:07:18	00:29:13	00:58:22	03:54:00	
23	00:00:27	00:01:47	00:07:08	00:28:34	00:57:05	03:48:00	
24	00:00:26	00:01:45	00:06:58	00:27:52	00:55:41	03:43:00	33:56:00
25	00:00:25	00:01:42	00:06:48	00:27:14	00:54:25	03:38:00	
26	00:00:25	00:01:40	00:06:39	00:26:38	00:53:12	03:33:00	
27	00:00:24	00:01:38	00:06:31	00:26:02	00:52:02	03:28:00	
28	00:00:24	00:01:35	00:06:22	00:25:28	00:50:52	03:24:00	31:00:00
29	00:00:23	00:01:33	00:06:13	00:24:53	00:49:42	03:10:00	
30	00:00:23	00:01:31	00:06:06	00:24:22	00:48:42	03:05:00	

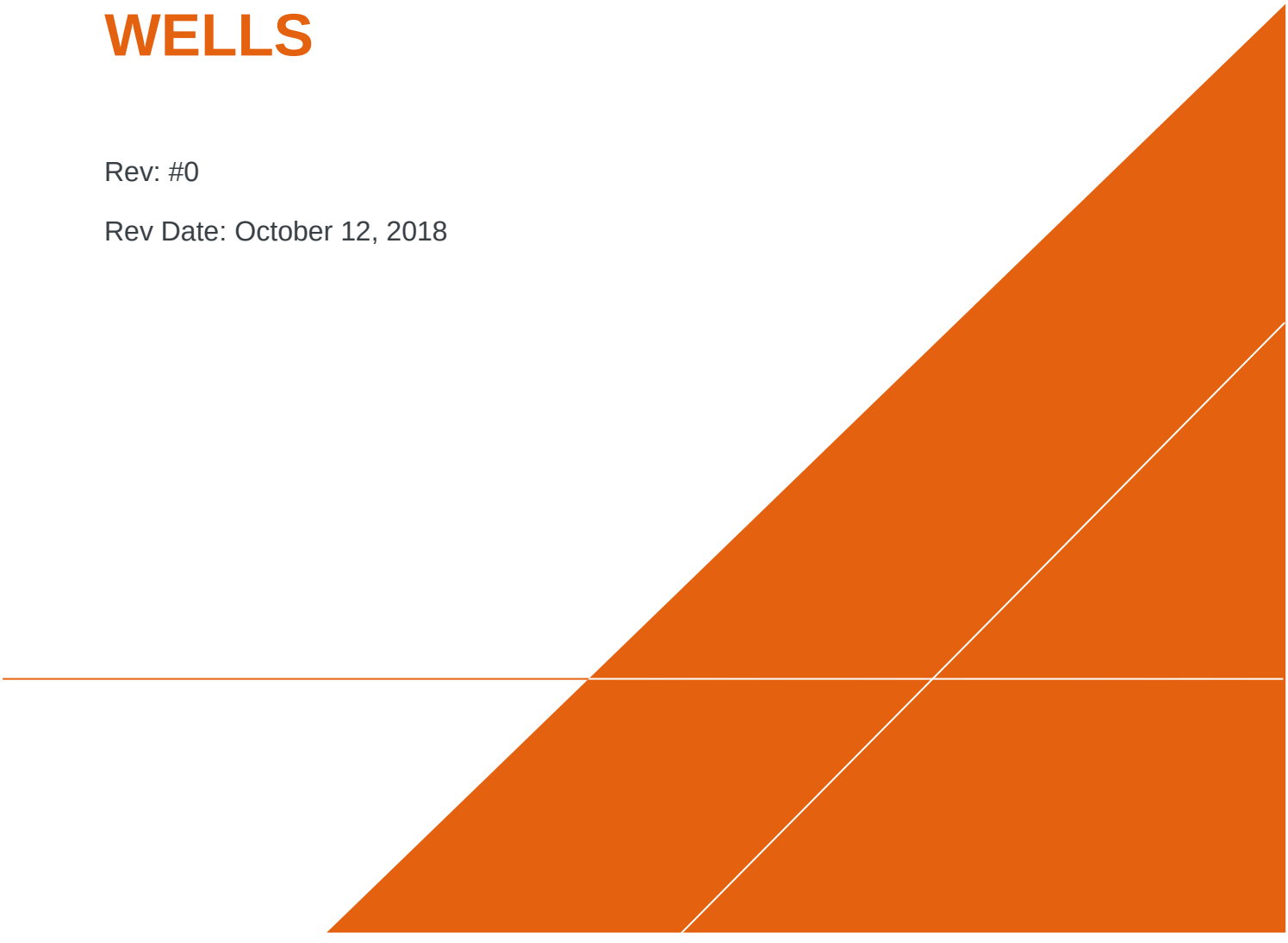
10 inches
9 inches
8 inches
7 inches
6 inches
5 inches
4 inches
3 inches
2 inches
1 inch
1/10in
0 mm
10 mm
20 mm
30 mm
40 mm
50 mm
60 mm
70 mm
80 mm
90 mm
100 mm
110 mm
120 mm
130 mm
140 mm
150 mm
160 mm
170 mm
180 mm
190 mm
200 mm
210 mm
220 mm
230 mm
240 mm
250 mm

ARCADIS Design & Consultancy for natural and built assets

TGI - LOW-FLOW GROUNDWATER PURGING AND SAMPLING PROCEDURES FOR MONITORING WELLS

Rev: #0

Rev Date: October 12, 2018

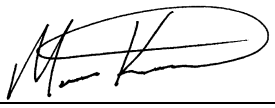


VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	October 12, 2018	All	Updated and re-written as TGI with new branding and content	Marc Killingstad

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

APPROVAL SIGNATURES

Prepared by:		10/12/2018
	Ryan McKinney	Date:
Technical Expert Reviewed by:		10/12/2018
	Marc Killingstad (Technical Expert)	Date:

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

Groundwater samples are collected from monitoring wells to evaluate groundwater quality. The protocol presented in this Technical Guidance Instruction (TGI) describes the procedures to purge monitoring wells and collect groundwater samples using the low flow purging/sampling methodology. This protocol has been developed in accordance with the United States Environmental Protection Agency (USEPA) Region I *Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells* (EQASOP-GW4; September 19, 2017).

Both filtered and unfiltered groundwater samples may be collected using this low-flow sampling method. Filtered samples will be obtained using a 0.45-micron disposable filter. Project teams will evaluate the last time the monitoring wells were developed and determine if additional development might be necessary. Water samples will not be taken immediately following well development. Sufficient time will be allowed for the groundwater flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as identified in the site-specific Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. The HASP will also identify any access control requirements.

Prior to mobilizing to the field, the groundwater sampling team will review and be thoroughly familiar with relevant site-specific documents including but not limited to the task-specific work plan or field implementation plan (FIP)/field sampling plan, Quality Assurance Project Plan (QAPP), HASP, historical information, and other relevant site documents.

Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. Additionally, the groundwater sampling team will review and be thoroughly familiar with documentation provided by equipment manufacturers and become familiar with the operation of (i.e., hands-on experience) all equipment that will be used in the field prior to mobilization.

4 EQUIPMENT LIST

Specific to this activity, the following materials (or equivalent) will be used:

- Site-specific HASP and health and safety documents identified in the HASP
- Field Implementation Plan (FIP) that includes site map, well construction records, sampling plan (sample analyses, sample volume required, and sample holding time), and prior groundwater sampling records (if available)
- Field notebook and/or smart device (phone or tablet)
- Low-flow sampling field forms (**Attachment A**)
- Appropriate personal protective equipment (PPE) (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the HASP
- Well keys and other tools to remove manhole covers (manual torque wrench with 9/16” socket and flat head screwdriver typical)
- Photoionization detector (PID) or Flame ionization detector (FID) (as appropriate, depending on site-specific constituents of concern)
- Electronic water-level indicator (e.g., Solinist Model 101) or oil/water interface probe with 0.01-foot accuracy (oil/water as appropriate, note that sampling will not be performed when sheen or light non-aqueous phase liquid [LNAPL] is present)
- Down-hole multiparameter water-quality sonde (temperature/pH/specific conductivity/oxidation reduction [ORP]/turbidity/dissolved oxygen) meter and flow-through measurement cell; for example:

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

  - YSI 6-Series Multi-Parameter Instrument
  - Horiba U-22 Multi-Parameter Instrument.
  - Hydrolab Series 3 or Series 4a Multiprobe and Display.
- Plastic sheeting (e.g., Weatherall Visqueen) to protect all down-hole sampling equipment from contact with potential sources of contamination.
- Decontamination equipment
  - Non-phosphate laboratory soap (Alconox or equivalent), brushes, clean buckets or clean wash tubs—new buckets or tubs will be purchased if it cannot be determined if the present items are clean
  - Distilled or de-ionized water for equipment decontamination
- Indelible ink pen
- 150-foot measuring tape (or sufficient length for the maximum site depth requirement)
- Sampling pump, which may consist of one or more of the following:
  - Submersible pump (e.g., Grundfos Redi-Flo 2)
  - Peristaltic pump (e.g., ISCO Model 150)
  - Bladder pump (e.g., Marschalk System 1, QED Micropurge, Geotech)
- Appropriate controller and power source for pump:
  - Submersible and peristaltic pumps require electric power from either a generator or a deep cell battery
  - Submersible pumps such as Grundfos require a pump controller to run the pump
  - Bladder pumps require a pump controller and a gas source (e.g., air compressor or compressed N2 or CO2 gas cylinders)
- Teflon® tubing or Teflon®-lined polyethylene tubing of an appropriate size for the pump being used
  - For peristaltic pumps, dedicated Tygon® tubing (or other type as specified by the manufacturer) will be used through the pump apparatus
  - Teflon® will not be used when sampling for per- and polyfluoroalkyl substances (PFAS)
- Graduated cylinder and stop watch or other device to measure time to determine pumping rate
- Appropriate water sample containers (supplied by the laboratory)
- Appropriate blanks (trip blank supplied by the laboratory)
- Sample labels and Chain-of-Custody forms (COC)
- 0.45-micron disposable filters (if field filtering is required)

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

- A supplemental turbidity meter (e.g., Horiba U-10, Hach 2100P, LaMotte 2020) may be required for specific projects and will be specified in the project FIP/ work plan and the kick-off notes.
    - If used, in-line 'T' and valve allows for collection of water for turbidity measurements before the pump discharge enters the flow-through cell

NOTE: *The maintenance requirements for the above equipment generally involve decontamination or periodic cleaning, battery charging, and proper storage, as specified by the manufacturer. For operational difficulties, the equipment will be serviced by a qualified technician.*

5 CAUTIONS

Different USEPA regions and/or state regulatory agencies may stipulate deviations from this document. It is the responsibility of the Project Team (Project Manager and Technical Lead) to be fully aware of the requirements from the applicable regulatory framework.

Weather

- If heavy precipitation occurs, and no cover over the sampling area and monitoring well can be erected, sampling may be discontinued until adequate cover is provided. Rain water could compromise groundwater samples.
- Avoid extreme weather situations. Be aware that thermal currents and vertical mixing of cold and warm water inside the well casing could create a convection cell within the well and compromise data collection (e.g., biological mechanisms).
    - Direct sunlight and hot ambient temperatures may cause the groundwater in the tubing or flow-through-cell to heat up and de-gas. This may result in the loss of volatile organic compounds (VOCs) and dissolved gases. Shade the equipment from direct sunlight, keep the tubing as short as possible, and avoid the hottest times of the day.
    - Sampling during freezing conditions may adversely impact the data quality objectives. USEPA recommends low-flow sampling be conducted at air temperatures above 32°F (0°C) or taking special precautions to prevent groundwater from freezing in the equipment.

Cross-Contamination

- To mitigate potential cross-contamination, groundwater samples are to be collected in a pre-determined order from least impacted to impacted based on previous analytical data. If no analytical data are available, collect samples in order of up-gradient, then furthest down-gradient to source area locations.
- Note that permanent markers could introduce volatile constituents into the samples; *therefore, indelible ink is recommended* to be used for labels on sample containers or sample coolers.
- When using a gasoline generator, this power source will be set-up at least 30 feet downwind from the well to avoid exhaust fumes to contaminate samples.

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

Pumps

- Preferred methods of extracting groundwater are adjustable rate, submersible pumps - such as centrifugal pumps or bladder pumps – constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®). However, *PTFE will not be used when sampling for per- and polyfluoroalkyl substances (PFAS). PTFE could contain PFAS.*
- When using a bladder pump for collecting VOCs and dissolved gases, “best practice” is to set-up the pump to deliver sufficient water to fill a 40 mL VOC vial.
- The use of peristaltic pumps will be based on the type of data to be collected. *Because the use a peristaltic pump can result in de-gassing of VOC and / or dissolved gases from groundwater, a different type of pump will be considered if these compounds are of concern.*
- *Manual or motor driven inertial pumping devices are not recommended because they cause greater disturbance during purging and pumping than regular pumps and are less easily controlled. This could cause a higher degree of data variability.*

Tubing

- When sampling for VOCs, SVOCs, pesticides, PCBs and inorganics, use of PTFE (Teflon®) or PTFE-lined tubing is preferred. However, PTFE tubing will not be used when sampling for PFAS.
- PVC, polypropylene or polyethelene tubing may be used when sampling for metals or other inorganics.
- Tubing with inside diameters of 1/4 or 3/8 inch is recommended because this will help ensure tubing remains water filled when operating at very low pumping rates.

General Precautions

- Store and/or stage empty and full sample containers and coolers out of direct sunlight.
- It may be necessary to field filter the groundwater for some parameters (e.g., metals) during collection, depending on preservation, analytical method, and project quality objectives. The task-kick-off notes and the FIP/work plan will list the samples that require field filtering.
- Be careful not to overtighten lids with Teflon® liners or septa (e.g., 40 mL vials). Over-tightening can cause the glass to shatter or impair the integrity of the Teflon® seal.

6 HEALTH AND SAFETY CONSIDERATIONS

The HASP will be followed, as appropriate, to ensure the safety of field personnel.

Appropriate personal protective equipment (PPE) will be worn at all times in line with the task and the site-specific HASP.

Review all site-specific and procedural hazards as they are provided in the HASP, and review Job Safety Analysis (JSA) documents in the field each day prior to beginning work.

Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or non-aqueous phase liquid (NAPL) (e.g., oil). Other potential hazards include pressurized wells, stinging

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

insects that may inhabit well heads, other biologic hazards (e.g. ticks in long grass/weeds around well head), and potentially the use of sharp cutting tools (scissors, knife)—open well caps slowly and keep face and body away to allow to vent any built-up pressure; only use non-toxic peppermint oil spray for stinging insect nests; review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives, and use appropriate hand protection.

Generators and cord and plug equipment will employ an overcurrent protection device such as an integrated ground fault circuit interrupter (GFCI) cord. Grundfos pump controllers will not run properly with a GFCI, so the power source will be equipped with other overcurrent protection means.

Overtightening of lids with Teflon® liners can cause the glass to shatter and create a risk for hand injuries.

7 PROCEDURE

Field personnel will set up and perform low-flow sampling in accordance with the following procedures.

1. Review FIP and groundwater sampling records from previous sampling events (if available) prior to mobilization to estimate the optimum pumping rate and anticipated drawdown for each well to perform sampling as efficiently as possible (i.e., reach a stabilized pumping condition)
2. Calibrate field instruments according to manufacturer procedures for calibration and record calibration procedure and results in field log
3. All equipment will either be new or decontaminated in accordance with appropriate guidance document (*TGI – Groundwater and Soil Sampling Equipment Decontamination)* prior to use
4. Visually inspect the well to ensure that it is undamaged, properly labeled and secured
    a) Damage or other conditions that may affect the integrity of the well will be recorded in the Field Activity Daily Log and brought to the attention of the designated Field Manager and/or Project Manager
    b) Record well construction and conditions on the Low-Flow Sampling Field Form (**Attachment A**)
5. Place clean plastic sheeting on the ground near the well to keep monitoring and sampling equipment off the surface unless the equipment is elevated above the ground (e.g. on a table).
6. Open the well cover while standing upwind of the well. Remove the well cap and place it on the plastic sheeting. If appropriate or required for site-specific conditions, insert the photoionization detector (PID) probe approximately 4 to 6 inches into the casing or the well headspace and cover it with a gloved hand. Record the PID reading in the field log. Perform air monitoring in the breathing zone according to the HASP and/or JSA.
7. Measure and record the initial depth to groundwater prior to placing the pumps
8. Prepare and install the pump in the well

NOTE: *Groundwater will be purged from the wells using an appropriate pump. If the depth to water is below the sampling range of a peristaltic pump (approximately 25 feet below ground surface), a*

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

submersible or bladder pump will be used, provided that the well is constructed with a casing diameter of at least two (2) inches (the minimum well diameter capable of accommodating such pumps). For smaller diameter wells, where the depth to water is below the sampling range of a peristaltic pump, alternative sampling methods (i.e., bailing or small diameter bladder pumps) will be used to purge and sample the groundwater. Bladder pumps are preferred over peristaltic and submersible pumps to prevent volatilization if sampling of VOCs and/or dissolved gasses is required. Purge water will be collected and containerized according to the direction of the project team.

a) For submersible and non-dedicated bladder pumps, decontaminate the pump according to site decontamination procedures. Non-dedicated bladder pumps will require a new bladder and attachment of an air-line, sample discharge line, and safety cable prior to placement in the well. Attach the air-line tubing to the air-port on the top of the bladder pump. Attach the sample discharge tubing to the water port on the top of the bladder pump. Take care not to reverse the air and discharge tubing lines during bladder pump setup, as this could result in bladder failure or rupture. Attach and secure a safety cable to the eyebolt on the top of pump (if present, depending on pump model used). Slowly lower the pump, safety cable, tubing, and electrical lines into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Avoid twisting and tangling of safety cable, tubing, and electrical lines while lowering the pump into the well; twisted and tangled lines could result in the pump becoming stuck in the well casing. Also, make sure to keep tubing and lines from touching the ground or other surfaces while introducing them into the well, as this could lead to unintended contamination.

b) If using a bladder pump, connect the air-line to the pump controller output port. The pump controller will be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose. Tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Teflon® tape may be used on the threads of the cylinder to provide a tighter seal. Once the air compressor or gas cylinder is connected to the pump controller, turn on the compressor or open the valve on the cylinder to begin the gas flow. Turn on the pump controller power (if an on/off switch is present) and verify that all batteries are charged and fully functioning before starting the pump.

c) If a peristaltic pump is being used, slowly lower the sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. The pump intake or sampling tube must be kept at least two (2) feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

d) If using an in-line ‘T’ and valve, install between pump discharge water line and the bottom inlet port of the flow-through cell. Attach a short piece of tubing to the outlet. This set-up will be used to collect samples for turbidity readings.

9. Connect the pump discharge water line to the bottom inlet port on the flow-through cell connected to the water quality meter.

10. Before starting the pump, ensure that the water level inside the well has stabilized (i.e., measure the water level multiple times after deploying the pump in the well)

11. Start pumping the well at 200 to 500 milliliters (mL) per minute (or at lower site-specific rate if specified) and adjust the pumping rate to cause little or no water level drawdown in the well (less

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

than 0.3 feet below the initial static depth to water measurement): the water level should stabilize, however, this is not always possible.

12. If the well diameter is of sufficient size, measure the water level every 3 to 5 minutes (or as appropriate, lower flow rates may require longer time between readings) during pumping

13. Maintain a steady flow rate to the extent practicable and do not break pump suction or cause entrainment of air in the sample

14. Record pumping rate adjustments and depths to water

    If necessary, reduce pumping rates to the minimum capabilities of the pump to avoid pumping the well dry and/or to stabilize indicator parameters; if the recharge rate of the well is very low, use alternative purging techniques, which will vary based on the well construction and screen position:

    For wells screened across the water table, the well may be pumped dry and sampling can commence as soon as the volume in the well has recovered sufficiently to permit collection of samples

    For wells screened entirely below the water table, the well can be pumped until a stabilized level (which may be greater than the maximum displacement goal of 0.3 feet) is maintained and monitoring for stabilization of field indicator parameters can commence; if a lower stabilization level cannot be maintained, the well may be pumped until the drawdown is at a level slightly higher than top of the well screen

15. The sampling process may commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples

16. After water levels have stabilized and a sufficient volume has been purged, continue pumping and begin monitoring field indicator parameters (e.g., turbidity, temperature, specific conductance, pH, ORP, and dissolved oxygen [DO]) every 3 to 5 minutes (or after each volume of the flow-through cell has been purged or other appropriate interval) using a flow-through analytical cell or a clean container such as a glass beaker and collect samples for turbidity readings using the T-valve

17. Record field indicator parameters on the groundwater sampling log

18. The well is considered stabilized and ready for sample collection when three consecutive readings are within the following limits:

    - **Turbidity** within ± 10% for values greater than 5 nephelometric turbidity unit [NTU] or if three turbidity values are less than 5 NTU, consider the values as stabilized;
    - **Dissolved Oxygen (DO)** within ± 10% for values greater than 0.5 mg/L or if three DO values are less than 0.5 mg/L, consider the values as stabilized;
    - **Specific Conductance** within ± 3%;
    - **Temperature** within ± 3%;
    - **pH** within ± 0.1 unit;
    - **Oxidation/Reduction Potential (ORP)** within ±10 millivolts (mV);

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

NOTE: *Alternate stabilization goals may exist in different geographic regions, consult the site-specific FIP/work plan for stabilization criteria).*

NOTE: *If the parameters have stabilized but turbidity remains relatively high (e.g., greater than 50 NTU), the pump flow rate may be decreased to a minimum rate of 100 mL/min to reduce turbidity levels as low as possible.*

NOTE: *If field indicator parameters do not stabilize within one (1) hour of the start of purging, but the groundwater turbidity has been minimized (i.e., within ± 10%) and the values for all other parameters are within ± 10%, the well may be sampled; however, consult specifications in the FIP/work plan and/or the project technical lead.*

NOTE: *DO is extremely susceptible to various external influences (including temperature or the presence of bubbles on the DO meter); therefore, great care will be taken to minimize the agitation or other disturbance of water within the flow-through cell while collecting these measurements. If air bubbles are present on the DO probe or in the discharge tubing, remove them before taking a measurement. If DO values are not within acceptable range for the temperature of groundwater, again check for and remove air bubbles on the probe before re-measuring. The table below may be used as a general guide for DO values under various temperatures; however, understand that groundwater contaminants may affect oxygen solubility. If DO value is 0.00 or less, then the meter will be serviced and re-calibrated. If DO values are above possible results, then the meter will be serviced and re-calibrated.*

NOTE: *During extreme weather conditions, stabilization of field indicator parameters may be difficult to attain. Modifications to the sampling procedures to alleviate these conditions (e.g., measuring the water temperature in the well adjacent to the pump intake) will be documented in the field logbook/on the sampling form.*

NOTE: *If other field conditions are suspected of preventing stabilization of certain parameters, observations will be documented in the field logbook/on the sampling form.*

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

Oxygen Solubility in Fresh Water

Temperature (degrees C)	Dissolved Oxygen mg/L
0	14.6
1	[illegible]
2	[illegible]
3	[illegible]
4	[illegible]
5	12.75
6	12.43
7	[illegible]
8	11.83
9	11.55
10	[illegible]
11	11.01
12	[illegible]
13	10.52
14	10.29
15	[illegible]
16	[illegible]
17	9.65
18	[illegible]
19	[illegible]
20	9.07
21	[illegible]
22	[illegible]
23	[illegible]
24	[illegible]
25	[illegible]
26	[illegible]
27	[illegible]
28	[illegible]
29	[illegible]
30	[illegible]
31	[illegible]
32	[illegible]
33	7.16
34	7.06
35	[illegible]

Reference: Masters, G.M., Introduction to Environmental Engineering, Prentice Hall Publishing Company, Boston, [illegible] pages (1998)

19. Complete the sample label(s) and cover the label(s) with clear packing tape to secure the label onto the container

20. After the indicator parameters have stabilized, collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container

    a) If a flow-through analytical cell is being used to measure field parameters, the flow-through cell will be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection

    b) Under no circumstances will analytical samples be collected from the discharge of the flow-through cell

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

c) If an in-line 'T' and valve are used, the valve needs to be removed as well

d) Samples will be collected in the following order: VOCs, total organic carbon (TOC), semi-volatile organic compounds (SVOCs), metals and cyanide, and others (or other order as defined in the site-specific FIP/work plan)

e) When the container is full, tightly screw on the cap

21. If sampling for total and filtered metals and/or polychlorinated biphenyls (PCBs), a filtered and unfiltered sample will be collected

    a) Install an in-line, disposable 0.45-micron particle filter on the discharge tubing after the appropriate unfiltered groundwater sample has been collected

    b) Continue to run the pump until an initial volume of "flush" water has been run through the filter in accordance with the manufacturer's directions (generally 100 to 300 mL)

    c) Collect the filtered groundwater sample by diverting flow out of the filter into the appropriately labeled sample container

    d) When the container is full, tightly screw on the cap

22. Secure with packing material and store the samples on ice (targeting 4° Celsius) in an insulated transport container provided by the laboratory and include a temperature blank in each container to be shipped

23. Record on the Low-Flow Sampling Field Form (and bound field logbook) the time at which sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance and the presence or lack of odors or sheens), and the values of the stabilized field indicator parameters as measured during the final reading during purging (see **Attachment A**)

24. Turn off the pump and air compressor or close the gas cylinder valve if using a bladder pump setup

25. Slowly remove the pump, tubing, lines, and safety cable from the well

    a) If using dedicated tubing, do not allow the tubing or lines to touch the ground or any other surfaces which could contaminate them

    b) If using dedicated tubing, it will be folded - without pinching it - to a length that will allow the well to be capped and also facilitate retrieval of the tubing during later sampling events.

    c) Use a length of rope or string to tie the tubing to the well cap

    d) Alternatively, if tubing and safety line are to be saved and reused for sampling the well at a later date, coil the tubing neatly and placed in a clean plastic bag that is clearly labeled with the well ID ensuring the bag is tightly sealed before placing it in storage

26. Secure the well and properly dispose of personal protective equipment (PPE) and disposable equipment

27. Complete the procedures for packaging, shipping, and handling with the associated Chain-of-Custody

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

28. Complete decontamination for flow-through analytical cell and submersible or bladder pump, as appropriate (*TGI – Groundwater and Soil Sampling Equipment Decontamination*)
29. At the end of each day of the sampling event, perform calibration check of field instruments and record procedure and results in field log

8 WASTE MANAGEMENT

Materials generated during groundwater sampling activities, including disposable equipment and excess purge water, will be stored on site in appropriately labeled containers and disposed of properly. Waste will be managed in accordance with the *TGI – Investigation-Derived Waste Handling and Storage,* the procedures identified in the FIP or QAPP as well as state-, federal- or client-specific requirements. Be certain that waste containers are properly labeled and documented in the field log book.

9 DATA RECORDING AND MANAGEMENT

Management of the original documents from the field will be completed in accordance with the site-specific QAPP.

In general, forms (e.g., Low-Flow Sampling Field Forms), logs/notes (including daily field and calibration logs), digital records, and Chain-of-Custody records will be maintained by the field team lead.

Field logs and Chain-of-Custody records will be transmitted to the Arcadis Project Manager and/or Task Manager, as appropriate, at the end of each day unless otherwise directed. Electronic data files will be sent to the project team and uploaded to the electronic project folder daily.

Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements.

10 QUALITY ASSURANCE

Quality assurance procedures will be conducted in accordance with the Arcadis Quality Management System or the site-specific QAPP.

Unless described otherwise in the project-specific FIP/work plan, QAPP, or Sampling and Analysis Plan, quality assurance/quality control samples will be collected as follows:

- One duplicate for every 10 samples
- One laboratory matrix/matrix spike sample for every 20 samples

In addition to the quality control samples to be collected in accordance with this TGI, the following quality control procedures will be observed in the field:

- Collect samples from monitoring wells, in order of increasing concentration, to the extent known based on review of historical site information if available
- Equipment blanks will include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well)

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

- Collect equipment blanks after wells with higher concentrations (if known) have been sampled
- Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures—calibrate instruments at the beginning of each day, verify the calibration at the end of each day, and record all calibration activities in the field notebook
- Clean all groundwater sampling equipment prior to use in the first well and after each subsequent well following the procedure for equipment decontamination

11 REFERENCES

USEPA. 1986. *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (September 1986).

USEPA. 1991. *Handbook Groundwater, Volume II Methodology*, Office of Research and Development, Washington, DC. USEPN62S, /6-90/016b (July 1991).

USEPA Region I. 2017. *Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells* (EQASOP-GW4; September 19, 2017).

U.S. Geological Survey (USGS). 1977. *National Handbook of Recommended Methods for Water-Data Acquisition: USGS Office of Water Data Coordination*. Reston, Virginia.

12 ATTACHMENTS

Attachment A - Low-Flow Sampling Field Form

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

ATTACHMENT

Attachment A - Low-Flow Sampling Field Form

Downloaded and printed copies from the Approved Procedure Library are uncontrolled documents.

LOW-FLOW GROUNDWATER SAMPLING FORM

ARCADIS

Project No. _____ Well ID _____ Date _____

Project Name/Location _____ Weather _____

Measuring Pt. Description _____ Screen Setting (ft-bmp) _____ Casing Diameter (in.) _____ Well Material ____ PVC ____ SS

Static Water Level (ft-bmp) _____ Total Depth (ft-bmp) _____ Water Column (ft) _____ Gallons in Well _____

MP Elevation _____ Pump Intake (ft-bmp) _____ Purge Method: _____ Sample Method _____

Pump On/Off _____ Volumes Purged _____ Centrifugal _____ Submersible _____ Other _____

Sample Time: Label _____ Gallons Purged _____

Purge Start _____ Replicate/

Purge End _____ Code No. _____ Sampled by _____

Time	Minutes Elapsed	Rate (gpm)/(mL/min) 200mL/min +	Depth to Water (ft) -0.3	Gallons Purged	pH ± 0.1	Cond. (µMhos)/(mS/cm) ± 3%	Turbidity (NTU) ± 10%	DO (mg/L) ± 10%	Temp. (°C)/(°F) ± 3%	Redox (mV) ± 10mV	Appearance	
											Color	Odor
Stabilization Calculations (±)												
Stabilization Criteria					**± 0.1 s.u.**	**±3%**	**± 10% or within 1 NTU (1)**	**± 10%**	**±3%**	**±10 mV**		

(1) **Turbidity** < 50 NTU and ±10% or within 1 NTU of a previous reading when <10 NTU

Constituents Sampled	Container	Number	Preservative

Comments _____

Well Casing Volumes

Gallons/Foot	*1" = 0.04*	*1.5" = 0.09*	*2.5" = 0.26*	*3.5" = 0.50*	*6" = 1.47*
	1.25" = 0.06	*2" = 0.16*	*3" = 0.37*	*4" = 0.65*	

Well Information

Well Location: _____ Well Locked at Arrival: Yes / No

Condition of Well: _____ Well Locked at Departure: Yes / No

Well Completion: Flush Mount / Stick Up Key Number To Well: _____

NEW YORK STATE OF OPPORTUNITY.
Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

April 2023



www.dec.ny.gov

Table of Contents

Objective 1
Applicability 1
Field Sampling Procedures 1
Analysis and Reporting 2
Routine Analysis 2
Additional Analysis 2
Data Assessment and Application to Site Cleanup 3
Water Sample Results 3
Soil Sample Results 3
Testing for Imported Soil 4
Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS 5
Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids 6
Appendix C - Sampling Protocols for PFAS in Monitoring Wells 8
Appendix D - Sampling Protocols for PFAS in Surface Water 10
Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells 12
Appendix F - Sampling Protocols for PFAS in Fish 14
Appendix G - PFAS Analyte List 22
Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids 24

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Data Assessment and Application to Site Cleanup Page 3	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	3/28/2023
Water Sample Results Page 3	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.	NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These guidance values also include criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt).Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.	3/28/2023
Soil Sample Results Page 3	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:	NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:	3/28/2023
Protection of Groundwater Page 3	PFOA (ppb) 1.1 PFOS (ppb) 3.7	PFOA (ppb) 0.8 PFOS (ppb) 1.0	3/28/2023

Citation and Page Number	Current Text	Corrected Text	Date
Footnote 2 Page 3	The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	3/28/2023
Testing for Imported Soil Page 4	If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.	3/28/2023
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Interim SCO Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP)… criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	"Include in the text… LC-MS/MS for PFAS using methodologies based on EPA Method 537.1"	"Include in the text ….EPA Method 1633"	
Appendix A	"Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101"	Deleted	
Appendix B	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	

Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix D	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	"These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report."	"These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER)."	
Appendix H	"The holding time is 14 days…"	"The holding time is 28 days…"	
Appendix H, Initial Calibration	"The initial calibration should contain a minimum of five standards for linear fit…"	"The initial calibration should contain a minimum of six standards for linear fit…"	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R^2 value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments, or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third-party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These human health criteria should also be applied to surface water that is used as a water supply. This guidance also includes criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	0.8	1.0

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These

[2] The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
-
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the current SOP developed by the Division of Fish and Wildlife (DFW) entitled "General Fish Handling Procedures for Contaminant Analysis" (Ver. 8). This SOP should be followed when collecting fish for contaminant analysis. Note, however, that the Bureau of Ecosystem Health will not be supplying bags or tags. All supplies are the responsibility of the collector

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

   1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

   2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

   3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

   1. Project and Site Name.

   2. DEC Region.

   3. All personnel (and affiliation) involved in the collection.

   4. Method of collection (gill net, hook and line, etc.)

   5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

   1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

   2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

   3. Date collected.

   4. Sample location (waterway and nearest prominent identifiable landmark).

   5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **The Bureau of Ecosystem Health will supply the bags.** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with

the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

No materials containing Teflon.
No Post-it notes.
No ice packs; only water ice or dry ice.
Any gloves worn must be powder free nitrile.
No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
Wash hands after handling any food containers or packages as these may contain PFCs.
Keep pre-wrapped food containers and wrappers isolated from fish handling.
Wear clothing washed at least six times since purchase.
Wear clothing washed without fabric softener.
Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name _____ DEC Region _____

Collections made by (include all crew) _____

Sampling Method: □Electrofishing □Gill netting □Trap netting □Trawling □Seining □Angling □Other _____

Preservation Method: □Freezing □Other _____ Notes (SWFDB survey number): _____

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, _____, of _____ collected the
(Print Name) (Print Business Address)

following on _____, 20____ from _____
(Date) (Water Body)

in the vicinity of _____
(Landmark, Village, Road, etc.)

Town of _____, in _____ County.

Item(s) _____

_____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on _____, 20_____.

_____ _____
Signature Date

I, _____, received the above mentioned sample(s) on the date specified and assigned identification number(s) _____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

_____ _____
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2

Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

TGI - Sub-Slab Vapor and Soil Vapor Sampling Using Whole Air Canisters

Rev: 2

Rev Date: August 4, 2023

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
1	1	9/18/2016	All	Updated Rev0	Mitch Wacksman
2	2	8/4/2023	All	Updated Rev1	Sarah Jonker Christina Weaver Robert Uppencamp

Approval Signatures

Prepared by:		8/4/2023
	Sarah Jonker (Preparer)	Date
Reviewed by:		8/4/2023
	Robert Uppencamp (Subject Matter Expert)	Date

1 Introduction

This Technical Guidance Instruction (TGI) provides the methods and procedures for collecting whole air samples via USEPA Method TO-15 for sub-slab vapor or exterior soil vapor using whole air stainless-steel canisters.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

This Technical Guidance Instruction (TGI) has been updated to reflect United States Environmental Protection Agency (USEPA) criteria (USEPA 2015) and best practices.

This document describes the procedures for collecting exterior soil vapor or sub-slab soil vapor (herein referred to as "soil vapor") samples using whole air stainless-steel canisters for the analysis of volatile organic compounds (VOCs) by USEPA Method TO-15 (TO-15). This document assumes a sample port (either sub-slab port or exterior soil vapor probe) has already been installed. This document covers the above ground assembly and sampling methods.

Separate TGIs are available in the TGI library for the installation of sub-slab ports and exterior soil vapor probes. Sampling is typically able to commence a minimum of 2 hours after installation of a sub-slab port (VaporPin®) and

a minimum of 24 hours after installation of a soil vapor probe. Confirm equilibration times with the project's regulatory jurisdiction.

Method TO-15 typically uses a 1-liter, 3-liter, or 6-liter stainless-steel canisters to collect a whole air sample. The whole air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide typical compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment, materials, and detailed instructions for collecting soil vapor samples for VOC analysis.

4 Personnel Qualifications

Arcadis field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, Department of Transportation (DOT)/International Air Transport Association HazMat #1, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. Arcadis field sampling personnel will be well versed in the relevant technical guidance instructions (TGIs) and possess the required skills and experience necessary to successfully complete the desired field work. Arcadis personnel responsible for leading soil vapor sample collection activities must have previous soil vapor sampling experience.

5 Equipment List

The equipment required for soil vapor sample collection is presented below. All stainless-steel supplies must be cleaned/decontaminated prior to use.

5.1 Laboratory

- 1, 3, or 6-liter whole air stainless-steel canisters. Order either batch certified canisters or individually certified canisters as required by the project. Order one extra whole air stainless-steel canister per 20 samples to account for a potential loss of vacuum malfunction in shipping, if feasible. A 1-liter whole air stainless-steel canister is typical for soil vapor sampling and will achieve most reporting limit requirements. Confirm the applicable screening levels for the project will be met by the laboratory reporting limits.
- Flow controllers must be ordered for each whole air stainless-steel canister ordered. Flow controllers will come with in-line particulate filters and vacuum gauges. Flow controllers are pre-calibrated to specified sample duration (e.g., 5, 10, or 30 minutes) or flow rate (e.g., between 80-200 milliliters per minute [mL/min]). Confirm with the laboratory that the flow controller comes with a particulate filter and vacuum gauge.
- Order a stainless-steel duplicate tee as needed. Projects typically require 1 duplicate per 10 samples or 20 samples. Confirm the project QA/QC requirements.

5.2 Supplies

Soil vapor probes are typically completed with all sample assembly components permanently connected and contained within the manway vault. Purging materials and sampling media are required.

Supplies to build one sub-slab port assembly are listed below. Clean/decontaminate all stainless-steel supplies prior to use. Tubing and ferrules cannot be reused. Stainless-steel supplies should be Swagelok® & Parker A-Lok

compatible compression fittings. Supplies can be purchased at companies such as Swagelok® www.swagelok.com, McMaster Carr www.mcmaster.com, or ESP Supply www.shop-esp.com.

Two sub-slab sample assembly types are detailed in Section 8. Materials to build each type of sample assembly are listed below.

Sub-Slab Port Assembly for Vapor Pin™ with Barb Fitting using the Sample Configuration with Purge Isolation

- 1: 1/4-inch stainless-steel valve with compression fittings.
- 6: 1/4-inch stainless-steel compression nuts.
- 6: 1/4-inch stainless-steel front and back compression ferrules.
- 1: 1/4-inch stainless steel union tee. Some labs have flow controllers with a purge port and valve built in. Confirm with the lab flow controller setup (request a diagram or photo). A Luer-Lok™ 3-way valve can be used at the tee fitting as well.
- 36-inches: 1/4-inch outer diameter (OD) Teflon®, Teflon® lined, or Nylaflow tubing.
- 8-inches: 1/4-inch inner diameter (ID) silicone tubing.
- 60-mL syringe equipped with a three-way Luer-Lok™ valve. Alternately, a low-flow air pump may be used.
- 1-liter Tedlar® bag.

Sub-Slab Port Assembly for Vapor Pin™ with Barb Fitting using Separate Purge and Sample Configuration

- 1: 1/4-inch stainless-steel ball with compression fittings.
- 3: 1/4-inch stainless-steel compression nuts.
- 3: 1/4-inch stainless-steel front and back compression ferrules.
- 24-inches: 1/4-inch OD Teflon®, Teflon® lined, or Nylaflow tubing.
- 8-inches: 1/4-inch ID silicone tubing.
- 60-mL syringe equipped with a three-way Luer-Lok™ valve. Alternately, a low-flow air pump may be used.
- 1-liter Tedlar® bag.

5.3 Rental Equipment

Appropriate equipment and materials for quality assurance testing are detailed in the respective quality assurance TGIs (i.e., helium leak testing, water dam testing, methane testing).

- Nitrile gloves.
- Low-flow air pump with time-elapse clock (GilAir or equivalent) capable of a flow rate between 100 ≤ to ≤ 200 mL/min for purging. This may require a low-flow module. Alternately, a 60-mL syringe with a three-way Luer-Lok™ valve may be used.
- Air pump calibration instrument such as a DryCal® Defender (or equivalent), as needed.
- Photoionization detector (PID) with calibration kit, as needed.
- Multi-gas monitor (LANDTEC® GEM™ 2000 PLUS/5000 or similar) capable of detecting percentage of carbon Dioxide, methane, and oxygen with calibration kit, as needed.
- Portable weather meter, as needed. Alternately, weather applications or weather websites can be used.

5.4 Personal Gear and Documents

- Appropriate-sized open-end wrench (typically 9/16-inch and 1/4-inch, #14 spanner for Vapor Pins®).
- 1/4-inch adjustable wrench.
- Channel locking plier with 1.5-inch or larger opening (helium tank manifold and 2-way valves).
- Non-VOC containing modelling clay to mitigate leaks.
- Chain-of-custody (COC) form(s).
- Sample collection log or current Soil Vapor Sampling FieldNow® TO-15 application.
- Work gloves.
- Field notebook or current Soil Vapor Sampling FieldNow® TO-15 application.

6 Cautions

The following cautions and field tips should be reviewed and considered prior to installing or collecting a soil vapor sample.

- Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances including sunscreens, hand sanitizer, or alcohol-based cleaning products. Do not smoke cigarettes/cigars before and/or during the sampling event.
- Ensure the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., 2 to 10 inches of mercury [in. Hg]) remains in the canister when sample collection is terminated.
- The integrity of the sample train and sample port will be tested in accordance with the project specific requirements. These procedures are contained in their own TGI documents and include helium leak testing, water dam testing, and methane testing.
- It is important to record the canister vacuum, start and stop times, and sample identification on a proper field sampling form or current Soil Vapor Sampling FieldNow® TO-15 application. You should observe and record the time/ vacuum at the start, and then again one or two minutes after starting the sample collection. It is a good practice to lightly tap the vacuum gauge with your finger before reading it to make sure the needle is not stuck. If the canister is filling as expected, the sampling rate should match the rate of the flow controller set point. If available utilize an independent analog or digital gauge to verify vacuum; may be laboratory provided. Consult your project manager, risk assessor, or air sampling expert by phone if the canister does not appear to be working properly due to insufficient or rapid pressure changes.
- When sampling, carefully consider elevation. If your site is over 2,000 feet above sea level, or the difference in elevation between your site and your lab is more than 2,000 feet, then pressure effects will be significant. If you take samples at a higher elevation, they will contain less air for a given ending vacuum reading. High elevation samples analyzed at low elevation will result in more dilution at the lab, which could affect reporting limits. Conversely, low elevation samples received by a laboratory at high elevation may appear to not have much vacuum left in them. http://www.uigi.com/Atmos_pressure.html.

- If possible, have equipment shipped two to three days before the scheduled start of the sampling event so that all materials can be checked. Check the vacuum in each canister as soon as they arrive. If the initial vacuum registers less than -25 inches of Hg, then the canister is not appropriate for use and another canister should be used. The initial vacuum required varies by jurisdiction; confirm with the project regulatory authority. If an analog or digital gauge is available when conducting inventory, ensure the vacuum is similar to the laboratory recorded vacuum on the sample tag. Order replacements, if needed.
- Requesting extra canisters and flow controllers from the laboratory should also be considered to ensure that you have enough equipment on site in case of an equipment failure, especially at remote sites.
- When taking field measurement readings of the soil vapor conditions, it is best practice to collect reading from a Tedlar® bag instead of directly from sample port. This is due to field instruments having a flow rate of greater than 200 ml/min, which can cause partitioning of contaminants during sampling. In addition, for health and safety reasons, when there are elevated concentrations of site contaminants it is best not to purge into the sampler's breathing zone.
- Considering laying out a new trash bag or tarp on the ground next to the sample port to prevent sampling equipment from touching potentially impacted ground (i.e., asphalt parking lot with car oil stains).

7 Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling must be carefully performed to minimize the potential for injury and the spread of hazardous substances.

Soil vapor sampling is often done on the ground with workers on their knees. Low stools, knee pads, or a large pad can be used under the entire sample area (i.e., a large, folded box). This will protect the worker's knees. Ensure proper hand protection is worn while working with hand tools during sample train assembly. The metal-on-metal fittings often create small metal splinters when cross-threaded. Always use gloves when handling the canisters, fittings, valves, etc. Do not blow the metal splinters off towards other workers. Use outer nitrile gloves when handling all sample train components to prevent potential cross contamination.

8 Procedure

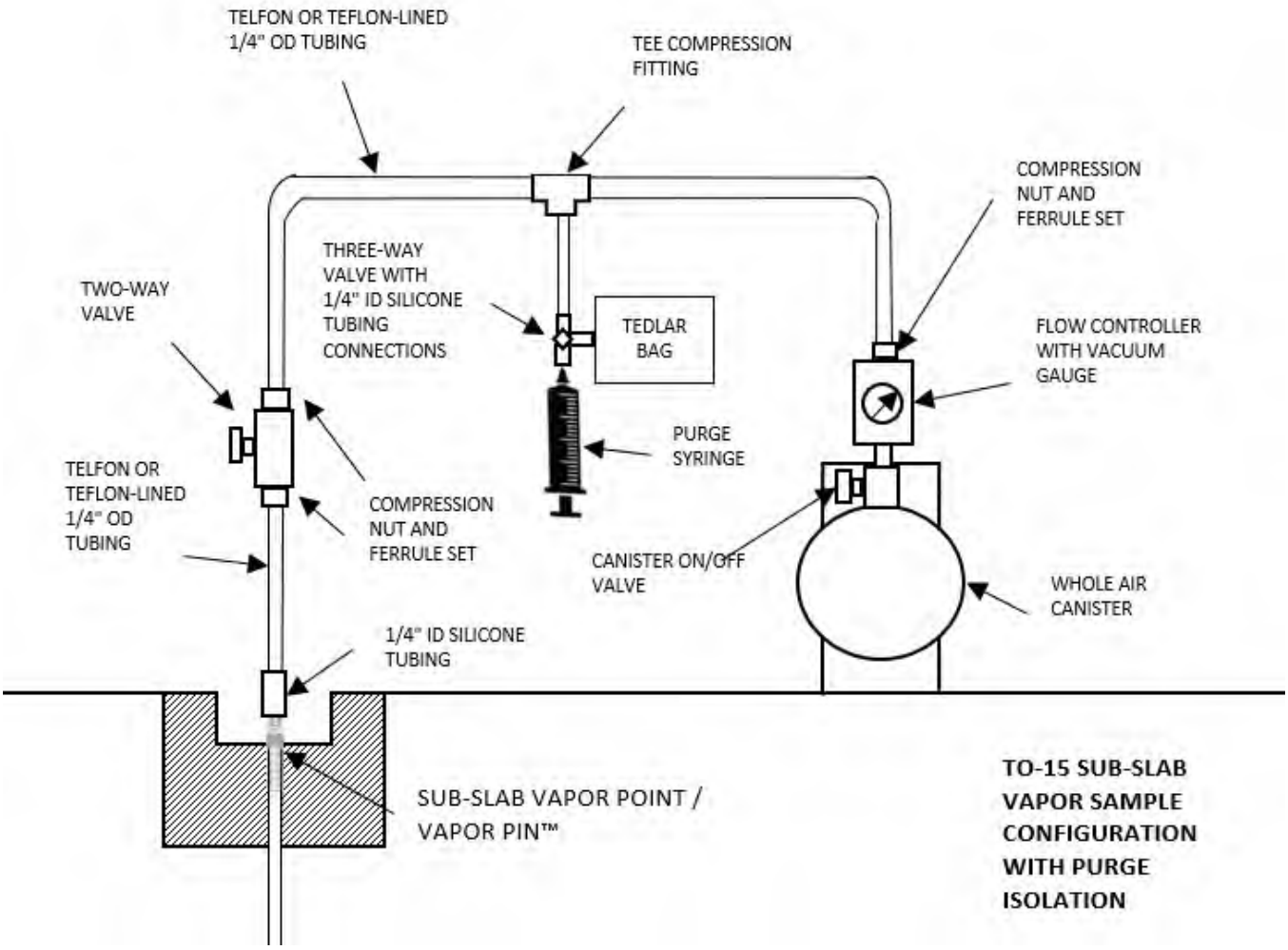
8.1 Sample Train Assembly

The following procedures should be used to collect a soil vapor sample using a whole air stainless-steel canister. These methods can be used for both soil vapor probe samples and interior sub-slab soil vapor samples collected from both permanent and temporary sample point installations. Two configurations of the sample train are acceptable in most jurisdictions; confirm with the project regulatory authority.

Sub-Slab Port Assembly for Vapor Pin™ with Barb Fitting using the Sample Configuration with Purge Isolation

1. Pre-assemble the sample train for each sub-slab port to be sampled (Vapor Pin® with barb fitting). Cut three ~10-inch pieces of 1/4- inch OD Teflon®, Teflon® lined, or Nylaflow tubing and 1 ~6-inch piece of the same tubing.
2. Connect one piece of the 10-inch tubing to the two opposite sides of the stainless-steel tee with compression nuts and ferrule sets. Install a compression nut and ferrule set to the other side of each tubing piece.
3. Remove the cap from the canister and connecting the flow controller with in-line particulate filter and vacuum gauge. The flow controller attaches directly to the canister and the pre-set rate dictates the sample duration. The laboratory may have connected the canister and flow controller prior to shipping. Attach the canister and flow controller assembly to the tubing from one side of the stainless-steel tee.
4. Unless the flow controller manifold came with a purge port and valve, one will need to be added. Cut a short length (~6-inches) of 1/4- inch OD Teflon®, Teflon® lined, or Nylaflow tubing. Connect to the open end of the tee fitting using a compression nut and ferrule set. This tee adds a leg to the sample train that will be used to purge “dead” air from the sample train.
5. Connect the purge syringe with three-way valve and/or air pump to the free end tubing from the tee using a length short piece of 1/4-inch ID silicon tubing.
6. Attach a two-way compression valve to the remaining free end of the tee tubing. Cut another 6-inch piece of 1/4-inch OD Teflon tubing and connect to the other side of the two-way valve with a compression nut and ferrule set. The two-way valve will be immediately adjacent to the sample point in the train assembly. This valve is used to isolate the sample train from the sample point prior to sampling in order to test the sample train’s integrity. See Section 8.3 for purging details.
7. When collecting duplicate or other quality assurance/quality control (QA/QC) samples as required by applicable regulations and guidance, couple two canisters using a stainless-steel compression duplicate sample tee-fitting supplied by the laboratory. Attach flow controller with in-line particulate filter and vacuum gauge to duplicate sample tee.
8. Attach the terminal end of the two-way compression valve to the sample port as appropriate. This may be done using the options below:
    a. Use a section of silicon tube to connect the Teflon sample tubing to the barbed fitting of a Vapor Pin® port.
    b. Use Swagelok® or equivalent compression fittings to connect Teflon tubing to the sample port. Teflon tape should never be used on Swagelok® or equivalent compression fittings.

A schematic of the first suggested sample train setup isolating the purge line is illustrated below:

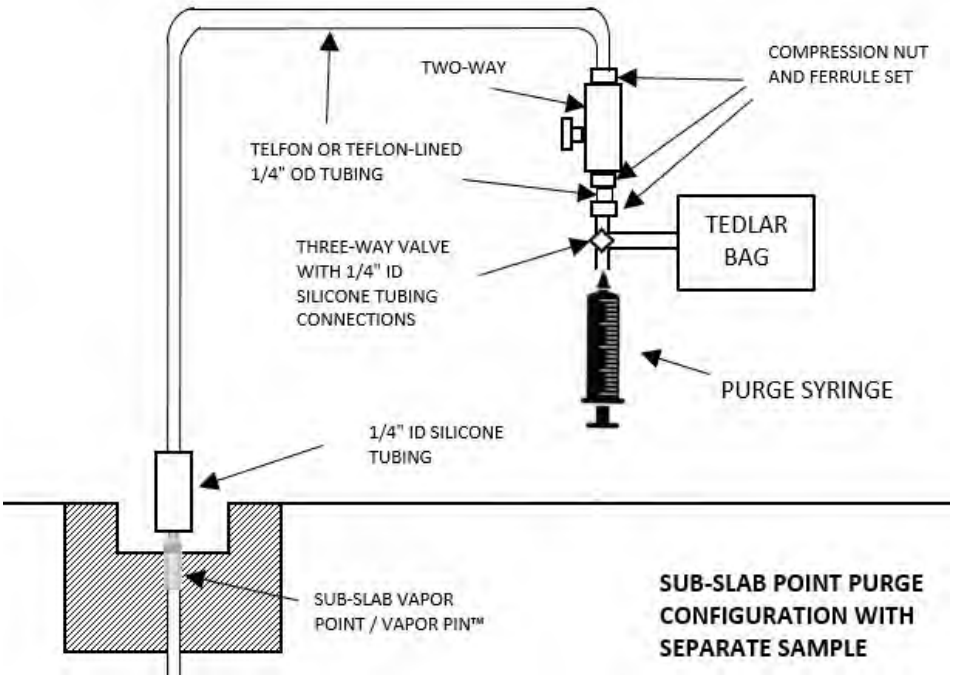


Sub-Slab Port Assembly for Vapor Pin™ with Barb Fitting using Separate Purge and Sample Configuration

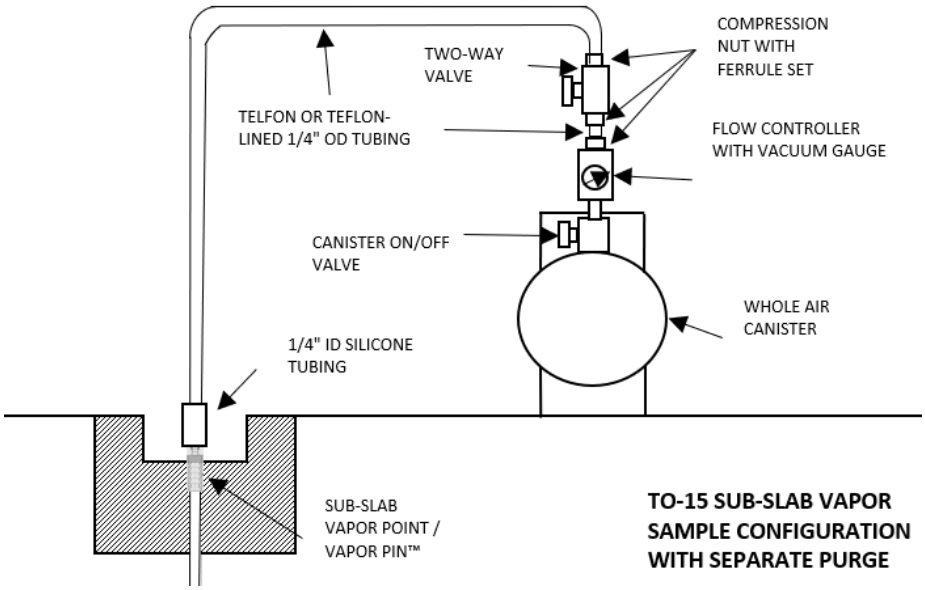
1. Pre-assemble the sample train for each sub-slab port to be sampled (Vapor Pin® with barb fitting). Cut an approximate 18-inch length and a 1-inch length of Teflon or Teflon-lined 1/4-inch OD tubing. Cut a 2-inch piece of 1/4-inch ID silicone tubing. Connect the silicone tubing to one end of the 18-inch length of tubing. Connect a stainless-steel two-way valve with compression fittings to the other side of the Teflon tubing. Connect the 1-inch piece of Teflon tubing to the other side of the two-way valve. Connect a compression nut and ferrule set to the other end of the 1-inch piece of Teflon tubing for the connection to the canister. This sample train is found within the well vault at permanent soil vapor probes.
2. Assemble the sample train by removing the cap from the canister and connecting the flow controller with in-line particulate filter and vacuum gauge. The flow controller attaches directly to the canister and the pre-set rate dictates the sample duration. The laboratory may have connected the canister and flow controller prior to shipping.

3. At sub-slab ports, connect the silicone end of the sample train to the barb fitting of the Vapor Pin®. For both sub-slab ports and soil vapor wells, connect a three-way valve to a syringe using the Lok-Lur tip. Connect one end of the sample train to the three-way valve with a 1-inch piece of silicone tubing and the last end to a Tedlar bag with a 1-inch piece of silicone tubing. A personal air pump capable of 200 milliliters per minute (mL/min) can be substituted for the syringe. See Section 8.3 for purging details.

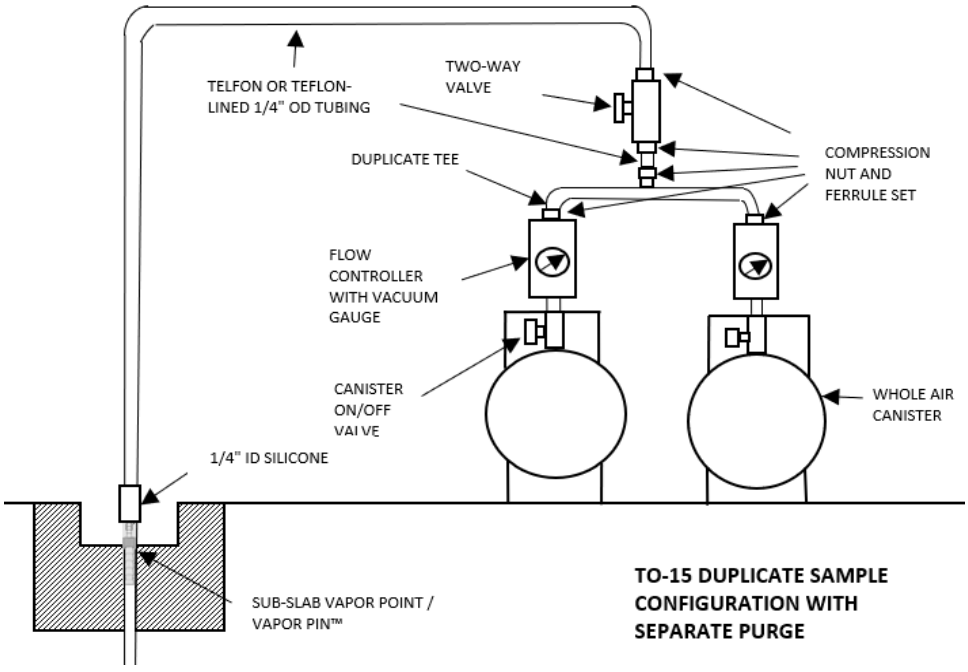
A schematic of the suggested second type of sample train setup is illustrated below:



4. Once purging is complete, close the two-way valve, then disconnect the silicon tubing next to the two-way compression valve from the sample assembly. Connect the canister and flow controller using the installed compression nut.



5. When collecting duplicate or other quality assurance/quality control (QA/QC) samples as required by applicable regulations and guidance, couple two canisters using stainless-steel duplicate sample T-fitting supplied by the laboratory. Attach flow controller with in-line particulate filter and vacuum gauge to duplicate sample tee-fitting as illustrated below.



8.2 Sample Documentation

Record weather information at the beginning of each day of the sampling event at a minimum. If appropriate record weather information during the middle and end of each day of the sampling event. Use the weather function in the current Soil Vapor Sampling FieldNow® TO-15 application. If using a field sampling form contact the local airport or other suitable information source (e.g., weatherunderground.com, or NOAA) to obtain the following information:

- wind speed and direction;
- ambient temperature;
- barometric pressure; and
- relative humidity.

Record information on sample label tags on canister, on field sample log/current Soil Vapor Sampling FieldNow® TO-15 application, and COC. This includes:

- canister number;
- flow controller number;
- sample ID;
- time: start/end;
- initial vacuum in canister; and
- final vacuum in canister once sampling is complete.

Take a photograph of the canister, completed canister tag, and surrounding area.

8.3 Sample Collection

At sub-slab ports, connect the sample train to the sub-slab port barb fitting with 1/4-inch ID silicone tubing. The two-way compression valve should be closed. Soil vapor probes are typically completed with all sample train components permanently connected and contained within the manway vault.

When calculating the purge volume for exterior soil gas probes, the void space of the sand pack around the probe tip and the void space of the dry bentonite in the annular space should not be included in the calculated purge volume purged immediately prior to sampling. The void space of the sand pack and dry bentonite is purged directly after installation.

8.3.1 Shut-in Test and 3-Volume Purge

Sample Train Purge Isolation Setup with Syringe

1. Perform a shut-in test or leak-down-test with the two-way compression valve closed to the sample port. Open the three-way valve to the syringe and pull a vacuum. Quickly close the three-way valve and record the pressure indicated on the gauge.
2. Open the canister valve but do not open the two-way valve on the sample assembly.

3. Record the vacuum indicated on the gauge connected to the canister. Observe the vacuum gauge for at least two minutes. If there are no leaks in the system, this vacuum should be held exactly (estimate the decimal place – i.e., 29.1 inches of Hg). Tap the gauge and wait to see if pressure drops on the gauge.
4. If vacuum holds, document values and proceed with purge by opening the two-way sample assembly valve. If not, attempt to rectify the situation by tightening fittings and restart shut-in test.
5. Purge approximately three volumes of air from the sample port and tubing using the syringe or personal air pump capable of <200 mL/min into the Tedlar® bag using a flow rate <200 mL/min. Purge volume is calculated using the equation:

Purge volume=3 x π x inner radius of tubing x length of tubing

6. Purge air will be collected into a Tedlar® bag to so VOCs are not released into interior spaces or the sampler's breathing zone. Perform quality control method tests such as helium leak testing, water dam testing, or field screening for VOCs concurrently per the project-specific work plan.
7. Close the three-way valve to the syringe to isolate this leg of the sample train.

Sample Train Separate Purge/Sample Setup with Canister

1. Connect the three-way valve, syringe, and Tedlar bag to the sample train. Open the two-way compression valve and purge approximately three volumes of air from the sample port and tubing using the syringe or personal air pump capable of <200 mL/min into the Tedlar® bag using a flow rate <200 mL/min. Purge volume is calculated using the equation above.
2. Close the two-way compression valve and disconnect the syringe purge setup.
3. Connect the canister and flow controller to the sample train. Perform a shut-in test or leak-down-test by opening the canister valve but do not open the two-way valve on the sample assembly.
4. Record the vacuum indicated on the gauge connected to the canister. Observe the vacuum gauge for at least two minutes. If there are no leaks in the system, this vacuum should be held exactly (estimate the decimal place – i.e., 29.5 inches of Hg).
5. If vacuum holds, document values and proceed with sampling by opening the two-way sample assembly valve. If not, attempt to rectify the situation by tightening fittings and restart shut-in test.

8.3.2 Sampling

1. Open the canister valve to initiate sample collection. Record the start time and the initial canister vacuum on the sample log or FieldNow® application. If the initial vacuum registers less than -25 inches of Hg (-27 inches of Hg in Michigan), then the canister is not appropriate for use and another canister should be used. The initial vacuum required varies by jurisdiction; confirm with the project regulatory authority.
2. Check the canister approximately halfway through the sample duration and note progress on sample logs or FieldNow® application. If the vacuum decreases greater than a rate of 200 mL/min or the vacuum stops decreasing during sample collection contact the project team.

8.3.3 Termination of Sample Collection

1. Sampling a 1-liter canister will take approximately 5 to 10 minutes, so do not leave it unattended or get distracted.

2. Record the final vacuum on the sample collection log or FieldNow® app. Stop collecting the sample by closing the canister valve then the sample train valve. The canister should have a minimum amount of vacuum (approximately 5 inches of Hg or slightly greater). Check with the project team on final pressure requirements as these vary by region.
3. Record the date and local time (24-hour basis) of valve closing on the canister tag, sample collection log or FieldNow® application and COC form.
4. Disconnect sample tubing from the sample port; collect post sample fixed gas readings if required; and replace any coverings or abandon as appropriate to mitigate tripping hazards.
5. Remove the flow controller from the canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench. If the canister and flow controller were shipped pre-assembled from the laboratory do not disassemble; simply re-install the brass plug on the flow controller fitting.
6. Verify the appropriate forms and sample labels are filled out appropriately as directed by the laboratory (e.g., affix card with a string).
7. Package the canister and flow controller per DOT regulations for return shipment to the laboratory. These regulations can be found at the Transportation Safety Program's Team Site on the Source. The canister does not require preservation with ice or refrigeration during shipment. Refer to TGI – Soil Gas Methane Monitoring for Shipping Determination of Soil Gas Samples if sampling in an area with unknown or known methane conditions. A shipping determination form is required for shipment of any type of samples prior to field mobilization.
8. Complete and verify the COC form and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) or sign COC over to courier. Consult with the project team on appropriate shipping speeds and shipment insurance.

9 Waste Management

No specific waste management procedures are required.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

11 Quality Assurance

Quality assurance and quality control (QA/QC) will be conducted following project requirements.

11.1 Duplicate Samples

Duplicate samples should be collected in the field as a quality assurance step per project requirements. Generally, one duplicate is taken per 10 or per 20 samples analyzed, but project specific requirements should take precedence. A duplicate tee is required when collecting soil vapor duplicate samples.

11.2 Equipment Blank

Equipment blank samples may be collected in the field as a quality assurance step in order to verify and evaluate the effectiveness of decontamination procedures for new, recycled, or reused materials (i.e., syringes, Swagelok® fittings, 1/4-inch tubing) per project requirements. Generally, one equipment blank sample is taken per 20 sample locations, but project specific requirements should take precedence. Equipment blank sampling steps detailed below:

1. Connect reused and/or decontaminated sample supplies to a nitrogen-filled passivated stainless-steel canister and have in line with a 1-liter canister. Open the valves to begin sampling.
2. Record the final vacuum. Stop collecting the sample by closing the canister valves. The canister should have a minimum amount of vacuum (approximately 5 inches of Hg or slightly greater).
3. Record the date and local time (24-hour basis) of valve closing on the sample collection log on the sample collection log or FieldNow® app and COC form.

12 References

DiGiulio et. al. 2003. Draft Standard Operating Procedure (SOP) for Installation of Sub-Slab Vapor Probes and Sampling Using EPA TO-15 to Support Vapor Intrusion Investigations. http://www.cdphe.state.co.us/hm/indoorair.pdf.

DiGiulio et. al. 2006. Assessment of Vapor intrusion in Homes Near the Raymark Superfund Site Using Basement and Sub-Slab Air Samples. USEPA. EPA/600/R-05/147.

USEPA. 1999a. 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). Center for Environmental Research Information. Office of Research and Development. January.

USEPA. 2015. Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. OSWER Publication 9200.2-154. June.

New York State Department of Health (NYSDOH). 2005. DRAFT “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” February 23, 2005.

TGI – Administering Helium Tracer Gas Leak Test

Rev: 4

Rev Date: May 31, 2024

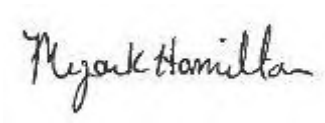
Power PDF Trial
www.kofax.com

Version Control

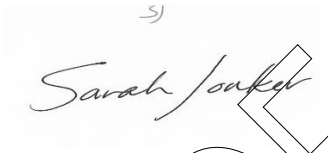
Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	1	December 14, 2016	All		Mitch Wacksman
	2	December 5, 20218		Revised purge rate to be consistent with other vapor intrusion TGIs. Add Health and Safety Considerations section.	Eric Cathcart Mitch Wacksman
	3	December 30, 2021	All	Updated format for QMS Library, Content Updates, Remove "Vapor Intrusion" from title since not necessary.	Robert Uppencamp
	4	May 30, 2024	All	Update	Sarah Jonker

Power PDF Trial
www.kofax.com

Approval Signatures

Prepared by:  5/30/2024

Megan Hamilton (Subject Matter Expert) Date

Reviewed by:  5/30/2024

Sarah Jonker (Subject Matter Expert) Date

Power PDF Trial
www.kofax.com

1 Introduction

This Technical Guidance Instruction (TGI) provides recommended procedures for administering a helium tracer leak test during soil vapor or sub-slab vapor sampling. A separate TGI is available for administering a helium tracer leak test in the State of California. Some clients outside of California may also require the use of the California requirements. The *TGI – Sub-Slab Vapor or Soil Vapor Sampling Using Whole Air Canister* is presented under a separate cover and should be referenced in conjunction with this TGI.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control method to verify the integrity of the vapor port seal and the numerous connections comprising the sample train. Without the use of a tracer, verification that a soil vapor sample has not been diluted by ambient or indoor air is difficult.

This TGI focuses on using helium as a tracer gas. It should be noted that a field helium meter could register a false positive if methane is present in the subsurface. In this case an alternative method should be employed such

PowerPDF Trial
www.xinyan.com

as a water dam test or use of a different tracer gas (i.e., isopropyl alcohol with caution). The protocol for using a tracer gas includes the following basic steps:

1. Enrich the atmosphere in the immediate vicinity of the sample port where ambient air could enter the sampling train during sampling with the tracer gas; and
2. Measure a vapor sample from the sample tubing for the presence of elevated concentrations (> 10%) of the tracer. Percent leakage is defined as the ratio of tracer gas concentration in the purged air as compared to the concentration of tracer gas in the shroud. If the leakage is greater than 10% personnel must rectify issues with the seal at the sample port and repeat the helium leak testing procedure. If the seal cannot be fixed, consider reinstallation of the sample point at the direction of your local Subject Matter Expert (SME). The calculation to determine leakage percentage is as follows:

$$\%\ Leakage = \frac{Tracer\ Gas\ Concentration\ in\ Purged\ Air}{Tracer\ Gas\ Concentration\ in\ Shroud} * 100$$

The intent of the leak check compound is to enhance the integrity of the soil gas sample by demonstrating that minimal or no ambient air breakthrough during sampling is occurring. Although it is preferable not to have any tracer gas breakthrough, minor amounts of breakthrough (less than 10% leakage) may be acceptable if the breakthrough is appropriate for the project's data quality objectives. Detecting leak check compounds indicate potential field problems. Some potential sources of leaks in sampling trains are poor quality fittings, stripped, over tightened, dirty or worn threads, and excessive sampling train connections. Regardless of the cause of the leak, a data adjustment factor based upon the concentration of the leak check compound to compensate for the inability to collect representative samples is inappropriate. In addition, if the leak is greater than 10%, the data may be qualified as rejected.

Note that the display screen of the most commonly used helium detector, the Dielectric MGD-2002, shows concentration values in ppm until it exceeds the 10,000 ppm threshold. You will need to convert the ppm read out into a percentage prior to performing the above calculation; 1% = 10,000 pm. A plastic pail, bucket, garbage can or even a plastic bag can serve as a shroud to keep the tracer gas in contact with the port during the testing.

There are two basic approaches to testing for the tracer gas:

1. Include the tracer gas in the list of target analytes reported by the laboratory; and/or
2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to sampling for the compounds of concern. Note that tracer gas samples can be collected via syringe, Tedlar® bag, etc. They need not be collected in evacuated stainless-steel canisters or minicans. If your project will not be utilizing laboratory analysis to confirm tracer gas in the sample collected, performing an additional leak check after the sample is collected is required.

This TGI focuses on monitoring helium using a portable sampling device, although helium can also be analyzed by the laboratory along with other volatile organic compounds (VOCs) from the same canister that is used for TO-15 sampling – see the TGI for *Sub-Slab Vapor or Soil Vapor Sampling Using Whole Air Canister* for details. Real-time tracer sampling allows the investigator to confirm the integrity of the port seals prior to formal sample collection.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling points. If the results of the initial samples indicate that the port seals are adequate, the Project Manager can consider reducing the number of locations at which tracer gas samples are used in future monitoring rounds. At a minimum, at least 10% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor points as part of a long-term monitoring program, the port should be tested

Power PDF Trial
www.kotaxcom

prior to the first sampling event. Tracer gas testing of subsequent sampling events may often be reduced or eliminated unless conditions have changed at the site. Soil gas port integrity should certainly be rechecked with Tracer gas if land clearing/grading activities, freeze thaw cycles, or soil desiccation may have occurred. Points should also be rechecked if more than 2 years have elapsed since the last check of that port.

4 Personnel Qualifications

Arcadis field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Arcadis field sampling personnel will be competent in the relevant procedures and possess the required skills and experience necessary to successfully complete the desired field work. Arcadis personnel responsible for directing tracer gas testing must have previous experience conducting similar tests without direct supervision.

5 Equipment List

The equipment required to conduct a helium tracer gas test is presented below:

- Appropriate PPE for site (as required by the Health and Safety Plan).
- Helium (ultra-high purity [UHP] or laboratory grade).
- Compatible regulator for helium tank.
- Shroud (plastic bucket, garbage can, plastic bag, plastic drop cloth, laboratory provided helium leak detection kit, etc.).
    - The size of the shroud should be sufficient to fit over the sample port. It is worth noting that using the smallest shroud possible will minimize the volume of helium needed; this may be important when projects require a large number of helium tracer tests.
    - If using a solid structure as your shroud it will need to have three small holes in it. These holes will include one on the top (to accommodate the sample tubing), and two on the side (one for the helium detector probe, and one for the helium line). If using a plastic bag or drop cloth, these inlets can be run underneath the heavy chain or sandbags used to seal the shroud.
    - The shroud should ideally enclose the sample port and as much as possible of the sampling train.
- One or two helium detectors capable of measuring from 1 - 100% (Dielectric MGD-2002, Mark Model 9522, or equivalent).
- Tedlar® bag.
- 1/4-inch OD tubing (Teflon®, Nylaflow or similar).
- 1/4-inch inner diameter silicone tubing (to connect to either pump or syringe, helium tank, if Vapor Pins™ are present, etc.).
- Seal material for shroud (rubber gasket, VOC-free modeling clay, sand-bags, weighted chain, bentonite, etc.) to keep helium levels in shroud stable in windy conditions. Although the sealing material is not in direct contact with the sample if leakage does not occur, sealing materials with high levels of VOC emissions should be avoided, since they could contaminate a sample if a leak occurs. If using modeling clay, it must be a natural color, made in the US, and meet the ASTM requirement for no VOCs.
- Appropriate-sized open-end wrench (typically 9/16-inch and 1/2-inch, #14 spanner for Vapor Pins™).

Powered by www.kofax.com

- 1-inch adjustable wrench.
- 1 1/8-inch open-end wrench or channel locking plier with 1.5-inch or larger opening (helium tank manifold and two-way valves).
- Sample collection log.
    - FieldNow® TO-15 application.
    - Standard Soil Vapor Sampling Log.
    - San Mateo County Soil Vapor Sampling Log.
- Nitrile gloves.
- Work Gloves.
- Field notebook/tablet.

6 Cautions

- Helium is an asphyxiant! Be cautious with its use indoors! Never release large volumes of helium within a closed room! When in use during soil vapor sampling, place the cylinder in a horizontal position on the ground surface close to the sample train to mitigate tipping hazards. Upon daily sample completion, immediately close the flow valve, release the remaining gas within the flow regulator, and disconnect from the gas cylinder using the appropriately sized wrench. Compressed gas cylinders should be handled with caution; see Section 3.32 of the Arcadis United States Employee Field Health & Safety Handbook on the use, transport, and storage of compressed gasses before beginning field work.
- Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field staff should review the attachment on safely handling compressed gas cylinders prior to commencing field work.
- Care should be taken not to pressurize the shroud while introducing helium. If the shroud is completely air tight and the helium is introduced quickly, the shroud can be over-pressurized and helium can be pushed into the ground. Provide a relief valve or small gap where the helium can escape.
- Because minor leakage around the port seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 10%) of tracer gas are observed in a sample, the port seal should be enhanced and fittings within the sampling train should be checked and/or tightened to reduce the infiltration of ambient air and the tracer test readministered.
- . If an alternate sample train yields the same tracer gas breakthrough, sample collection should not proceed at the sample location in question. The project team will need to consult with their local SME to determine whether a new sample point should be installed at a later date to replace the sample location with repeated tracer gas breakthrough.
- Flow rates between 100 to 200 milliliters per minute (mL/min) and vacuums less than 100 inches of water (7.3 inches of mercury [Hg]) should be maintained during purging and sampling to minimize stripping (partitioning of vapors from pore water to soil gas), to prevent ambient air from diluting the soil gas samples, and to reduce

PDF Trial
www.xdf.com

variability between contractors. Maintaining these flow rates and vacuums will increase the likelihood that representative samples will be collected. A flow rate greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100 inches of water (7.3 inches of Hg) or less must be maintained during sampling whenever a higher flow rate is used.

- This TGI is not a substitute for a Work Plan. Staff involved with a soil vapor sampling event must review the Work Plan prior to pre-field planning activities.

7 Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling must be carefully performed to minimize the potential for injury and the spread of hazardous substances.

Soil Vapor sampling is often done on the ground with workers on their knees. Knee pads or a large pad can be used under the entire sample area (i.e., a large folded box). This will protect the worker's knees and the sampling equipment from touching the potentially impacted ground (i.e., asphalt parking lot with car oil stains).

The metal on metal fittings often create small metal splinters, so always used gloves when handling the canisters, fittings, valves, etc. Do not blow the splinters off towards other workers.

8 Procedure

The helium tracer test can be conducted when using temporary or permanent sampling points and inside or outside a facility. A visual of an example helium tracer gas test equipment set up in included as Figure 1.

1. Attach the sample train to the sample point. This can be accomplished utilizing a number of different methods depending on the sample install (i.e., Swagelok® or comparable fittings).
2. Place the shroud over the sample point and tubing (sampling media, tubing, sampling point, valves, etc.).
3. Pull the tubing through hole in top of shroud. Seal opening at top of shroud with VOC free modeling clay.
4. Place weight on top of shroud to help maintain a good seal with the ground.
5. Insert helium tubing and helium detector probe into side of shroud. Seal both with modeling clay to prevent leaks.
6. Fill shroud with helium. Fill shroud slowly, allowing atmospheric air to escape either by leaving a gap where the shroud meets the ground surface or by providing a release value on the side of the shroud. Do not pressurize the shroud!
7. Use the helium detector to monitor helium concentration within the shroud from the lowest hole drilled in the shroud (bottom of the shroud nearest where the sample tubing intersects the ground). Helium should be added until the environment inside the shroud has > 40% helium.
8. Purge the sample point through the sample tubing into a Tedlar bag using a syringe equipped with a three-way Luer lock valve. The purge rate should at least match the sample collection rate but not exceed 200 ml/min. Test the air in the Tedlar bag for helium using portable helium detector. If the point is free of leaks there should be very low helium in the purge air from the soil. The natural concentration of helium in the atmosphere is 0.00052% by volume and there are few if any natural sources of helium to soil gas.

Power PDF Trial
www.kofax.com

9. If there is greater than 10% ratio of tracer gas concentration in the purged air as compared to the concentration of tracer gas in the shroud, a significant leak may be present, and personnel should rectify issues with the seal at the sample port and repeat the testing procedure. If the seal cannot be fixed, consider reinstallation of the sample point at the direction of your local SME.
10. Monitor and record helium level in shroud before, during and after tracer test. Maintain helium concentration at target level during sampling.
11. Monitor and record helium level in purge exhaust.
12. At successful completion of tracer test and sample point purging, the soil vapor sample can be collected. Maintain 40% helium in the shroud during sampling.
13. After sample collection, repeat the helium leak test process in Step 8 to verify breakthrough did not occur during sampling.

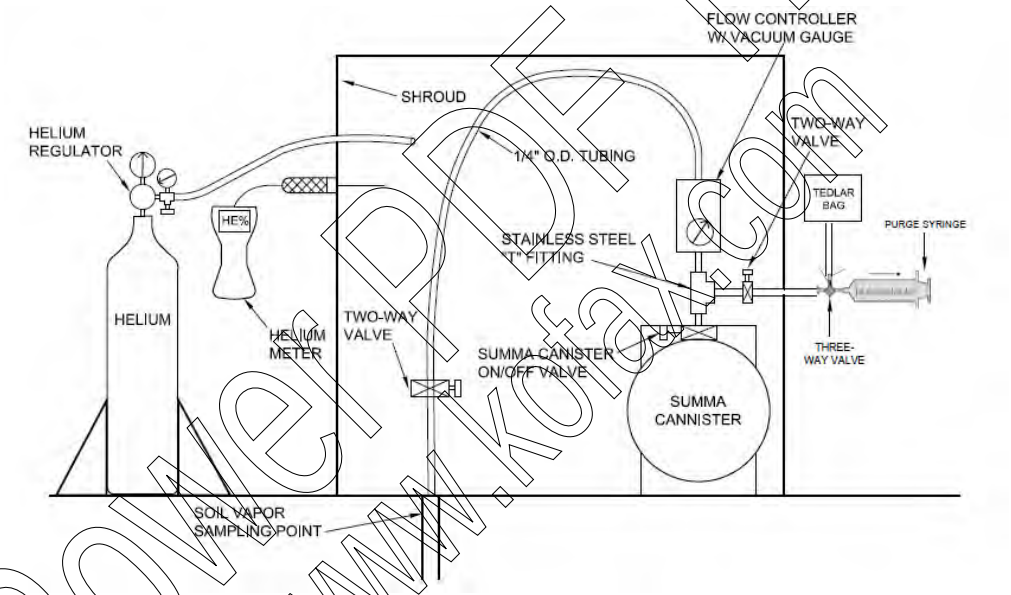


Figure 1 - Sampling Set Up with canister enclosed in shroud. Some jurisdictions only require the soil vapor sampling point or sub-slab port be enclosed in the shroud.

Power PDF Trial
www.kofax.com

9 Waste Management

No specific waste management procedures are required.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff

are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

Measurements will be recorded on the sample logs or FieldNow® digital form at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location, and the helium concentrations in both the shroud and the purge air before, during, and after tracer testing. Any problems encountered should also be recorded in the field notes.

11 Quality Assurance

Conduct quality assurance as required by the project-specific work plan and/or Quality Assurance Project Plan (QAPP).

12 References

New Jersey Department of Environmental Protection (NJDEP). 2018. Vapor Intrusion Technical Guidance. January.

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

United States Environmental Protection Agency (USEPA). 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. June.

Power PDF Trial
www.kofax.com

TGI - Sub-Slab Soil Gas Sampling Point Installation Using Vapor PIN™ Approach

Rev: 2

Rev Date: December 30, 2021

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	1	July 20, 2017	All	Original/Rev 1	Dawn Cacia Mitch Wacksman
	2	December 30, 2021	All	Rev 2 for QMS Library / Updates	Robert Uppencamp

Approval Signatures

Prepared by:		7/20/2017
	Dawn Cacia (Preparer)	Date
Reviewed by:		12/30/2021
	Robert Uppencamp (Subject Matter Expert)	Date

1 Introduction

This Technical Guidance Instruction (TGI) provides the methods and procedures for installing sub-slab vapor ports using the Vapor Pin™ approach.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

This document describes the procedures for installing permanent sub-slab sampling probes using the Vapor Pin™ approach. These sample probes can then be used for the collection of sub-slab soil gas samples, for vacuum readings, or other uses. When not in use, the probes can be sealed in place without having to abandon the point.

The following sections list the necessary materials, equipment, and detailed instructions for installing sub-slab sampling points using the Vapor Pin™ approach.

4 Personnel Qualifications

Arcadis field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as

needed. Arcadis field sampling personnel will be well versed in the relevant standard operating procedures (SOPs), technical guidance instructions (TGIs) and possess the required skills and experience necessary to successfully complete the desired field work. Arcadis personnel responsible for leading sub-slab soil gas sampling point installation activities must have previous sub-slab soil gas sampling point installation experience.

5 Equipment List

- Appropriate personal protective equipment (PPE), as required by the site-specific Health and Safety Plan (HASP) and the job safety analysis (JSA)
- Electric hammer drill (big – e.g., Bosch, Hilti, etc.)
- 5/8-inch and 1 ½-inch concrete drill bits for impact drill (drill bit length contingent on slab thickness)
- 2-inch concrete coring drill bit (for stainless steel flush mount cover installation)
- Contractor Cox Colvin Vapor Pin™ Kit that includes:
  - Decontaminated Stainless Steel Vapor Pin™ with barbed fitting (0.5-inch outside diameter at end, 0.8125-inch diameter at middle, 3.5-inch in length)
  - Vapor Pin™ sleeves
  - Vapor Pin™ rubber protective caps
  - Secure, steel flush mount covers or plastic flush mount cover
  - Spanner screwdriver
  - Stainless steel drilling guide
  - Installation/Extraction tool
  - Bottle brush
  - Vapor Pin™ SOP
- Photoionization detector (PID) with appropriate eV lamp for site related contaminants of concern (COCs)
- Dead blow hammer
- Pliers
- Whisk broom and dustpan or shop vacuum with clean fine-particle filter
- Spray bottle with distilled water
- Paper towels
- Nitrile gloves
- Work gloves
- Knee pads
- Ground fault circuit interrupter (GFCI)
- Extension cords capable of amperage required for hammer drill
- Plastic sheeting
- Field notebook and/or FieldNow® application

6 Cautions

The following cautions and field tips should be reviewed and considered prior to installing or collecting a sub-slab soil gas sample.

- When drilling sample collection holes, be mindful of utilities that may be in the area. Always complete utility location, identification and marking before installing sub-slab ports as required by the Arcadis Utility Location Policy and Procedure. Be aware that public utility locator organizations frequently do not provide location information within buildings so alternative lines of evidence must be used. If the driller is concerned about a particular location, consult the project manager about moving it to another location. Do not hesitate to use Stop Work Authority; if something doesn't seem right stop and remedy the situation.
- Use of Vapor Pins™ and drill bit length will be based on the thickness of the slab encountered. Every effort will be made to establish the thickness of the slab during the preliminary investigation activities, such as interviews with site personnel, review of construction drawings, building walk through and utility clearance process. If slab is determined to be too thin for Vapor Pins™ – install a standard port using the permanent probe approach consistent with the corresponding TGI.
- Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), use hand sanitizer, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the installation event.
- Only a clean decontaminated hammer drill and drill bits should be used for installation. A hammer drill dedicated to VI work is preferred. Be extra cautious if using rental equipment.
- Field personnel will properly seal the sub-slab soil gas sampling point at the slab surface to prevent leaks of atmosphere into the sub-slab soil gas sampling point during purging and sampling. Permanent ports will be fit snug into the predrilled hole by ensuring that the silicone sleeve is fitted properly around the Vapor Pin™ before installation and expands sufficiently inside the hole during installation. A protective cap will be installed on the end of the barb fitting. If this is not done properly, the integrity of the sample port may be compromised.
- If possible, have equipment shipped two to three days before the scheduled start of the installation event so that all materials can be checked. Order replacements if needed.

7 Health and Safety Considerations

All sampling personnel should review the appropriate HASP and JSA prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling must be carefully performed to minimize the potential for injury and the spread of hazardous substances. For sub-slab soil gas sampling point installation, drilling with an electric concrete impact drill should be done only by personnel with prior experience using such a piece of equipment or directly supervised by an experienced person and with the appropriate health and safety measures in place as presented in the JSA. It is possible to encounter high concentrations of VOCs in sub-slab soil gas, so the amount of time the borehole remains open should be minimized. For the same reason, when installing sub-slab soil gas sampling points in spaces with minimal dilution potential, such as closets, it is advisable to provide local ventilation. Finally, sub-slab soil gas sampling point installation should be completed at least 24 hours in advance or after any indoor air sampling to avoid cross contamination of the indoor air samples.

Proper procedures should be used to eliminate exposure to silca dust when drilling through concrete and asbestos containing materials such as floor tile, etc.

8 Procedure

Permanent sub-slab soil gas sampling points are installed using a hammer drill and manual placement of the Vapor Pin™ probe. After a dry fit, the vapor probe is inserted into the hole and installed using a dead blow hammer to tap the installation/extraction tool over the Vapor Pin™ to protect the barb fitting. The vapor probe is equipped with a rubber protective cap that is used to close the sampling port when not in use. A figure presenting a properly installed Vapor Pin™ is below:



Figure 1 - Cross-section of properly installed Vapor Pin™(Cox-Colvin Vapor Pin™ Installation SOP [2016])

The Vapor Pin™ and tubing will be purged prior to collecting the soil gas sample. Detailed installation methods are as follows:

1. Complete the procedure in the Arcadis Utility Location and Clearance Standard prior to drilling activities.
2. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet) if present.
3. Lay down plastic sheeting to keep the work area clean. Check to make sure shop vacuum is working properly and fine concrete particles will not pass through filter.
4. Advance the 1½-inch drill bit approximately 1.75 inches into the slab (Please note that if the stainless-steel flush mount is being used, advance the 2-inch drill bit approximately 1/8 inch into the slab first before using the 1½-inch drill bit). This hole is drilled deep enough to permit the top of the Vapor Pin™ to be set flush with the slab when the Vapor Pin™ is inserted into the 5/8-inch hole drilled under Step 7, below. Careful not to advance too far into the slab. This will cause the threaded portion of the Vapor Pin™ to be set too deeply to engage with stainless-steel cover. Clean up cuttings with shop vacuum, bottle brush, and dust pan.
5. Drill a 5/8-inch-diameter hole into the concrete slab using the hammer drill. Do not fully penetrate the slab at this time. Stop drilling approximately 1-inch short of penetrating the slab.
6. Use the shop vacuum, bottle brush and dust broom to clean up the work area and material that may have fallen into and around the drill hole.

7. Advance the 5/8-inch drill bit the remaining thickness of the slab and approximately 3 inches into the sub-slab material to create an open cavity. Record any observations from the drill cuttings, if possible, regarding approximate soil type(s), presence of soil moisture/water, and presence or absence of a plastic sub-slab sheet. Record PID readings.
8. Use the bottle brush, dust broom and dust pan to clean material around and within the hole. Do not use the shop vacuum to clean up the drill hole after the full thickness of the slab has been penetrated.
9. Using a Vapor Pin™ without the silicone sleeve fitted, test fit the components so that the proper depth of the 1½-inch hole provides enough space for the Vapor Pin™. Adjust so that the Vapor Pin™ will lie flush with the slab surface and does not create a tripping hazard.
10. Re-drill the 5/8-inch hole to ensure it remains clear. This can also be accomplished using a piece of steel rod, sample tubing or a piece of heavy wire (e.g., coat hanger).
11. Assemble the Vapor Pin™ for installation by fitting the silicone sleeve over the lower end of the pin.
12. Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the Vapor Pin™ to protect the barb fitting, and tap the Vapor Pin™ into place using a dead blow hammer. Make sure the installation/extraction tool is aligned with the Vapor Pin™ to avoid damaging the barb fitting. Place the rubber protective cap over the Vapor Pin™ barb so that it covers the first barb. Do not push the cap down so that it is flush as this will make it very difficult to remove when preparing to sample.
13. For flush mount installations, cover the Vapor Pin™ with a flush mount cover, using either the plastic cover or by threading the stainless-steel secure cover onto the Vapor Pin™. Replace the surface covering (e.g., carpet) if warranted. Sample collection location should be returned to pre-sampling conditions to the extent feasible given the presence of a permanent probe.
14. All permanent sub-slab soil gas sampling points should be allowed to equilibrate for a minimum of 24 hours before proceeding to sample collection.

9 Waste Management

Silica dust generated from drilling through concrete must be captured and disposed of properly. If drilling through known or potential asbestos containing materials (e.g., floor tile, linoleum, etc.), discuss with the project manager and VI lead for proper management and disposal of dust and cuttings.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

11 Quality Assurance

Conduct quality assurance as required by the project-specific work plan and/or Quality Assurance Project Plan (QAPP).

12 References

Cox-Colvin & Associates, Inc. 2016. Standard Operating Procedure Installation and Extraction of the Vapor Pin™. http://vaporpin.coxcolvin.com/wp-content/uploads/2016/09/Vapor-Pin-SOP-09-2016-Web.pdf

TGI - Indoor or Ambient Air Sampling and Analysis Via USEPA Method TO-15

Rev: 2

Rev Date: December 30, 2021

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	1	August 19, 2016	All	Update Rev 0	Margaret Bartee Mitch Wacksman
	2	December 30, 2021	All	Updated Rev 1 and for QMS Relaunch	Sarah Jonker Robert Uppencamp

Approval Signatures

Prepared by:  12/30/2021

Sarah Jonker (Subject Matter Expert) Date

Reviewed by:  12/30/2021

Robert Uppencamp (Subject Matter Expert) Date

1 Introduction

This document describes specific procedures and considerations to be used by Arcadis staff to collect indoor air or ambient air samples in passivated stainless-steel canisters (e.g., SUMMA®) for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Compendium Method TO-15 (TO-15).

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

This Technical Guidance Instruction (TGI) document describes the methods and procedures for collecting indoor air or ambient air samples with passivated stainless-steel canisters (e.g., SUMMA®) and the subsequent analysis of volatile organic compounds (VOCs) using USEPA TO-15.

4 Personnel Qualifications

Arcadis field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as

needed. Arcadis field sampling personnel will be competent in the relevant procedures and possess the required skills and experience necessary to successfully collect indoor air and ambient air samples and the desired field work. Arcadis personnel responsible for directing indoor air and/or ambient air sample collection activities must have previous indoor air sampling experience and be able to complete the field work without direct supervision.

5 Equipment List

The equipment required for indoor air and ambient air collection is presented below:

- 6-liter, stainless steel passivated canisters (e.g., SUMMA®). Request one canister for each sampling location, plus duplicate canisters per project-specific requirements. If feasible, order extra canisters at a rate of 10 to 20% of the total number of sampling canisters (including duplicates).
- Flow controllers with in-line particulate filters and vacuum gauges. Flow controllers are pre-calibrated by the laboratory to the sampling duration [typically 8-hours in commercial/industrial settings and 24-hours in residential settings] specified by the project team). Vacuum gauges are also generally supplied by the laboratory. Flow controllers can be connected to the canister via 9/16-inch compression fittings or quick-connect fittings.
- Open-end wrench. Typical canister caps require 9/16-inch wrenches.
- Chain-of-custody (COC) form.
- Sample collection log (attached) or the Fulcrum Application: FieldNow® – TO-15 Indoor/Outdoor Air Collection Log Version 2.0 (Tier 1).
- Box, chair, tripod, or similar to hold canister above the ground surface at approximate breathing height (3-5 feet).
- Hand-held weather meter (optional).
- Nitrile gloves
- Camera (if photography is permitted at sampling locations).
- Chain and padlock or bike lock (for securing ambient air canisters).
- Zip ties
- Independent digital gauge (optional).
- Outdoor Air Sampling Tag noting: “Environmental Testing – Do Not Disturb”

For abnormal situations (i.e., sumps, crawlspaces with no access, where canisters must be hidden, etc.), Teflon tubing may be used to collect an air sample. In these situations, ¼-inch Swagelok fittings (including nut, front sleeve, and back sleeve) or other methods may be appropriate to affix tubing to canister. Teflon tubing may be connected to various lengths of electrical fish rods with zip ties (do not use tape) to direct the end of the tubing into a crawlspace or other area.

6 Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, keep canisters away from heavy pedestrian traffic areas (e.g., main entranceways, walkways), if possible. Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances, use hand sanitizer, or smoke cigarettes before and/or during the sampling event.

Specify sample collection duration with the laboratory when ordering equipment and confirm with the laboratory upon equipment receipt. Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target sample duration and a measurable vacuum (e.g., 5 inches Hg) remains in the canister when sample collection is terminated. In extreme cold temperature, it is suggested the final measurable vacuum remains higher (e.g., 10 inches of Hg) to account for pressure loss. Digital gauges are recommended.

7 Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task.

8 Procedure

Preparation of Passivated Canister and Collection of Sample

1. Record the following information on the sampling form (use a hand-held weather meter, contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):
   - Ambient temperature
   - Barometric pressure
   - Wind speed
   - Relative humidity
   - Significant recent precipitation
   - Snow/ice cover
1. For indoor air sampling, note whether the heating, ventilation, and air conditioning (HVAC) system is operational and record settings.
2. For outdoor air sampling, canisters should be initiated at least 30 minutes prior to initiating the first indoor air sample and should be placed upwind of the structure(s) being sampled.
2. Attach an outdoor air tag to each outdoor air canister using a zip tie as applicable. Outdoor air tags are usually only required for off-site locations where disturbance of the canister may occur. The outdoor air tag should include the words, “Environmental Testing – Do Not Disturb”. If possible, place the outdoor air canister(s) in areas with less foot traffic.
3. Choose the sampling location in accordance with the project sampling plan. If a breathing zone sample is required, place the canister on a box, chair, tripod, or other similar stand to locate the canister orifice 3 to 5 feet above the ground or floor surface. The canister may be affixed to wall/ceiling support with nylon rope or placed on a stable surface. In general, areas near windows, doors, air supply vents, and/or other potential sources of “drafts” shall be avoided.
4. Record canister serial number and flow controller number on the sampling log or FieldNow® application and COC form. Assign sample identification (ID) and record on canister ID tag on the sample collection log or FieldNow® application and COC form.
5. Remove the brass dust cap from the canister with the wrench. Attach the independent gauge provided by the laboratory or a digital gauge to the canister. For compression fittings tighten with fingers first, then gently with

the wrench (roughly a quarter turn). Use caution not to over tighten fittings. For quick-connect fittings simply attach the gauge to the canister. Open the canister and record the initial vacuum on the sampling log or FieldNow® application and COC form. Close the canister and remove the gauge. The initial pressure reading should be evaluated with respect to project-specific and regulatory jurisdictional requirements. If the initial pressure registers less than -25 inches of Hg, then the canister is not appropriate for use, and another canister should be used. Note: confirm specific project jurisdiction regulatory requirements for initial pressure.

6. Attach the flow controller and integrated vacuum gauge to the canister with the wrench. Tighten with fingers first, then gently with the wrench (roughly a quarter turn). Use caution not to over tighten fittings. Some laboratories ship the canister and flow controller pre-assembled. Confirm that connections are appropriately tight. For quick-connect fittings simply attach to the canister. Caution – some quick-connect canisters do not have valves and begin sampling as soon as the flow controller is attached.
7. Open the canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening on the sample collection log and COC form. Collection of duplicate samples will include collecting two samples side by side at the same time or by using a duplicate tee. Duplicate tees can be requested from the laboratory and made from Teflon tubing and Swagelok fittings.
8. Check the initial canister pressure using the vacuum gauge. Ensure the initial pressure on the flow controller vacuum gauge matches the pressure from the independent gauge, note difference in the canister on the sample log.
9. Photograph the canister and surrounding area within the FieldNow® application; if photography is permitted at sampling locations. Also photograph the sample tag.
3. If feasible, check the canister approximately half-way through the sample duration and note progress on sample logs.

Termination of Sample Collection

1. Arrive at the sampling location at least 1 to 2 hours prior to the end of the sampling interval (e.g., 6 hours following sample initiation for an 8-hour sampling duration).
2. The appropriate canister pressure for termination of sampling is between -2 and -10 inches of Hg with the optimal ending pressure of -5 inches of Hg. Leaving some vacuum in the canister provides a way to ensure that the sample was collected over the appropriate duration and to evaluate whether the canister leaks before it reaches the laboratory. Stop collecting the sample by turning the valve on the canister when the canister pressure reaches approximately -5 inches of Hg and when the desired sample time has elapsed. If the canister pressure is outside of the appropriate range at the end of the sampling duration, consult with the project manager before ending the sample.
3. Record the final canister pressure. Record the date and local time (24-hour basis) of valve closing on the sample collection log or FieldNow® application and COC form.
4. Remove the flow controller from the canister. Connect the independent gauge to confirm the final canister pressure using the procedure as described above. Re-install brass cap on canister fitting and tighten with the wrench.
5. Package the canister and flow controller in accordance with Department of Transportation regulations available on the Transportation Health and Safety's Team Site on the Source for return shipment to the laboratory. The canister does not require preservation with ice or refrigeration during shipment.
6. Complete the forms and sample labels provided by the laboratory as directed (e.g., affix card with string).

7. Complete the COC form; copy, photograph, or scan a version for the project file (if possible); and place the form in the shipping container. Close the shipping container and affix the custody seal to the container closure. Transmit canisters via courier delivery service (e.g., Federal Express or UPS) to laboratory for analysis.

9 Waste Management

No specific waste management procedures are required.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

Notes and pictures taken during the sampling process that cannot be collected using the FieldNow® application will be compiled and uploaded to the project specific folder on SharePoint and/or Collaboration Hub.

11 Quality Assurance

Conduct quality assurance as required by the project-specific work plan and/or Quality Assurance Project Plan (QAPP). Additionally:

4. Canisters should be pre-cleaned by an accredited laboratory and individually certified clean.
5. Communicate with laboratory to insure that project-specific reporting limits and deliverables are met.
6. If tubing is used during sampling activities, the tubing should be Teflon or Teflon-lined tubing.
7. All fittings should be stainless-steel.
8. Ambient (outdoor) air sample(s) should be collected each day of the indoor air sampling event to evaluate background VOC concentrations.

12 References

Not Applicable

Attachment 2

Product Inventory Form and Air Sampling Log

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: _____

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

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

* 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.

ARCADIS

Indoor Air Sample Log

Sample ID _____ Project/No. _____

Date _____ Sampling Personnel _____

Weather _____ _____

Precipitation w/in preceding 12 hours? Y / N Amount:_____in _____

Current Building Type: Residential Commercial Industrial

Building Construction Characteristics (e.g., rancher, apartment): _____

General Description of Building Materials (e.g., concrete, cinder block): _____

Characteristics of basement:

	Floor:	**Foundation Walls:**	**Moisture:**
Finished			
Unfinished	Concrete	Concrete	Wet
	Dirt	Block	Damp
	Other _____	Layed up stone	Dry

DESCRIPTION OF SAMPLE LOCATION:

Location _____

Floor Level: Basement / 1st Floor

Room size ft x ft: _____

Location Sketch:

SAMPLE COLLECTION:

Sample Time: _____

Sample Rate: _____

Sample Volume: _____

CONTAINER DESCRIPTION:

_____ L Summa Canister

ANALYTICAL METHOD:

_____

Attachment 3

Low-Flow Groundwater Sampling Form

LOW-FLOW GROUNDWATER SAMPLING FORM

ARCADIS

Project No. _____ Well ID _____ Date _____

Project Name/Location _____ Weather _____

Measuring Pt. Description _____ Screen Setting (ft-bmp) _____ Casing Diameter (in.) _____ Well Material ____ PVC ____ SS

Static Water Level (ft-bmp) _____ Total Depth (ft-bmp) _____ Water Column (ft) _____ Gallons in Well _____

MP Elevation _____ Pump Intake (ft-bmp) _____ Purge Method: _____ Sample Method _____

Pump On/Off _____ Volumes Purged _____ Centrifugal _____ Submersible _____ Other _____

Sample Time: Label _____ Gallons Purged _____

Purge Start _____ Replicate/

Purge End _____ Code No. _____ Sampled by _____

Time	Minutes Elapsed	Rate (gpm)/(mL/min) 200mL/min +	Depth to Water (ft) -0.3	Gallons Purged	pH ± 0.1	Cond. (µMhos)/(mS/cm) ± 3%	Turbidity (NTU) ± 10%	DO (mg/L) ± 10%	Temp. (°C)/(°F) ± 3%	Redox (mV) ± 10mV	Appearance	
											Color	Odor
Stabilization Calculations (±)												
Stabilization Criteria					**± 0.1 s.u.**	**±3%**	**± 10% or within 1 NTU (1)**	**± 10%**	**±3%**	**±10 mV**		

(1) **Turbidity** < 50 NTU and ±10% or within 1 NTU of a previous reading when <10 NTU

Constituents Sampled	Container	Number	Preservative

Comments (L/D)NAPL observations: _____

Well Casing Volumes

Gallons/Foot	*1" = 0.04*	*1.5" = 0.09*	*2.5" = 0.26*	*3.5" = 0.50*	*6" = 1.47*
	1.25" = 0.06	*2" = 0.16*	*3" = 0.37*	*4" = 0.65*	

Well Information

Well Location: _____ Well Locked at Arrival: Yes / No

Condition of Well: _____ Well Locked at Departure: Yes / No

Well Completion: Flush Mount / Stick Up Key Number To Well: _____

Attachment 4

Chain-of-Custody Form

ARCADIS

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: | Telephone:

Address: | Fax:

City | State | Zip | E-mail Address:

Project Name/Location (City, State): | Project #:

Sampler's Printed Name: | Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

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

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

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

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

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

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

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

Attachment 5

PID Calibration Log

PID Calibration Log

ARCADIS

Zero Gas Source: _____ Instrument Type: _____ PAGE ____ of ____

Lot Number/Expiration Date: _____ Serial Number: _____

Calibration Gas Source: _____ Instrument Type: _____

Lot Number/Expiration Date: _____ Serial Number: _____

Concentration: _____ _____

Instrument Number	Date	Time	Zero Cal. OK (Y/N)	Calibration Gas Reading	Comments	Calibration w/in 2% (Y/N)?	Alarms Set (Yes/No)?	User Initials

Attachment 4

EQuIS™ Laboratory Standard Operating Procedure

INTRODUCTION

ARCADIS manages and verifies/validates analytical data generated by commercial analytical laboratories in the EQuIS database (product of Earthsoft, Inc.). All laboratories contracted by ARCADIS or their clients, on a site-by-site basis, may be required to submit electronic data deliverables (EDDs) in addition to the hard copy report. This Standard Operating Procedure (SOP) describes the structure, format, and submission requirements for electronic data deliverables (EDDs) in the EQuIS EFWEDD (Sample, Test, Result, Batch) format.

This document is a general guidance for preparation of the required electronic data and associated quality control information. The structure of the EDD as defined in this document will remain constant unless Earthsoft modifies the database structure. Reference values and requirements for population of additional fields with specific information will not change from project to project.

Modification to reference value lists may NOT be made by the laboratory without authorization from ARCADIS.

Section I provides ARCADIS contact information and the procedure to submit electronic deliverables directly via e-mail. However, all EDDs will be required to be submitted in a final CD compilation for each specific sampling event or as directed by the ARCADIS Project Manager (PM).

Section II outlines the table structures and general requirements of the EDDs. The EDD structure is based on EarthSoft's EFWEDD EDD format. EarthSoft's EDD format has not been changed; however, some 'optional' fields identified in the EarthSoft EDD have been modified to be 'required' in this EDD format. Additional information regarding the EarthSoft products can be found at http://www.earthsoft.com/.

Section III presents some additional explanation and requirements for populating the table structure and population set forth in Section II.

Section IV summarizes the use of the EDP. Each laboratory **MUST** use EDP to check each EDD file set prior to submission to ARCADIS. The EDP Error Report must be submitted with the EDD. ***All errors identified by the EDP routine must be corrected prior to forwarding the files for entry into the EQuIS database. Or approval for submittal with errors must be authorized by ARCADIS.***

I. CONTACT INFORMATION

Laboratories should contact the ARCADIS National Program Lab Managers with questions regarding this document. The contact info is as follows:

Richard J. Murphy, Ph.D.
Principal Scientist
ARCADIS U.S., Inc.
630 Plaza Drive, Suite 100
Highlands Ranch, CO, 80129
Phone: 720.344.3804
Cell: 303.475.5210
Fax: 720.344.3535
Richard.murphy@arcadis-us.com

OR

Dennis K. Capria
Principal Scientist/Associate
ARCADIS
6723 Towpath Road
Syracuse, NY 13214
Phone: 315.446.9120
Direct: 315.671.9299
Fax: 315.449.0025
Cell: 315.751.1672
Dennis.capria@arcadis-us.com

ELECTRONIC LABORATORY DATA CHECKER EDP

Prior to submitting an EDD to ARCADIS, the EarthSoft EDP must be run to check and verify the EDD structure, format and reference value compliance. The EDP report must be submitted for each file with each EDD set. The Data Checker error report, which demonstrates that the EDD files were successfully checked, must be electronically submitted with the four EDD files to ARCADIS.

REFERENCE VALUES

A specific set of values is required to be utilized in populating certain key fields of the EDD. The Reference Value Lists for the EDP will be provided for each ARCADIS subcontracted laboratory. The Reference Value Lists must be utilized as provided. Alterations or additions to the Reference Values are **NOT** allowed **without prior** written authorization by the ARCADIS Data Manager. Electronic mail may be considered written authorization.

ELECTRONIC DATA DELIVERABLE (EDD) SUBMISSION

Prior to submission to ARCADIS, each data file must also be reviewed by the laboratory to ensure that the sample IDs, dates, times and other inter-related information is consistent between all four (4) files and the EDD is complete. All parameters that are subcontracted to other laboratories must be included in the EDD for a specific SDG or Laboratory Project Number. It is not acceptable to submit separate EDDs for subcontract parameters. Manual review of the files may be necessary to complete this review.

It is **IMPERATIVE** that the EDD results match the hard copy results. If the results do not match the lab will correct the error ASAP at no additional charge. This includes issues involving various rounding routines for different electronic data management programs within the laboratory (i.e. LIMS vs. EPA CLP). Significant figures must also match hard copy and be consistent from one sampling event to the next. Reporting limits must be consistent between events as well and must be in compliance with the Laboratory Task Order or Project Statement of Work. There may be instances where diluted surrogates and unrecovered spike compounds will require population of the EDD with numeric values in lieu of data flags in the hard copy report. The ARCADIS Data Manager will provide project specific guidance for these conditions. Adherence to the SOP requirements for population of spike/surrogate recovery and RPD fields is required to allow electronic validation of the data.

The EDP Reports for each file must be submitted with the 4 files of the actual EDD.

Laboratories must submit EDDs via e-mail for verification of compatibility and completeness to the assigned ARCADIS Data Manager for the project.

The subject line of this e-mail must include the following text:

[Facility-Code] [Laboratory Project/Log/SDG Number] - EDD Submission

The e-mail should also include the laboratory contact name and phone number.

EDDs must be submitted via e-mail prior to or at the same time the final hard copy document is delivered. ARCADIS may review the EDDs prior to requesting final submittal on CD. EDDs will be returned to the laboratory for modifications until the files can be successfully imported into the EQuIS Project Database and Electronic Data Validation can be performed without field population errors. Any revisions to the EDD will be required within 24 hours of notification to the laboratory regarding observed problems with the EDD. When the EDD is acceptable to the ARCADIS Data Manager and Project Manager, a CD containing all final versions of the EDD should be submitted to ARCADIS for archiving.

Invoices for analytical work will not be approved for payment until the final EDD revisions are acceptable.

II. ELECTRONIC DELIVERABLE DATA FORMAT

This section identifies the structure and format requirements for EQuIS EFWEDD EDDs submitted by all laboratories to ARCADIS. Specific field definitions are presented for each of the four files. Laboratories should review the unique requirements for these fields. The format population and adherence to the criteria are mandatory. Data are electronically validated and errors are quickly identifiable if the EDD is incorrect.

GENERAL FORMAT REQUIREMENTS

All laboratory data must be saved as an ASCII file format using the following standard format. Each subcontracting laboratory's data must be incorporated into the primary laboratory's EDD.

Each data field must be either separated by tabs or enclosed in double quotes (") and separated by commas. Data fields that do not contain information may be represented by two commas. Maximum length of text fields is indicated in the parentheses. If the input information is less than the maximum field length, **DO NOT ADD** spaces to account for the difference.

Each record must be terminated with a carriage return/line feed (i.e., standard DOS text file). The file can be produced using any software with the capability to create ASCII files.

THE LABORATORY SHALL LEAVE THE HEADERS IN EACH ASCII FILE TO ASSIST IN REVIEW AND RESOLUTION OF ERRORS.

Four files are required for each SDG or Laboratory Project Number: one each for samples, tests, results, and batches. Each file must be saved as a Tab Delimited or Comma Separated file.

Enterprise EDD File Naming Conventions
EDD packages must be named using a specific naming convention. An EDD Package consists of a .zip file containing the text (.txt) EDDs and a User Certificate. The zip file and text file names must contain the specific elements listed below under file naming conventions, separated by a period. A User Certificate file will be supplied to the lab by Arcadis for inclusion in the zip file. Please include in the subject line of emailed EDD submissions the facility code and Sample Delivery Group (SDG) number.

File Naming Conventions:
ZIP File Name = Unique ID.Facility Code.Format Name.zip
Text File EDDs Name = Unique ID.EDD Section Name.txt

Unique ID = SDG number.
Facility Code = The facility code (i.e., Site Name from ENFOS)
Format Name = The EQuIS EDD format name (e.g., ESBasic, EFWEDD, etc.).
EDD Section Name = The name of the section within the EDD (e.g. EFW2FSample, EFW2LabTST, etc.).

For example, ZIP File Name = "2009001.BP-99999.EFWEDD.zip" will contain the following files: "2009001.EFW2FSample.txt", "2009001.EFW2LabTST.txt", “2009001.EFW2LabRES.txt", '2009001.EFW2LabBCH.txt' and "pfoos.usr".

Package re-submittal
In order to re-submit corrected EDDs, the .zip file and text (.txt) EDDs must each be renamed. If the example EDD package above were to be re-submitted it would have ZIP File Name = "2009001B.BP-99999.EFWEDD.zip" containing "2009001B.EFW2FSample.txt", "2009001B.EFW2LabTST.txt", “2009001B.EFW2LabRES.txt", '2009001B.EFW2LabBCH.txt' and "pfoos.usr". Note that a “B” has been appended to the SDG name in both the zip file name and each of the text file names. A subsequent re-submittal of the same SDG would require that a C be appended and so on.

Referential integrity is enforced between tables (e.g. sys_sample_code present in the result, batch, and test tables must also be present in the sample table). For example, a data record with a specific sys_sample_code found in the result table, but not in the sample table, will cause and error in the Data Import Module and the file will not be allowed to be entered into the database. Dates and times associated with each test must match in the “Test” and “Result” files or the database will not allow entry of the entire file.

Reference values must be adhered to for a variety of fields as identified in the Reference Value list and described in the following table format requirements.

FORMAT DETAILS

The following four sections provide a detailed summary and the specific layout for each field required in each of the four (4) tables of the EDD. The ARCADIS EDD has been derived from the EarthSoft EFWEDD EDD.

Date is reported as MM/DD/YY (month/day/year) and time as HH:MM (hour:minute). Time must be reported in 24-hour (military) format (3:30 p.m. = 15:30 and 8:30 AM = 08:30 not 8:30). **NOTE:** Make certain that the LIMS systems format the date and time the same way for all files.

The columns in the following 4 tables relate to:

“Number” Column in Tables = Column of EDD table

“Attribute Name” = Column Name
PK after attribute indicates this is a primary key within Access for the table.

"Column Data" Type = Text or Numeric values required. Parenthetical number indicates total allowable number of characters in the field.

"Required" Column:

The column titled 'Required' will contain the text 'Yes' if the field is required to be populated by the laboratory. In addition, a "condition" is added to indicate additional information applying to population of the associated field. The first number of the condition relates to the table in which the condition applies, i.e. 1 is the Sample File, 2 is the Test File, 3 is the Result File, and 4 is the Batch File. Conditions apply as follows:

Condition	Table	Description
0	ALL	Field always required
1-1	SAMPLE	Field required for field samples only not required for laboratory samples
1-2	SAMPLE	Field required (parent_sample_code) for **laboratory** QC samples that have 'parents'
1-3	SAMPLE	Field not required for field samples
2-1	TEST	Field required if applicable for specific test
3-1	RESULT	Field required (result_value) for detected analytes only (TRG or TICs). Must be NULL if non-detect or surrogates, internal standards or spiked compounds
3-2	RESULT	Field required if available or appropriate for result
3-3	RESULT	Field required for matrix spikes or matrix spike duplicates (NOT required for surrogate compounds or LCS samples where the original concentration is assumed to be zero).
3-4	RESULT	Field required for surrogate compounds, LCS, Blank Spikes, Matrix Spikes, and Internal Standards.
3-5	RESULT	Field required for LCS duplicates, Blank Spike Duplicates, Matrix Spike Duplicates, Lab Replicates
3-6	RESULT	Field required for LCSD, BSD, MSD, and Lab duplicate samples
3-7	RESULT	Field required for surrogates and spike compounds
4-1	BATCH	Field required if available or appropriate for result

"REQUIRED":

"YES" = Required data if applicable

"NO" = Optional information unless otherwise directed by ARCADIS Data Manager or preferred for insertion by lab except where lab is specifically directed to leave the field Null.

Parent Sample Definition

Parent Samples are base samples for duplicates or spikes. i.e. original field samples used for matrix spikes or field sample used for Lab Duplicate/Replicate. A Matrix Spike is not the Parent Sample of the Matrix Spike Duplicate.

POPULATING SPIKE FIELDS

SURROGATES: surrogate recoveries are to be populated in qc_spike_added, qc_spike_measure, and qc_spike_recovery fields. Surrogates are analyte type = SUR. Control limits for surrogate recoveries must also be populated.

INTERNAL STANDARDS: internal standard values are to be populated in qc_spike_added, qc_spike_measure, and qc_spike_recovery fields. Internal Standards are analyte type = IS.

LCS, BS, and MS COMPOUNDS: recoveries are to be populated in qc_spike_added, qc_spike_measured, and qc_spike_recovery fields. Compounds spiked to evaluate method accuracy are analyte type = SC. Control limits for spike recoveries must also be populated.

LCSD, BD, AND MSD COMPOUNDS: recoveries are to be populated in qc_dup_spike_added, qc_dup_spike_measured, and qc_dup_spike_recovery fields. The Compounds spiked to evaluate method accuracy are analyte type = SC. Control limits for spike recoveries must also be populated. Additionally, the qc_rpd and qc_rpd_cl fields must be populated for these samples.

LAB REPLICATE SAMPLE DATA: values for lab duplicates/replicates are to be populated in qc_dup_spike_measured field. The qc_rpd and qc_rpd_cl fields must be populated for these samples.

III. ADDITIONAL REQUIREMENTS

SAMPLE TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
1	sys_sample_code	Text(40)	Yes (0)	Unique sample identifier (COC Sample ID). Each sample must have a unique value, including spikes and duplicates. Unique sample identifiers **throughout** the database are an **ABSOLUTE** restriction enforced by EQuIS Chemistry. This unique identifier also carries through to each subsequent sampling event where the samples IDs must be unique for EVERY event of the project (continuing years). Laboratory QC samples must also have unique identifiers between sampling event and from 1 year to the next and between laboratories in the event subcontractors are used. For Matrix Spike, Matrix Spike Duplicate, and Laboratory Duplicates of Field Samples, add the suffix **MS, MSD, and LR**, respectively to create unique identifiers for these types of Lab QC samples.
2	sample_name	Text(30)	No	Additional sample identification information as necessary. Is not required to be unique (i.e., duplicates are OK).

SAMPLE TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
3	sample_matrix_code	Text(10)	Yes (0)	Code, which distinguishes between different types of sample matrix. **Examples**: Soil samples =“SO” , groundwater samples = “WG”. Field Blanks, Trip Blanks, and Rinsate Blanks = “WQ”. Water Method Blanks and liquid matrix spikes = “WQ” Soil Method Blanks and soil/sludge/sediment matrix spikes = “SQ’ This field refers to the sample matrix not the matrix after preparation or extraction. See rt_matrix for the list of valid values.
4	sample_type_code	Text(10)	Yes (0)	Code that distinguishes between different types of samples. **For example**, normal field samples = “N” and laboratory method blank =“LB”. Field QC sample types are Field Duplicates = “FD”, Field Blanks = “FB”, Trip Blanks = “TB”. Lab QC sample types are LCS or Blank Spikes = “BS”, LCSD or BS Duplicates = “BD” and Matrix Spikes = “MS” and Matrix Spike Duplicates = “SD”. See rt_sample_type in Reference Values list of valid values.
5	sample_source	Text(10)	Yes (0)	Must be either "Field" for field samples **or** "Lab" for laboratory QC samples. No other values are allowed. Matrix spikes and lab duplicate/replicate are "Lab" samples, even though the parent is a "Field" and the base sample came from the field. The spiking or splitting for duplication is done in the lab. Field duplicates as submitted to the lab by field sampling teams are “Field”
6	parent_sample_code	Text(40)	Yes (1-2)	The value in the "sys_sample_code" that identifies the sample that was the source of this sample. *For example*, the Matrix Spike and the Matrix Spike Duplicate or Lab Replicates parent_sample_code is the sys_sample_code for the originating field sample that is spiked to generate the MS/MSD or split by the lab for use as the laboratory duplicate. This field is only required in the EDD for laboratory "clone" samples (e.g., matrix spikes and duplicates). Field duplicates are submitted blind to the laboratory, so this field cannot be completed by the laboratory. This field must be blank for samples that have no parent (e.g., normal field samples, method blanks, etc.).
7	sample_delivery_group	Text(10)	Yes (0)	Sample delivery group or laboratory Project/Log Number. All deliverables must reference the SDG or Lab Log-in Number. **This field MUST BE POPULATED**
8	sample_date	Date	Yes (1-1)	Date of sample collection in **MM/DD/YY** format including trip blanks. Must be blank for laboratory samples.
9	sample_time	Time	Yes (1-1)	Time of sample collection in 24-hour (military) **HH:MM** format. 8:45 AM = 08:45 and 3:30 PM = 15:30. Must be blank for laboratory samples.

SAMPLE TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
10	sys_loc_code	Text(20)	No	Sample collection location. To be populated by ARCADIS unless otherwise directed at project initiation.
11	start_depth	Double	No	Beginning depth (top) of soil sample. To be populated by ARCADIS unless otherwise directed at project initiation.
12	end_depth	Double	No	Ending depth (bottom) of soil sample. To be populated by ARCADIS unless otherwise directed at project initiation.
13	depth_unit	Text(15)	No	Unit of measurement for the sample begin and end depths. IRPIMS-style unit of measurement codes (see table X03) are recognized by Chem; other codes may be allowed by the Chem project manager. To be populated by ARCADIS unless otherwise directed at project initiation.
14	chain_of_custody	Text(15)	Yes (1-1)	Chain of custody identifier or number. A single sample may be assigned to only one chain of custody. The COC identifier will be provided by the field sampling team based on conventions established for a specific project.
15	sent_to_lab_date	Date	No	Date sample was sent to lab (in MM/DD/YY format for EDD).
16	sample_receipt_date	Date	Yes (1-1)	Date that sample was received at laboratory in **MM/DD/YY** format. Must be blank for laboratory samples.
17	sampler	Text(30)	No	Name or initials of sampler.
18	sampling_company_ code	Text(10)	Yes (1-1)	Name or initials of sampling company (no controlled vocabulary). "ARCADIS" should be entered into this field unless otherwise directed at project initiation.
19	sampling_reason	Text(30)	No	Optional reason for sampling. No controlled vocabulary is enforced.
20	sampling_technique	Text(40)	No (1-1)	To be populated by ARCADIS unless otherwise directed at project initiation. Sampling technique. **For example**, low flow, bailing, MIP, etc… Must be blank for laboratory samples.
21	task_code	Text(10)	No	Code used to identify the task under which the field sample was retrieved.
22	collection_quarter	Text(5)	No	Quarter of the year sample was collected (e.g., "1Q96")
23	composite_yn	Text(1)	No	Boolean field used to indicate whether a sample is a composite sample.
24	composite_desc	Text(255)	No	Description of composite sample (if composite_yn is YES).

SAMPLE TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
25	sample_class	Text(10)	No	Navy sample class code.
26	custom_field_1	Text(255)	No	Custom sample field
27	custom_field_2	Text(255)	No	Custom sample field
28	custom_field_3	Text(255)	No	Custom sample field
29	comment	Text(255)	Yes (0)	Field required to contain the full sample ID code.
30	sample_receipt_time	Text(5)	Yes (1-1)	Time of sample receipt by laboratory in 24-hour (military) **HH:MM** format. 8:45 AM = 08:45 and 3:30 PM = 15:30

TEST TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
1	sys_sample_code (PK)	Text (40)	Yes (0)	SAME AS #1 IN SAMPLE TABLE. This value is used in enforcing referential integrity between tables. Must match sys_sample_code in Sample Table.
2	lab_anl_method_name (PK)	Text (35)	Yes (0)	Laboratory analytic method name or description. See rt_analytic_method in reference value tables for list of valid values.
3	analysis_date (PK)	Date/ Time	Yes (0)	Date of sample analysis in MM/DD/YY format. Refers to initiation of the analysis not prep method date.
4	analysis_time (PK)	Text (5)	Yes (0)	Time of sample analysis in 24-hour (military) HH:MM format. Note that this field, combined with the "analysis_date" field is used to distinguish between reextractions, reanalyses, and dilutions. Please ensure that retests have "analysis_date" and/or analysis_time" different from the original test event (and complete test_type field as appropriate).
5	total_or_dissolved (PK)	Text (1)	Yes (0)	"T" for total metal organic carbon concentration, "D" for dissolved or filtered metal or organic carbon concentration ONLY. USE "N" for organic (or other) constituents for which neither "total" nor "dissolved" is applicable including TDS.
6	column_number (PK)	Text (2)	Yes (2-1)	Applicable for GC or HPLC methods. "1C" for first column analyses, "2C" for second column analyses, or "NA" for analyses where not applicable. If any "2C" tests are listed, then there must be corresponding "1C" tests present also. Laboratories must indicate which of the two columns is to be considered "primary" by entering “Y” in the "reportable_result" field of the result table for the result presented in hard copy reports. It is NOT acceptable to identify both “1C” and “2C” reportable_result as “Y:; one must be “N” if” “1C” and “2C” are provided in the EDD.

TEST TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
7	test_type (PK)	Text (10)	Yes (0)	Type of test. Valid values include "initial", "reextract", and "reanalysis", "dilution" are acceptable. See rt_test_type for al valid values.
8	lab_matrix_code	Text (10)	Yes (0)	Code that distinguishes between different types of matrix analyzed. Soil = "SO"; groundwater = "GW" and TCLP = TCLP as a lab matrix. See rt_matrix for valid values
9	analysis_location	Text (2)	Yes (0)	"LB" for fixed-based laboratory analysis, "FI" for field instrument, "FL" for mobile field laboratory analysis, or.
10	basis	Text (10)	Yes (0)	"Wet" for wet-weight basis; or "Dry" for dry-weight basis. For tests for which this distinction is not applicable use Wet
11	container_id	Text (30)	No	Sample container identifier.
12	dilution_factor	Single	Yes (0)	Test or analytical run dilution factor. **Must** be "1'" if no dilution.
13	Prep_method	Text (35)	Yes (2-1)	Laboratory sample preparation method name. See rt_std_prep_method for valid values.
14	prep_date	Date/ Time	Yes (2-1)	Date of sample preparation in MM/DD/YY format.
15	prep_time	Text (5)	Yes (2-1)	Time of sample preparation in 24-hour (military) HH:MM format
16	leachate_method	Text (15)	Yes (2-1)	Method name, e.g., SW1311 or SW1312. See rt_analytic_method for valid values.
17	leachate_date	Date/ Time	Yes (2-1)	Date of leachate preparation in MM/DD/YY format.
18	leachate_time	Text (5)	Yes (2-1)	Time of leachate preparation in 24-hour (military) HH:MM format.
19	lab_name_code	Text (10)	Yes (0)	Unique identifier of the laboratory reporting results. See rt_subcontractor for valid values.
20	qc_level	Text (10)	NO	Not populated by Lab.
21	lab_sample_ id	Text (20)	Yes (0)	Laboratory sample identifier. A field sample may have more than one laboratory lab_sample_id; however it is limited to only ONE lab_sample_id per method).
22	percent_moisture	Text (5)	Yes (2-1)	Percent moisture of the sample portion used in the specific lab_anl_methd_name test; this value may vary from test to test for any sample. The value must be NUMERIC as "NN.MM", e.g., 70.1% could be reported as "70.1" but not as 70.1%". The database assumes that the number is a "%" and units of measure are not necessary. **NOTE: This field MUST be populated for all soil, sludge, and sediment samples whether or not the value is reported in the hard copy. Use "0" for lab soil QC samples.**
23	subsample_amount	Text (14)	Yes 0)	Amount of sample used for the test. THIS FIELD MUST BE POPULATED
24	subsample_amount_unit	Text (15)	Yes (0)	Unit of measurement for subsample amount. See rt_unit for valid values.

TEST TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
25	analyst_name	Text (30)	Yes (0)	Name or initials of laboratory analyst.
26	instrument_lab	Text (50)	Yes (0)	Instrument identifier.
27	comment	Text (255)	NO	Comments about the test as necessary (Optional).
28	preservative	Text (50)	Yes (2-1)	Indicate preservative or leave blank, if none. **THIS FIELD MUST BE POPULATED IF A PRESERVATIVE WAS IN THE SAMPLE AS RECEIVED FROM THE FIELD OR IF THE SAMPLE WAS PRESERVED BY THE LABORATORY BEFORE PREPARATION AND ANALYSIS.**
29	final_volume	Text (15)	Yes (2-1)	Final amount of extract or digestate.
30	final_volume_unit	Text (15)	Yes (2-1)	Unit of measure for final_volume. See rt_unit for valid values.

RESULT TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
1	sys_sample_code (PK)	Text (40)	Yes (0)	SAME AS #1 IN SAMPLE & TEST TABLES. This value is used in enforcing referential integrity between tables.
2	lab_anl_method_name (PK)	Text (35)	Yes (0)	Laboratory analytic method name. Must be same as lab_anl_method_name in Test File. See rt _analytic_method for valid values.
3	analysis_date (PK)	Date/Time	Yes (0)	Must be the SAME AS #3 IN THE TEST TABLE. This value is used in enforcing referential integrity between tables. Date of sample analysis in MM/DD/YY format.
4	analysis_time (PK)	Text (5)	Yes (0)	Must be the SAME AS #4 IN THE TEST TABLE. This value is used in enforcing referential integrity between tables.
5	total_or_dissolved_ (PK)	Text (1)	Yes (0)	Must be the SAME AS #5 IN THE TEST FILE.
6	column_number (PK)	Text (2)	Yes (3-2)	Must be the SAME AS #6 IN THE TEST FILE
7	test_type (PK)	Text (10)	Yes (0)	Must be the SAME AS #7 IN THE TEST FILE
8	cas_rn (PK)	Text (15)	Yes (0)	Chemical Abstracts Number for the parameter if available. This must be the true CAS # and "not made up". Where CAS #s are not available, i.e. wet chem. Parameters, identifiers will be provided by ARCADIS project requirements. See notes at end of section for TIC management. See rt_analyte for valid values. The lab is not authorized to add internally developed "CAS #s" for general chemistry parameters, surrogates, internal standards, TICs. CAS#s used for TICs must be available through an outside source such as "Chemfinder".
9	chemical_name	Text (60)	Yes (0)	Chemical name associated with CAS # in #8. The cas_rn field is the only chemical identifier information actually imported in EQuIS Chemistry.

RESULT TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
10	result_value	Text (20)	Yes (3-1)	Analytical result reported for **"TRG" or "TIC"** result_type **ONLY**. Appropriate and consistent number of significant digits must be entered. **MUST BE BLANK FOR NON-DETECTS.** "SUR", "IS", and "SC" results do **NOT** populate this field (populate the QC fields).
11	result_error_delta	Text (20)	Yes (3-2) [Radiochem)	Error range applicable to the result value for radiochemistry results.
12	result_type_code	Text (10)	Yes (0)	Must be either "TRG" for a target or regular results, "TIC" for tentatively identified compounds, "SUR" for surrogates, "IS" for internal standards, or "SC" for spiked compounds.[**LCS, LCSD, MS, MSD, BS, BSD]**
13	reportable_result	Text (10)	Yes (0)	Must be either "**Yes**" for results, which are considered to be reportable, **or** "**No**" for other results. Used to distinguish between multiple results where a sample is retested after dilution or to indicate which of the first or second column result should be considered primary. For re-analyses and dilutions all results must be entered into the database if hard copy data is provided **BUT ONLY ONE RESULT FOR EACH COMPOUND/ANALYTE MAY BE FLAGGED AS REPORTABLE**.
14	detect_flag	Text (2)	Yes (0)	Either "Y" for detected analytes or "N" for non-detects**. MUST be "N" for NON-DETECTS**.
15	lab_qualifiers	Text (7)	Yes (3-2)	Qualifier flags assigned by the laboratory. See rt_qualifier for valid qualifiers that may be used.
16	Organic_ yn	Yes/No	Yes (0)	Must be either "Y" for organic constituents or "N" for inorganic constituents.
17	method_detection_ limit	Text (20)	Yes (0)	Laboratory determined MDL per 40 CFR Part 136, adjusted for dilutions and percent moisture (if it applies).
18	reporting_detection_ limit	Text (20)	Yes (0)	Detection limit that reflects sample analysis conditions including analysis volumes and dilution factors. This should be the laboratory PQL or standard reporting limits
19	quantitation_limit	Text (20)	No	NOT Currently used unless specifically defined for the project.
20	Result_unit	Text (15)	Yes (0)	Units of measure relates to **ALL** results including result_value, qc_original_concentration, qc_spike added, qc_spike_measured, qc_dup_orginal_conc, qc_dup_spike_added, qc_dup_spike_measured. See rt_unit for valid values.
21	detection_limit_unit	Text (15)	Yes (0)	Units of measure for detection limit(s). See rt_unit for valid values.
22	tic_retention_time	Text (8)	Yes (3-2)	Retention time in minutes for tentatively identified compounds (TICs). Populated only for TIC result_type
23	result_comment	Text (255)	NO	MUST BE LEFT BLANK BY THE LAB

RESULT TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
24	qc_original_conc	Text (14)	Yes (3-3)	The concentration of the analyte in the original (unspiked) sample. Populated for matrix spike samples. Not populated where original concentration is assumed to be zero, i.e. LCS or BS samples.
25	qc_spike_added	Text (14)	Yes (3-4)	The concentration of the analyte added to the original sample. Populated for **ALL** Surrogates, and LCS, BS, and MS samples
26	qc_spike_measured	Text (14)	Yes (3-4)	The measured concentration of the analyte. Use zero for spiked compounds that were not detected in the sample. **MUST BE NUMBERIC** even if diluted out or not recovered (use “0” if diluted, matrix interference, elevated concentrations of target compounds, etc.) Populated for **ALL** Surrogates, and LCS, BS, and MS samples
27	qc_spike_recovery	Text (14)	Yes (3-4)	The percent recovery for “SUR” and “SC” results. **MUST BE NUMERIC** even if diluted out or not recovered (use “0” if diluted, matrix interference, elevated concentrations of target compounds, etc.) Report as percentage (e.g., report "120%" as "120"); DO NOT include “%” sign in field. Populated for **ALL** Surrogates, and LCS, BS, and MS samples
28	qc_dup_original conc	Text (14)	Yes (3-5)	The concentration of the analyte in the original (unspiked) sample. Populated for matrix spike duplicate samples. Not populated where original concentration is assumed to be zero, i.e. LCSD or BSD samples.
29	qc_dup_spike_added	Text (14)	Yes (3-5)	The concentration of the analyte added to the original sample. Populated for **ALL** LCSD, BSD, and MSD samples.
30	qc_dup_spike_measured	Text (14)	Yes (3-5)	The measured concentration of the analyte in the duplicate. Populated for **ALL** LCSD, BSD, and MSD samples. MUST be NUMERIC. Use zero for spiked compounds that were not recovered due to dilution, matrix interference, elevated concentrations of target compounds, etc..
31	qc_dup_spike_recovery	Text (14)	Yes (3-5)	The duplicate percent recovery. Populated for **ALL** LCSD, BSD, and MSD samples. **MUST be NUMERIC.** Use zero for spiked compounds that were not recovered due to dilution, matrix interference, elevated concentrations of target compounds, etc Report as percentage (e.g., report "120%" as "120").
32	qc_rpd	Text (8)	Yes (3-6)	The relative percent difference between MS and MSD, LCS and LCSD, BS and BSD, & primary field sample result and Lab Replicate. Populated for **ALL** LCSD, BSD, MSD, and LR samples. **MUST be NUMERIC**. Use zero for RPDs that were not calculated due to elevated concentrations of target compounds, dilution, matrix interference, etc Report as percentage (e.g., report "120%" as 120").
33	qc_spike_lcl	Text (8)	Yes (3-7)	Lower control limit for spike recovery. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as

RESULT TABLE				
Num	**Attribute Name**	**Column Data Type**	**Required**	**Attribute Definition**
				percentage (e.g., report "120%" as "120").
34	qc_spike_ucl	Text (8)	Yes (3-7)	Upper control limit for spike recovery. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage (e.g., report "120%" as "120").
35	qc_rpd_cl	Text (8)	Yes (3-6)	Relative percent difference control limit. Required for any duplicated sample. Report as percentage (e.g., report "120%" as "120").
36	qc_spike_status	Text (10)	Yes (3-4)	Used to indicate whether the spike recovery was within control limits. Use the "+" character to indicate failure, otherwise leave blank.
37	qc_dup_spike_status	Text (10)	Yes (3-5)	Used to indicate whether the duplicate spike recovery was within control limits. Use the "+" character to indicate failure, otherwise leave blank.
38	qc_rpd_status	Text (10)	Yes (3-6)	Used to indicate whether the relative percent difference was within control limits. Use the "+" character to indicate failure, otherwise leave blank. Required for any duplicated sample.

BATCH TABLE				
Num	**Attribute Name**	**Column Datatype**	**Required**	**Attribute Definition**
1	sys_sample_code (PK)	Text (40)	Yes (0)	SAME AS #1 IN SAMPLE , TEST TABLE. This value is used in enforcing referential integrity between tables.
2	lab_anl_method_name (PK)	Text (35)	Yes (0)	SAME AS #2 IN TEST TABLE. See rt _analytic_method for valid values.
3	analysis_date (PK)	Date	Yes (0)	SAME AS #3 IN TEST TABLE. This value is used in enforcing referential integrity between tables. Date of sample analysis in MM/DD/YY format. May refer to either beginning or end of the analysis as required by EQuIS Chemistry project manager.
4	analysis_time (PK)	Text (5)	Yes (0)	SAME AS #4 IN TEST, AND RESULT TABLES. This value is used in enforcing referential integrity between tables.
5	total_or_dissolved (PK)	Text (1)	Yes (0)	SAME AS #5 IN TEST TABLE. This value is used in enforcing referential integrity between tables.
6	column_number (PK)	Text (2)	Yes (4-1)	SAME AS #6 IN TEST TABLE. This value is used in enforcing referential integrity between tables.
7	test_type (PK)	Text (10)	Yes (0)	SAME AS #7 IN TEST TABLE. This value is used in enforcing referential integrity between tables.
8	test_batch_type (PK)	Text (10)	Yes (0)	Lab batch type. Valid values include "Prep", "Analysis", and "Leach". Additional valid values may optionally be provided by the EQuIS Chemistry project manager. This is a required field for all batches.
9	test_batch_id	Text (20)	Yes (0)	Unique identifier for all and each lab batches. Must be unique within EQuIS Chemistry database. For example, the same identifier cannot be used for a prep batch and an analysis batch and the values must be different from one sampling event to another. THIS IDENTIFIER CANNOT BE USED FROM ONE YEAR TO THE NEXT.

ADDITIONAL INFORMATION FOR PREPARING THE 4-FILE EDD

SAMPLE FILE AND SYS_SAMPLE_CODE

1. The sys_sample_code is the unique sample ID as supplied on the Chain of Custody form with the same spacing as identified on the COC or on a supplemental Sample ID list submitted to the laboratory with the Laboratory Task Order or prior to submission of samples.

2. In order to uniquely identify MS/MSD, laboratory duplicates, TCLP, and SPLP samples, the laboratory shall add a suffix to the original sample ID listed on the chain of custody:

   Matrix Spike Sample = xxxxx MS
   Matrix Spike Duplicate Sample = xxxxx MSD
   Lab Duplicate/Replicate = xxxxx LR
   TCLP Extract Sample = xxxxx TCLP
   SPLP Extract Sample = xxxxx SPLP

   These are the only characters that are allowed to be amended to ANY sample ID as listed on the COC or the sample ID list referred to above.
   The parent_sample_code shall be entered into the parent_sample_code field of the Sample File.

3. If the sample_name field is provided it must contain the full sample ID from the chain of custody.

4. Sample_Type_Code must be appropriately applied as follows:
   "N" = normal field samples
   "FD" = field duplicates samples submitted blind to the laboratory
   "TB" = trip blanks
   "FB" = field blanks
   "EB" = rinsate or equipment blanks
   "BS" = laboratory control samples or blank spikes
   "BD" = laboratory control sample duplicates or blank spike duplicates
   "MS" = matrix spikes
   "SD" = matrix spike duplicates
   "LR" = laboratory duplicates or laboratory replicates

5. The following "**matrix_type**" codes must be used ("**SQ**" = soil QC sample and "**WQ"** = water QC sample):
   Method Blank = "SQ" or "WQ"
   MS/MSDs = "SQ" or "WQ"
   LCS/LCSDs = "SQ" or "WQ"
   BS/BSDs = "SQ" or "WQ"

6. SDG Numbers or laboratory Log Numbers (per ARCADIS PM direction) **MUST** be populated in "**sample_delivery_group**" field of the **Sample File.**

QUALITY CONTROL SAMPLES AND DATA

7. The source of Lab Duplicates, Lab Replicates, Matrix Spikes, and Matrix Spike Duplicates is the Lab not the Field even if the MS/MSD are identified on the COC by the field sampling team. The samples are spiked in the laboratory not in the field.

8. Laboratory QC data, which span more than one SDG may be submitted with each appropriate SDG.

9. Laboratory LCS and LCSD should be reported as two separate samples.

10. **Matrix Spike and Matrix Spike Duplicate recoveries must be reported as "0" if the value is not calculated due to concentrations of the spiked analyte in the sample at concentrations above the 4X factor.**

11. **All laboratory method performance site-specific and batch Quality Control sample results (i.e. Method Blanks, LCS/LCSDs, Blank Spikes, Leachate Blanks as method appropriate) must be included in the EDD.** For most projects, this does **NOT** include **non-site-specific** matrix spikes and laboratory duplicates/replicates.

12. Laboratory batch sample duplicate/replicate and MS/MSD results from **non-project specific** samples (i.e. batch QC samples) shall **NOT** be included in the EDD.

13. Surrogates populate the qc_spike fields not qc_dup_spike fields or the result_value field even if the surrogates are reported for MSD, BSD, or LCSD samples.

14. QC_Spike_Added values for Spike, IS and Surrogate compounds are REQUIRED.

15. QC_Spike_Measured values for Spike, IS and Surrogate compounds are REQUIRED.

16. RPDs for LCSDs, BSDs, MSDs, and Laboratory Duplicates must be populated in the "**qc_rpd"** field. A value of "0" or "100" must be reported, as appropriate, if the RPD is not calculated due to excessive concentrations or interference present in the sample. The "**qc_rpd**" must be a numeric entry.

17. The RPD control limit must be listed in the "**rpd_cl"** field for all parameters where an RPD is reported. This includes lab duplicate/replicate samples.

SAMPLE FILE

18. The following "**matrix_type**" codes must be used for QC samples ("**SQ**" = soil QC sample and "**WQ"** = water QC sample):

    Method Blank = "SQ" of "WQ"
    MS/MSDs = "SQ" or "WQ"
    LCS/LCSDs = "SQ" or "WQ"
    BS/BSDs = "SQ" or "WQ"

19. SDG or Laboratory Project numbers must be populated in "sample_delivery_group" field.

TEST FILE

20. Percent moisture must be reported in the "**percent_moisture**" field in the **Test File** for all solid samples (i.e., soil, sediment, and sludge).

21. Subsample weights and final volumes must be listed for all parameters as appropriate.

RESULTS FILE

22. Result_value is only populated with data for "TRG" and "TIC" detections. All other data is entered in the "qc_" fields. The field must be "NULL" for non-detects and other analyte_types. The Reporting Limit must not be entered in this field.

23. Non-detected data shall have a lab_qualifier of "U" in addition to other qualifiers deemed applicable. The Detect_Flag shall be "N" and the Result_value field shall be blank.

24. The Reporting Limit must be provided for all parameters. The RL MUST be adjusted for dilutions made during analysis.

25. Surrogate recoveries MUST BE REPORTED in the qc_spike_measured and qc_spike_recovery fields, even if the surrogate had been diluted out. List “0” as the measured and recovered amount. Control Limits must also be entered for surrogates. Surrogates are “SUR” analyte_type not “TRG”.

26. Surrogate, LCS, LCSD, BS, BSD, MS, and MSD detected concentrations, and percent recoveries must be populated with a numeric value. A value of “0” **must** be entered if the Spiked Compound is diluted out or not recovered. An “+” is unacceptable as this is a numeric field.

27. “**QC_original_concentration**” must be populated for matrix spikes and matrix spike duplicates

28. Valid entries for the reportable_result field are "Yes" or "No” only.

29. ONLY report compounds of interest for any method blank, sample, and sample duplicate, trip blank.

30. Laboratory Qualifier designation must be consistent. For an estimated concentration with blank contamination “BJ” must be used. Note that “JB”, “B J” or “J B” cannot be used.

31. Explanation of Duplicate Qualifiers:

B	Analyte found in associated blank	Organic Analysis
B	<CRDL but >= Instrument Detection Limit	Inorganic Analysis
N	Presumptive evidence of a compound	Organic Analysis
N	Sample recovery not within control limits	Inorganic Analysis

It is preferred by ARCADIS that the laboratory not qualifiers with multiple explanations. **Any qualifiers utilized in the hard copy report or the electronic report must be defined in the hard copy report. There is no exception to this requirement for explanation of qualifiers applied to electronic data.**

32. Nomenclature for tentatively identified compounds (TIC):

Use the CAS # if it is available and **REAL** **(outside verifiable source)** for TICs and enter the chemical name in the chemical_name field.

For UNKNOWN TICs follow the following protocol:

cas_rn for unkown VOA TIC = VTIC 1 through VTIC 10
cas_rn for unkown SVOA TIC = SVTIC 1 through SVTIC 20

Enter “UNKNOWN”, “UNKNOWN Hydrocarbon”, “UNKNOWN Aliphatic”, or other identifier as appropriate or applicable in “chemical_name” field.

TICs will produce errors in the ELDC/EDDP that cannot be corrected by the laboratory. These are the only acceptable errors in the data checker report unless otherwise authorized by ARCADIS.

33. TCLP or SPLP results must be submitted in units of mg/L or appropriate liquid units. **(Make sure that moisture correction is not automatically enforced).**

BATCH FILE

34. The laboratory must use unique Batch File Names for each analytical department/method and for continuing years. Electronic validation utilizes Batch IDs to link field samples with quality control data. Overlapping Batch IDs are not acceptable.

GENERAL ISSUES

35. Incomplete chain-of-custody (C-O-C) forms must be immediately communicated to the project manager. Some of the C-O-C information is used for completion of the Sample_Matrix_Code and Sample_Delivery_Group. These discrepancies must be rectified upon receipt of samples at the laboratory prior to log in.

36. **Duplicate sample IDs are not acceptable within the EQuIS database. It is imperative that samples including field blanks, trip blanks, equipment blanks, field duplicates have unique sample IDs for projects including ongoing sampling events such as quarterly groundwater monitoring.**

SUBCONTRACTED PARAMETERS

37. The EDD must be populated with **ALL** appropriate and applicable fields, including **ALL** QC data for any subcontracted parameters.

PLEASE CONTACT THE ARCADIS PROJECT CHEMIST, DATA MANAGER or PROJECT MANAGER IF THERE ARE ANY QUESTIONS REGARDING PREPARATION OR GENERATION OF THE EDD.

EXAMPLE EDD REPORTS

The following subsections provide examples of how the EQuIS EDD should be populated for QC data.

RESULT FILE FIELDS FOR A NORMAL FIELD SAMPLE, TRG AND TIC RESULTS

The table below shows some of the fields in the Result File for a normal field sample (i.e., Sample_type_code = N, TB, FD, etc.) and "TRG" or "TIC" analyte_type_code. NOTE: all QC fields are blank.

cas_rn	result value	qc original conc	qc spike added	qc spike measured	qc spike recovery	qc dup. original conc	qc dupl. spike added	qc dup. spike measured	qc dup. spike recovery
93-76-5 94-75-7 94-82-6	3.17 1.56 2.31								

RESULT FILE FIELDS FOR A NORMAL FIELD SAMPLE WITH SURROGATES

The following table shows some of the fields in the result file for a normal field sample (i.e., Sample_type_code = N, TB, etc.). Note that QC fields are blank except on surrogate Rows.

cas_rn	result value	result unit	result type code	qc original conc	qc spike added	qc spike measured	qc spike recovery
93-76-5	1.56	mg/L	TRG				
94-75-7	3.17	mg/L	TRG				
PHEN2F		mg/L	SUR		12.5	12.9	103

RESULT FILE FIELDS FOR A MATRIX SPIKE

The following table shows some of the fields in the result file for a matrix spike sample (i.e., Sample_type_code = MS). Note that all "dup" QC fields are blank, and that the result_value field is NULL. Also, the qc_rpd field would be blank for these rows. The parent_sample_code must contain the contents of the sys_sample_code of the original (parent) sample.

cas_rn	result value	qc original conc	qc spike added	qc spike measured	qc spike recovery	qc dup. original conc	qc dupl. Spike added	qc dup. spike measured	qc dup. spike recovery
93-76-5		1.56	4.18	5.36	90.9				
94-75-7		3.17	4.18	7.15	95.2				
94-82-6		2.31	4.22	5.66	79.3				

RESULT FILE FIELDS FOR A MATRIX SPIKE DUPLICATE

The following table shows some of the fields in the result file for a matrix spike/matrix spike duplicate considered as a single sample (i.e., Sample_type_code = MSD). Note that all QC fields are completed, and that the result_value field is not needed. Also, the qc_rpd field would be completed for these rows. The parent_sample_code must contain the contents of the sys_sample_code of the original (parent) sample.

cas_rn	result value	qc original conc	qc spike added	qc spike measured	qc spike recovery	qc dup original conc	qc dup. spike added	qc dup spike measured	qc dup spike recovery
93-76-5						1.56	4.23	5.70	97.8
94-75-7						3.17	4.23	7.62	105
94-82-6						2.31	4.13	5.33	73.1

**RESULT FILE FIELDS FOR A LCS or BS **

The following table shows some of the fields in the result file for an LCS sample (i.e., laboratory control sample, blank spike, Sample_type_code = BS). The qc_rpd field is left blank for these rows.

cas_rn	result value	qc original conc	qc spike added	qc spike measured	qc spike recovery	qc dup original conc	qc dup spike added	qc dup spike measured	qc dup spike recovery
93-76-5		1.5	5.00	5.26	105				
94-75-7		10.2	1.00	1.02	102				
94-82-6		3.4	12.5	12.9	103				

RESULT FILE FIELDS FOR A LCS DUPLICATE OR BS DUPLICATE

The following table shows some of the fields in the result file for a laboratory control sample duplicate (i.e., Sample_type_code = BD). Note that the result_value field is not required. Also, the qc_rpd field must be completed for these rows.

cas_rn	result value	qc original conc	qc spike added	qc spike measured	qc spike recovery	qc dup original conc	qc dup spike added	qc dup spike measured	qc dup spike recovery	qc_rpd
93-76-5							5.00	4.92	98	2.0
94-75-7							1.00	0.95	95	6.6
94-82-6							12.5	11.8	94	12.3

REANALYSES, REEXTRACTIONS, DILUTIONS

The following table shows how to report retests for three different circumstances. The first example, the sample was retested (for 75-25-2) because the initial result required reanalysis due to QC failure. For the second example, the initial sample result (for 95-95-4) required dilution. The third example (for 67-66-3) required both reanalysis and dilution (reanalysis supercedes dilution). The fourth example (87-86-5) shows an initial result that require re-extraction due to QC failure or elevated concentrations that could not be diluted based on the original extraction. The other results are "turned off" by setting the reportable_result field to "No".

test_type	cas_rn	result_value	reportable_result
initial	75-25-2	1.2	No
reanalysis	75-25-2	1.1	Yes
initial	95-95-4	250E	No
dilution	95-95-4	328	Yes
initial	67-66-3	3.4	No
reanalysis	67-66-3	3.3	Yes
initial	87-86-5	980E	No
reextraction	87-86-5	1500	Yes

ANALYSES REQUIRING SECOND COLUMN CONFIRMATION

Analyte identification requiring confirmation by a second analytical technique is required by certain gas chromatography (GC) methods. A common technique used to confirm the identity of an analyte is to analyze the sample using a second GC column that is dissimilar from the GC column used for the first analysis. This confirmation technique is used routinely when analyzing samples for pesticides, herbicides, and certain volatile organic compounds (e.g., BTEX), and the two analyses often are performed simultaneously using an instrument equipped with dual GC columns connected to common injection port.

The method for reporting data from dual column GC analyses is not standard throughout the environmental laboratory industry. ARCADIS recommends that laboratories use the method described in SW-846 Method 8000B, unless project-specific requirements or the method used for analysis dictate otherwise. The following table illustrates the proper format to be used to report first and second column results. The results for the first and third constituents (75-25-2 and 95-95-4) are being reported from column 1, and the result for the second constituent (67-66-3) is being reported from column 2. The other results are "turned off" by setting the reportable_result field to "No".

column_number	cas_rn	result_value	reportable_result
1C	75-25-2	6.2	Yes
1C	67-66-3	3.4	No
1C	95-95-4	5.6	Yes
2C	75-25-2	1.3	No
2C	67-66-3	33.7	Yes
2C	95-95-4	5.4	No

REFERENCE TABLES

A number of fields in each of the EDD files must be entered to correspond exactly with reference values standardized by ARCADIS. These reference values will be updated from time to time. Each laboratory will be supplied a copy of the updated document. It is the laboratory's responsibility to submit EDDs using the most current reference tables as defined by a specific project.

The following table summarizes the EDD fields where standard reference values must be used:

EDD File	EDD Field	Reference Table
Sample	sample_type_code	rt_sample_type
	sample_matrix_code	rt_matrix
Test	lab_anl_method_name	rt_anl_mthd
	lab_matrix_code	rt_matrix
	prep_method	rt_std_prep_mthd
	subsample_amount_unit	rt_unit
	final_volume_unit	rt_unit
Result	lab_anl_method_name	rt_anl_mthd
	cas_rn	rt_analyte
	chemical_name	rt_analyte
	result_type_code	rt_result_type
	lab_qualifier	rt_qualifier
	result_unit	rt_unit
	detection_limit_unit	rt_unit
Batch	lab_anl_method_name	rt_anl_mthd

IV. EDP

The EDP data checker assists the **LABORATORY** in checking EDD files to ensure that they are error-free prior to submission to ARCADIS. All laboratories providing data to ARCADIS **must use** the EDP program to verify that EDDs are without error. The EDP error reports for each file **must be** submitted with each EDD.

The use of the EDDP helps to solve common data population problems including duplicate data, incorrectly populated fields, and incorrect methods, CAS #s, and other acceptable reference values. If an EDD is received by ARCADIS containing errors it will be rejected until the EDD report is acceptable for import into the EQuIS database. Invoice payment will not be made until the EDD is acceptable.

ARCADIS will provide laboratories with the most recent version of the EDP.

Attachment 5

Analytical Methods, Holding Times, QA/QC

Attachment 5
Analytical Methods/QA/QC Summary Table

Matrix Type	Field Parameters	Laboratory Parameters	Analytical Methods	Sample Preservation	Sample Container Volume and Type	Sample Hold Time	Field Duplicate Samples	Equipment Blank Samples	Trip Blank Samples	Ambient Air Samples	MS/MSD Samples
Groundwater	Temperature, Turbidity, pH, ORP, Conductivity, DO	Part 375 + VOCs + TICs	EPA 8260C	Cool to 4°C; HCl to pH <2; no headspace	Three 40-ml VOC vials with Teflon®-lined cap	Analyze within 14 days of collection	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	1 per shipment of VOC samples	NA	1 per 20 samples
		Part 375 + SVOCs + TICs	EPA 8270D SIM for 1,4-Dioxane	Cool to 4°C	Two 250 ml Amber Glass	7 days to extract, 40 days after extraction to analysis					
		Part 375 Metals +Mercury	EPA 6010C, EPA 7471B	HNO3	250 ml plastic	6 months, except Mercury 28 days					
		Hexavalent and trivalent Chromium	EPA 7196A	Cool to 4°C	250 ml plastic	24 hours					
		Cyanide	EPA 9014	NaOH	125 ml plastic	14 days					
		Part 375 Pesticides/Herbicides/PCBs	EPA 8081B/8082A/ 8151A	Cool to 4°C	Two 250 ml Amber Glass for Pesticides/PCB Two 1-liter Amber Glass for Herbicides	7 days to extract, 40 days after extraction to analysis					
		PFOA/PFOS	Method 1633	Cool to 4°C	125 ml plastic	28 Days					
Soil	Total VOCs via PID	Part 375 VOCs + TICs	EPA 8260C	Cool to 4°C	Two 40-ml VOC vials with 5ml H2O, one with MeOH or 3 Encore Samplers (separate container for % solids)	14 days	1 per 20 samples (minimum 1)	1 per 20 samples (minimum 1)	1 per shipment of VOC samples	NA	1 per 20 samples
		Part 375 SVOCs + TICs	EPA 8270D SIM for 1,4-Dioxane	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis					
		Part 375 Metals + Mercury	EPA 6010C, EPA 7471B	Cool to 4°C	2 oz. amber glass jar	6 months, except mercury 28 days					
		Hexavalent and Trivalent Chromium	EPA 7196A	Cool to 4°C	2 oz. amber glass jar	30 days					
		Part 375 Pesticides/Herbicides	EPA 8081B**/8151A**	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis					
		Part 375 PCBs	EPA 8082A	Cool to 4°C	4 oz. amber glass jar	14 days extract, 40 days after extraction to analysis					
		Cyanide	EPA 9014	Cool to 4°C	4 oz. glass jar	14 Days					
		PFOA/PFOS	Method 1633	Cool to 4°C	4 oz. Plastic	28 Days					
Indoor Air/ Sub-Slab SV/ Ambient Air	Screen with ppb range PID	Volatile Organic Compounds - New York State Target Analytes	EPA TO-15	None	6-Liter Summa Can	30 Days	1 per 20 samples (minimum 1 for sub-slab and 1 for Indoor Air)	NA	NA	1	NA

Notes:
1.PID - Photoionization Detector
2.VOC - Volatile organic compound
3.EPA - Environmental Protection Agency
4.TCL - Target compound list
5.TAL - Target analyte list

Appendix C

Generic Community Air Monitoring Plan

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

Appendix 1B
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

Appendix D

Health and Safety Plan

Site Specific Health and Safety Plan

Template Revision: 21 d

Project Name:	Horseheads - Grand Central Plaza Site Characterization
Project Number:	30147184
Client Name:	C. Gershon Company, Inc.
Date:	3/15/2025
HASP Expires	3/15/2026
Revision:	1

Approvals:

HASP Developer: Steve Lemoine

Project Manager: Lawrence Brunt

HASP Reviewer: Andrea Quimoyog

HASP Reviewer Name Typed



HASP Reviewer Signature (handwritten or digital signature)

Emergency Information

Site Address: 1020 Center Street, Horseheads, NY

Emergency Phone Numbers:

Emergency (fire, police, ambulance)		911
Emergency (facility specific, if applicable):		
Emergency Other (specify):		
Primary Client Contact:	Andrew Korik	315-671-9323
WorkCare (non-life-threatening injury/illness):		1-888-449-7787
Project H&S:	Andrew Korik	315-671-9323
Task Manager:	Andrew Korik	315-671-9323
Project Manager:	Lawrence Brunt	908-685-7878
H&S Specialist:	Alec MacAdam	720-454-0948
Area H&S Director:	Aaron Svitana	925-360-2313

Hospital Name and Address: Guthrie Corning Hospital
1 Guthrie Drive
Corning, NY 14830

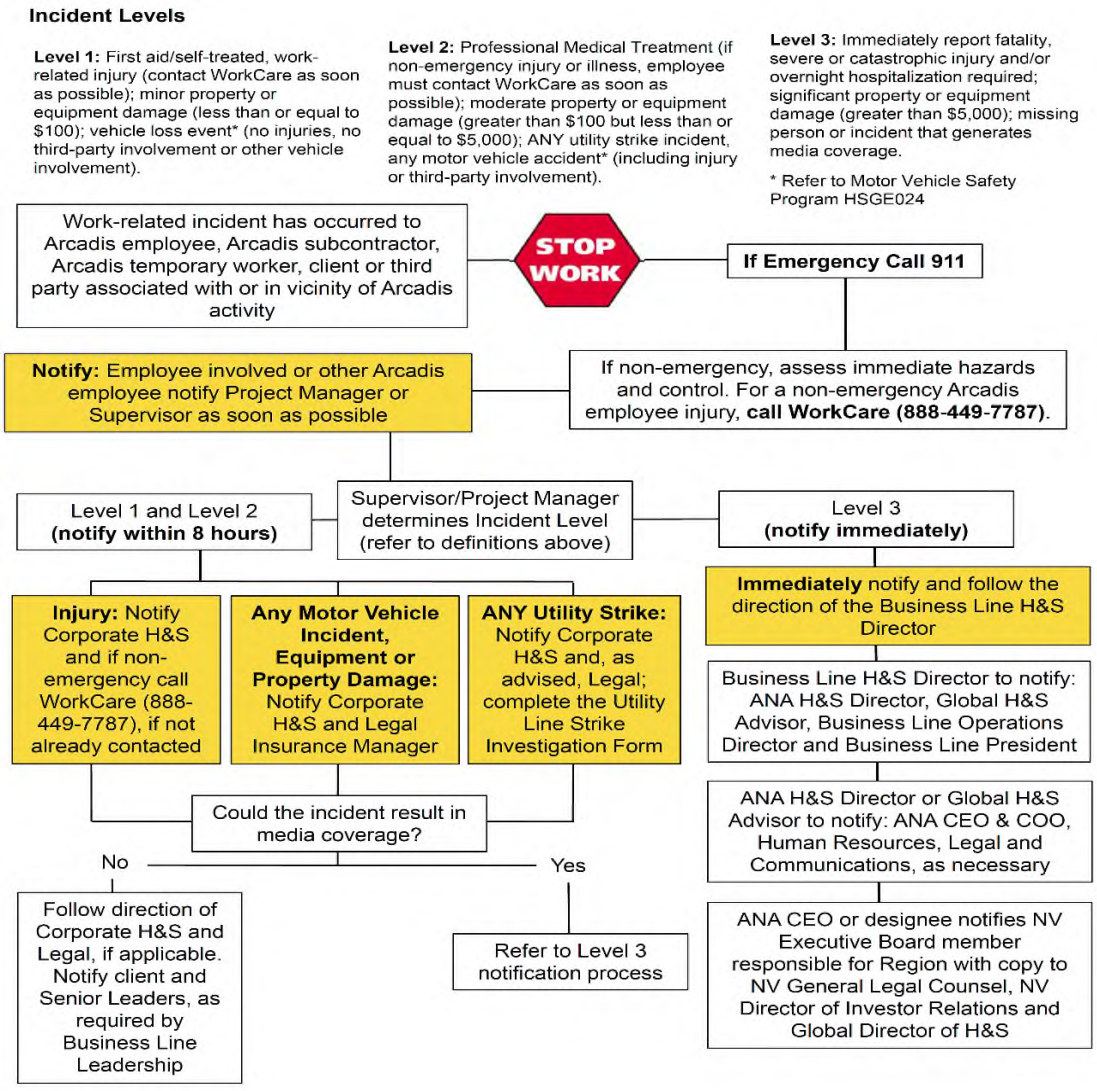
Hospital Phone Number: 607-937-7200

Supplemental Client Contact Information:
Dial 911/Facility Emergency Number/WorkCare as applicable

Other Important Phone Numbers:

Poison Control Center	1-800-222-1222
Nat. Response Ctr. (spills in reportable quantities)	1-800-424-8802
U.S. Coast Guard (spills to water)	1-800-424-8802

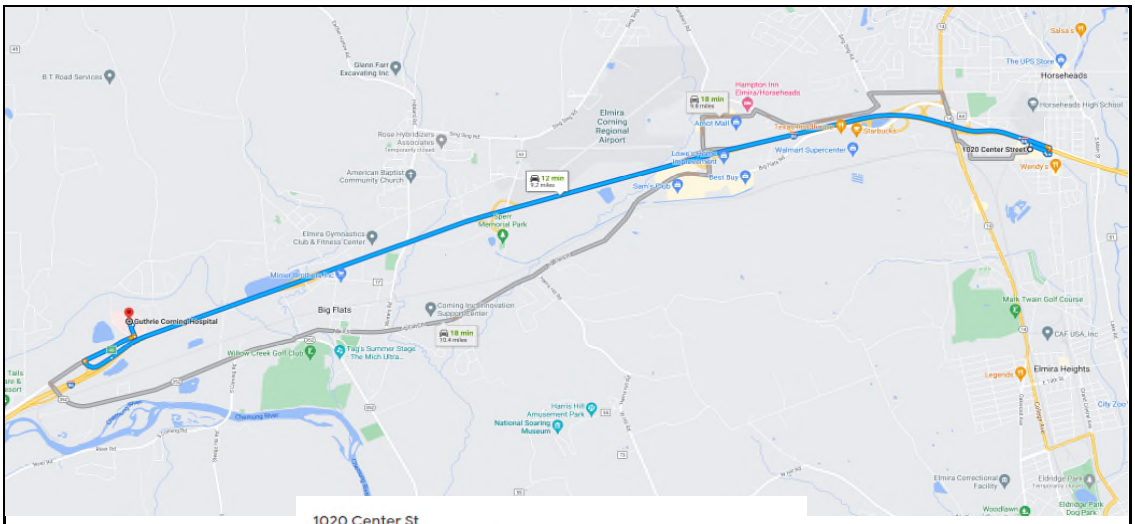
Incident Reporting Protocol Within Arcadis



Client Incident Reporting Protocol

1. Dial 911/Facility Emergency Number/WorkCare as applicable
2. Contact Project Manager - Lawrence Brunt - 908-685-7878
3. Contact Task Manager - Andrew Korik - 315-671-9323

Route to the Hospital



1020 Center St
Horseheads, NY 14845

Get on I-86 W/NY-17 W

3 min (0.6 mi)

1. Head north toward Center St

43 ft

2. Turn right

62 ft

3. Turn left

141 ft

4. Turn right

0.1 mi

5. Slight left toward Center St

89 ft

6. Slight left toward Center St

128 ft

7. Turn left onto Center St

322 ft

8. Turn left to merge onto I-86 W/NY-17 W

0.3 mi

Follow I-86 W/NY-17 W to East Corning Rd in Corning.
Take exit 48 from I-86 W/NY-17 W

7 min (8.1 mi)

9. Merge onto I-86 W/NY-17 W

7.8 mi

10. Take exit 48 toward NY-352/E Corning

0.3 mi

Continue on East Corning Rd to your destination

2 min (0.6 mi)

11. Turn right onto East Corning Rd

0.5 mi

12. Turn left

0.1 mi

13. Turn right

23 ft

14. Sharp left
Destination will be on the right

102 ft

Guthrie Corning Hospital
1 Guthrie Dr, Corning, NY 14830

Site Type

The project site is an active facility with the following attributes:

Parking Lot/Private Drive (NON ROW)	
Commercial	

Work in parking lots will require preparation of a Non-ROW Traffic Safety Plan.

Surrounding Land Use and Topography

The site is part of a larger of commercial / retail shopping plaza property that contains multiple commercial structures and retail spaces in a predominately commercial neighborhood in the Village of Horseheads, Chemung County, New York. The surrounding area consists of mixed use commercial, residential and municipal properties; interstate I-86 borders the property to the north, a railroad spur followed by a NYSDOT facility and furniture store to the west, Chemung Street, residential and commercial properties to the south and Center Street and commercial properties to the east.

Simultaneous Operations (SimOps)

Planned Arcadis site work will not be in proximity to SimOps work activities performed by non Arcadis employees or subcontractors. Arcadis will initiate stop work and evaluate the work activities through the JSA process if during the course of work a SimOps activity is identified that could reasonably affect health and safety of Arcadis employees and subcontractors.

Site Background

The property has been developed since approximately 1966 with the current plaza prior to that it was part of a farm. Two former tenant spaces were operated as dry-cleaning facilities and one former tenant space was used as an auto repair facility.

Project Tasks

The following tasks are identified for this project:

1	Drilling - Using mechanical methods
2	Waste - Containment of IDW in small containment devices greater than 10 gallons but less than or equal to 119 gallons capacity
3	Utilities - Clearance
4	Oversight - Oversight of contractors
5	Waste - Liquid waste sampling using manual methods
6	Waste - Solid waste sampling using manual methods
7	Decontamination - Small or hand-held objects using manual methods
8	Monitor well - Well installation, development, or purging contractor oversight
9	Sampling - Non-pressurized or passive air sampling using summa canisters, sample canisters, tedlar bags, or passive collection device
10	Monitor well - Well sounding, water level or product measurements using probes, tapes or downhole water parameter measurements
11	Sampling - Well sampling using pumps requiring pump installation/removal
12	Instrument Survey
13	Cooler/Sample Packing
14	Drum Loading
15	SSDS Installation Contractor Oversight

The following documents/plans/support associated with the above task(s) are attached or to be provided:
- The Arcadis Utilities and Structures Checklist must be used for utility clearance activities.
- Journey Management Plan.
- Site access agreements for off-site non-client owned private property access.
- Arcadis Work Authorization Form Letter

[X] Required Checklists/Work Forms

- *Tailgate Safety Briefing Form*
- *Vehicle Inspection Checklist*
- *Utility and Structures Checklist*

[ ] Required Permits

- *Not Applicable*

[X] Required H&S Standards

- *Heat Stress Prevention_ARC HSIH013*
- *Respirable Crystalline Silica_ARC HSIH012*

Short Service Employees (SSEs), Part Time As Needed Employees (PTANs) and Temporary Agency Employees

SSEs (employees who are employed with Arcadis for less than 1 year or are Inexperienced Workers) have the potential to work on this project. If SSEs are utilized, the project team working in conjunction with the SSE's administrative supervisor will ensure requirements of ARC HSGE019 "Short Service Employees" are completed. SSE's will be identified on the project Tailgate Safety Meeting Form.

Roles and Responsibilities

	Name	Role	Short Service Employee
1	Lawrence Brunt	Project Manager (PM)	
2	-	Associate Project Manager (APM)	
3	Andrew Korik	Task Manager	
4	Andrew Korik	Field Technical Lead	
5	Kyle Barber	Site Safety Officer (SSO) (Non-HAZWOPER)	
6			
7			
8			
9			
10			

☐ The staff listed above are the initial participants on this project phase of work. This phase of work will have rotating staff on a daily or weekly basis. See Project scheduling tool or equivalent tool for current staff roles and responsibilities.

Training

All Arcadis employees are required to have the following training to be on site:

Defensive Driving - Smith On-Line
HAZCOM GHS/EAP (non-certificate)
Hazwoper 8-Hour Annual Refresher
Hazwoper 40-Hour
H&S Program Orientation (non-certificate)
None
None
None
None
None
None
None
None
Client specific/Other:

Selected Arcadis employees are required to have the following additional training:

	Names or Numbers from above
First Aid/CPR	5
DOT HazMat #1	5
Fire Extinguisher (non-certificate)	5
Silica General Awareness	5
Hazwoper 8-Hour Supervisor	1
None	
None	
None	
None	
None	
None	
None	
None	
None	

(1) The Arcadis Basic H&S Training Suite includes the following non-certificate trainings: H&S Orientation, Hazard Communication (HAZCOM/GHS), Emergency Action Planning (EAP), Personal Protective Equipment, and Hearing Conservation. The Suite also includes the following certificate issued training: Smith System Forward/Backing Training.

Protecting Our People: Our Health, Safety and Wellbeing Principles

As a people first business, our mission is to improve quality of life by promoting that our employees, clients, and wider society are kept both physically and psychologically healthy and safe, through our shared commitment to Health, Safety and Wellbeing, as a core Arcadis value. This reflects our key priority of "Protecting our People" by mitigating risk and preventing harm in everything we do.

Protecting Our People ensures the safeguarding of Arcadians from physical and psychological harm. Through robust health, safety, security, and wellbeing approaches, we identify, control, and manage risks, prevent harm, and create a secure environment where Arcadians can thrive. Protecting Our People ensures the health, safety, security, wellbeing, and happiness of Arcadians whilst delivering sustainable outcomes for our customers.

To achieve our "Protecting Our People" values, Arcadis relies on our Health, Safety and Wellbeing Principles:



TRACK is a basic risk analysis and assessment tool which helps us to: 1) Identify, assess, and control hazards; and 2) maintain safe work behaviors and practices.

Apply TRACK every day when planning tasks and before starting any task and use TRACK again when conditions change



Every employee at Arcadis is empowered and expected to stop what they are doing if they feel that something could happen or if they simply are not sure if it is safe to move forward.

It is your responsibility to stop your own work, the work of other Arcadis staff, or work under Arcadis control, if you believe it to be unsafe.



Be accountable for keeping yourself and others around you safe by acting immediately to prevent harm. If you see something unsafe (or not right), say something!



Undertake Health and Safety Planning.

Prepare and maintain a Health and Safety Plan for all work activities outside of an office environment.



Report all incidents, significant near misses, and unsafe acts and conditions immediately so that they can be investigated, corrected to prevent recurrence, and the lessons learned shared.



Wellbeing is a fundamental element of our health, safety and wellbeing priority, to protect our People by eliminating risk and preventing harm in everything we do.



Harnessing the potential of Arcadians through comprehensive training,, empowering them with invaluable knowledge and transforming experiences, ensuring a workforce ready to champion protection, minimize risk, and safeguard all from harm.



This is the "face" of Health, Safety and Wellbeing and we are all stewards, from the Chief Executive Officer to the newest employee, We must purposely think about how our actions or inaction regarding health and safety impact on others.

General Task Hazard Assessment and Risk Control (HARC)

General:	Site-Wide

The 12 hazard category HARC ratings are not available in this General THA. The mitigated and unmitigated ratings for the hazards presented are based on the Risk Assessment Matrix below. Modify hazards and ratings as necessary to meet project needs.

Risk Assessment Matrix		Likelihood Ratings			
Consequences Ratings		A	B	C	D
People	Property	0 Almost Impossible	1 Possible but Unlikely	2 Likely to Happen	3 Almost Certain to Happen
1-Slight or No Health Effect	Slight or No Damage	0-Low	1-Low	2-Low	3-Low
2-Minor Health Effect	Minor Damage	0-Low	2-Low	4-Medium	6-Medium
3-Major Health Effect	Local Damage	0-Low	3-Low	6-Medium	9-High
4-Fatalities	Major Damage	0-Low	4-Medium	8-High	12-High

Hazard

Driving - On road - Injury or vehicle damage from motor vehicle accident or incident

Suggested FHSHB Ref:	3.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	MEDIUM	JSAs
Comments:	Use Smith System "5-Keys" when driving. See Driving JSA for details.	

Hazard

Driving - Driver - Injury, death or property damage due to driver distraction, fatigue, etc.

Suggested FHSHB Ref:	3.4, 3.21	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	LOW	Driver awareness/use of stop work authority
Comments:	Use route planning. Keep eyes moving while driving. See Driving JSA.	

Hazard

Biological - skin/eye irritation or damage from poisonous plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	LOW	See HASP "Tick/Poisonous Plant Hazards" Section
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Use skin pre-treatment lotions when available.	

Hazard

Biological - bites or stings from exposure to insects or arachnids

Suggested FHSHB Ref:	3.17: 2,3,7,8,9,10	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	LOW	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Do body check daily. For ticks see also HASP Tick/Poisonous Plant section	

Hazard

Biological - cuts, scrapes, skin/eye puncture from exposure to physically damaging plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:		

General Task HARC (continued)

Hazard		
Environmental - Thermal stress - Injury or illness from heat or cold		
Suggested FHSHB Ref:	3.16	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook
Mitigated Risk:	LOW	JSAs
Comments:	Use job rotation or rest breaks. Stay hydrated and eat regularly.	
Hazard		
Environmental - Inclement weather -Injury or equipment damage from inclement weather		
Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Weather Monitoring
Mitigated Risk:	LOW	Cont./Emerg. Planning
Comments:	Use 10/30 rule for lightning. See FHSHB section 3.12.2 for details.	
Hazard		
Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions		
Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques. See FHSHB/HASP Stretching Worksheet. Job rotation.	
Hazard		
Motion - Musculoskeletal - Injury from repeated work activity or body motion		
Suggested FHSHB Ref:	3.29.2	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use job rotation or lifting aids. See FHSHB/HASP Stretching Worksheet.	
Hazard		
Gravity - Falls - Injury due to slips and trips		
Suggested FHSHB Ref:	3.26.4, 4.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Housekeeping
Comments:	Use footwear appropriate for site conditions, plan routes and do not hurry while walking.	

Task Specific HARC

Task 1:	Drilling - Using mechanical methods							
HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low):						FHSHB Ref:	4.5	
Biological*	L	Chemical	L	Driving*	-	Electrical	M	
Environmental*	L	Gravity*	M	Mechanical	M	Motion*	H	
Personal Safety	L	Pressure	L	Radiation	-	Sound	H	
* *Hazard rating, if present, excludes General THA hazards in this category.*								
Hazard #1								
Chemical - gasses - injury due to inhalation, asphyxiation, skin/eye contact								
Suggested FHSHB Ref:	3.30, 3.32			To mitigate this hazard, use TRACK and the following:				
Overall Unmitigated Risk:	MEDIUM			Job Briefing/Site Awareness				
Mitigated Risk:	LOW			SDS (see also HASP Hazcom/GHS section)				
Comments:	Screen breathing zone during drilling with PID.							
Hazard #2								
Chemical - liquids, skin or eye irritation/damage/allergy								
Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33			To mitigate this hazard, use TRACK and the following:				
Overall Unmitigated Risk:	MEDIUM			JSAs				
Mitigated Risk:	LOW			PPE (see HASP "PPE" section)				
Comments:	Ensure contractor has completed inspection of drill rig (including all hoses/connections).							
Hazard #3								
Gravity - Falls - Injury due to falls from height								
Suggested FHSHB Ref:	3.26, 3.34			To mitigate this hazard, use TRACK and the following:				
Overall Unmitigated Risk:	HIGH			Job Briefing/Site Awareness				
Mitigated Risk:	LOW			H&S Standards				
Comments:	Use 3 point contact when climbing stairs or ladders.							
Hazard #4								
Mechanical - Pinch point - Injury by pinching of body part in mechanical process								
Suggested FHSHB Ref:	3.27.4			To mitigate this hazard, use TRACK and the following:				
Overall Unmitigated Risk:	MEDIUM			Site Awareness				
Mitigated Risk:	LOW			PPE (see HASP "PPE" section)				
Comments:	Check with contractor that pinch points are located and marked on rig. Review crush hazards with contractor.							
Hazard #5								
Environmental - Utilities - Injury or property damage from utility strike/damage								
Suggested FHSHB Ref:	3.36			To mitigate this hazard, use TRACK and the following:				
Overall Unmitigated Risk:	HIGH			Specialized Checklist/Forms				
Mitigated Risk:	MEDIUM			H&S Standards				
Comments:	Use three lines of evidence to clear utilities prior to drilling. Complete the Utility and Structures Checklist prior to starting work.							

Task 2:	Waste - Containment of IDW in small containment devices greater than 10 gallons but less than or equal to 119 gallons capacity

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.3

Biological*	L	Chemical	M	Driving*	-	Electrical	-
Environmental*	M	Gravity*	M	Mechanical	L	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Chemical- solids/particulates - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	SDS (see also HASP Hazcom/GHS section)
Comments:	Use appropriate PPE to prevent skin contact. Wash hands thoroughly before eating and drinking.	

Hazard #2

Chemical - solids/particulates, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	SDS (see also HASP Hazcom/GHS section)
Comments:	Keep eye solution in reach, have epi pen on hand if allergic. Have SDS available for chemicals that are onsite.	

Hazard #3

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Work Plan
Comments:	Follow procedures when moving drums; wear appropriate PPE (work gloves).	

Hazard #4

Motion - Struck by - Bodily injury from impact with moving object

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Work Plan
Comments:	Set up exclusion zone. Store drums in safe area away from traffic.	

Hazard #5

Chemical - liquids, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Follow procedures when moving drums; wear appropriate PPE (work gloves)	

Hazard #6

Chemical - liquid, solid, or gas - Equipment damage due to corrosion or spill

Suggested FHSHB Ref:	3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	See HASP monitoring section
Mitigated Risk:	LOW	JSAs
Comments:	Stand upwind of drum/container.	

Task 3:	Utilities - Clearance

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.36

Biological*	L	Chemical	L	Driving*	-	Electrical	M
Environmental*	L	Gravity*	L	Mechanical	M	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Work Plan
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Watch pinch points around moving equipment.	

Hazard #2

Electrical - Housekeeping - Injury or property damage due to frayed wiring, improperly mounted wiring, missing

Suggested FHSHB Ref:	3.25	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Inspections
Mitigated Risk:	LOW	JSAs
Comments:	Inspect equipment before each task.	

Hazard #3

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Wear leather work gloves.	

Hazard #4

Motion - Struck by - Bodily injury from impact with moving object

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	Site Awareness
Comments:	Use traffic controls.	

Hazard #5

Environmental - Sun or wind -Skin injury from sun or wind exposure

Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Field H&S Handbook (see ref. above)
Comments:	Wear appropriate clothing layer and sunscreen.	

Task 4:	Oversight - Oversight of contractors

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	L	Driving*	-	Electrical	L
Environmental*	L	Gravity*	L	Mechanical	L	Motion*	L
Personal Safety	L	Pressure	L	Radiation	L	Sound	M

Hazard #1

Chemical - liquids, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	SDS (see also HASP Hazcom/GHS section)
Comments:	Keep eye solution in reach, have epi pen on hand if allergic. Have SDS available for chemicals that are onsite.	

Hazard #2

Chemical - liquids - injury or illness from vapor inhalation

Suggested FHSHB Ref:	3.2, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Screen breathing zone during drilling with PID.	

Hazard #3

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Use caution handling bottleware post sampling.	

Hazard #4

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Select
Comments:	Check with contractor that pinch points are located and marked on rig. Review crush hazards with contractor.	

Task 5:	Waste - Liquid waste sampling using manual methods

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.31

Biological*	L	Chemical	M	Driving*	-	Electrical	-
Environmental*	M	Gravity*	M	Mechanical	-	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Use caution when opening overtightened or rusty drums; wear work gloves to protect hands. Use tools as intended by the manufacturer.	

Hazard #2

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Be aware of site contaminants; wear appropriate PPE (i.e., Nitrile gloves).	

Hazard #3

Chemical - solids/particulates, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Be aware of site contaminants; wear appropriate PPE (i.e., Nitrile gloves, safety glasses).	

Hazard #4

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Use caution when opening and closing drums; wear work gloves to protect hands. Use tools as intended by the manufacturer.	

Task 6:	Waste - Solid waste sampling using manual methods

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.31

Biological*	L	Chemical	L	Driving*	-	Electrical	-
Environmental*	M	Gravity*	M	Mechanical	-	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Use caution when opening overtightened or rusty drums; wear work gloves to protect hands. Use tools as intended by the manufacturer.	

Hazard #2

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Be aware of site contaminants; wear appropriate PPE (i.e., Nitrile gloves).	

Hazard #3

Chemical - liquids, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Be aware of site contaminants; wear appropriate PPE (i.e., Nitrile gloves, safety glasses).	

Hazard #4

Motion - Struck by - Bodily injury from impact with moving object

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Use caution when opening drums; wear work gloves to protect hands. Use tools as intended by the manufacturer.	

Hazard #5

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Work Plan
Comments:	Use appropriate tools and PPE.	

Hazard #6

Chemical - gasses - injury due to inhalation, asphyxiation, skin/eye contact

Suggested FHSHB Ref:	3.30, 3.32	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	SDS (see also HASP Hazcom/GHS section)
Comments:	Screen breathing zone during sampling with PID.	

Task 7:	Decontamination - Small or hand-held objects using manual methods

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.10.4

Biological*	L	Chemical	M	Driving*	-	Electrical	-
Environmental*	L	Gravity*	L	Mechanical	-	Motion*	L
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	SDS (see also HASP Hazcom/GHS section)
Comments:	Wear chemical resistant gloves while decontaminating equipment.	

Hazard #2

Chemical - liquids - injury or illness from vapor inhalation

Suggested FHSHB Ref:	3.2, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	SDS (see also HASP Hazcom/GHS section)
Comments:	Wear chemical resistant gloves while decontaminating equipment.	

Task 8:	Monitor well - Well installation, development, or purging contractor oversight

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	L	Driving*	-	Electrical	-
Environmental*	L	Gravity*	M	Mechanical	L	Motion*	L
Personal Safety	-	Pressure	L	Radiation	-	Sound	M

Hazard #1

Chemical - gasses - injury due to inhalation, asphyxiation, skin/eye contact

Suggested FHSHB Ref:	3.30, 3.32	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	Specialized Equipment (specify in comments)
Comments:	Monitor breathing zone with PID.	

Hazard #2

Environmental - Utilities - Injury or property damage from utility strike/damage

Suggested FHSHB Ref:	3.36	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Specialized Checklist/Forms
Mitigated Risk:	MEDIUM	H&S Standards
Comments:	Make sure Underground Utility Checklist is complete prior to disturbing ground.	

Hazard #3

Pressure - Hydraulic - Injury from hydraulic process or device failure

Suggested FHSHB Ref:	2.5, 4.5, 4.6	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	H&S Standards
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Stay clear of hydraulic machinery while drilling.	

Hazard #4

Motion - Struck by - Bodily injury from impact with moving object

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Stay clear of moving parts during drilling.	

Task 9:	Sampling - Non-pressurized or passive air sampling using summa canisters, sample canisters, tedlar bags, or passive collection device

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	L	Driving*	-	Electrical	-
Environmental*	-	Gravity*	L	Mechanical	-	Motion*	L
Personal Safety	-	Pressure	-	Radiation	-	Sound	L

Hazard #1

Chemical - gasses - injury due to inhalation, asphyxiation, skin/eye contact

Suggested FHSHB Ref:	3.30, 3.32	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Screen breathing zone with PID.	

Hazard #2

Environmental - Utilities - Injury or property damage from utility strike/damage

Suggested FHSHB Ref:	3.36	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Specialized Checklist/Forms
Mitigated Risk:	MEDIUM	H&S Standards
Comments:	Use three lines of evidence to clear utilities prior to drilling.	

Hazard #3

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Wear gloves while making connections to SVI equipment.	

Task 10:	Monitor well - Well sounding, water level or product measurements using probes, tapes or downhole water parameter measurements

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	L	Driving*	-	Electrical	-
Environmental*	L	Gravity*	M	Mechanical	-	Motion*	L
Personal Safety	-	Pressure	L	Radiation	-	Sound	L

Hazard #1

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Work Plan
Comments:	Allow yourself to position your body correctly while sampling or working on monitoring wells. Do not keep body in awkward position, this will avoid muscle strain.	

Hazard #2

Chemical- liquids - injury or illness from skin absorption

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	HASP
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Always don PPE such as nitriles at all times.	

Hazard #3

Chemical - liquids - injury or illness from vapor inhalation

Suggested FHSHB Ref:	3.2, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Air Monitoring with PID
Mitigated Risk:	LOW	JSAs
Comments:	Scan breathing zone with PID.	

Task 11:	Sampling - Well sampling using pumps requiring pump installation/removal

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	L	Chemical	M	Driving*	-	Electrical	L
Environmental*	M	Gravity*	M	Mechanical	L	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	M

Hazard #1

Chemical - liquids, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	HAZWOPER Training, review historical analytical groundwater results and select appropriate PPE. Use absorbent pads to eliminate direct contact with PPE.	

Hazard #2

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Utilize proper tools and PPE. Use leather gloves when necessary and be cautious when opening and closing well covers/caps.	

Hazard #3

Motion - Struck by - Bodily injury from impact with moving object

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Job Briefing/Site Awareness
Comments:	Install cones/barricades as necessary to delineate work areas. Review site map. Observe vehicular traffic adjacent to the work area.	

Hazard #4

Chemical - liquids - injury or illness from vapor inhalation

Suggested FHSHB Ref:	3.2, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Allow well venting and perform initial screening as needed with a PID.	

Hazard #5

Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions

Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques - bend with the knees and not the back. Use the buddy system for lifting items that are greater than 50 lbs. or awkward loads.	

Task 12:	Instrument Survey

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	M	Chemical	-	Driving*	-	Electrical	-
Environmental*	M	Gravity*	M	Mechanical	-	Motion*	M
Personal Safety	L	Pressure	-	Radiation	-	Sound	L

Hazard #1

Gravity - Falls - Injury due to slips and trips

Suggested FHSHB Ref:	3.26.4, 4.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	Site Awareness
Comments:	Be aware of slip/trip/fall hazards when performing instrument survey.	

Task 13:	Cooler/Sample Packing

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.9

Biological*	-	Chemical	M	Driving*	-	Electrical	-
Environmental*	L	Gravity*	L	Mechanical	-	Motion*	M
Personal Safety	-	Pressure	-	Radiation	L	Sound	-

Hazard #1

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Maintain a firm grip on glassware to prevent breaking while loading into cooler. Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Clean up any broken bottles immediately.	

Hazard #2

Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions

Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Admin. Controls (specify in comments)
Mitigated Risk:	LOW	JSAs
Comments:	Use proper lifting techniques and keep back straight, bend with the knees. Use buddy system for coolers that weigh greater than 50 lbs.	

Task 14:	Drum Loading

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 3.3

Biological*	L	Chemical	M	Driving*	-	Electrical	-
Environmental*	M	Gravity*	M	Mechanical	L	Motion*	M
Personal Safety	L	Pressure	L	Radiation	-	Sound	L

Hazard #1

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Work Plan
Comments:	Follow procedures when moving drums; wear appropriate PPE (work gloves).	

Hazard #2

Chemical - liquids, skin or eye irritation/damage/allergy

Suggested FHSHB Ref:	3.9, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Follow procedures when moving drums; wear appropriate PPE (work gloves).	

Hazard #3

Chemical - liquid, solid, or gas - Equipment damage due to corrosion or spill

Suggested FHSHB Ref:	3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Stand upwind of drum/container.	

Hazard #4

Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions

Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	JSAs
Comments:	Bend with the knees and not the back. Use a drum dolly or heavy equipment to transport drums.	

Task 15:	SSDS Installation Contractor Oversight

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 4

Biological*	L	Chemical	M	Driving*	-	Electrical	M
Environmental*	L	Gravity*	L	Mechanical	M	Motion*	M
Personal Safety	-	Pressure	L	Radiation	-	Sound	M

Hazard #1

Chemical - solids/particulates, injury or illness from inhalation

Suggested FHSHB Ref:	3.2, 3.22, 3.30, 3.33	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	JSAs
Comments:	Inhalation of dust during cutting of concrete, stand upwind of work area.	

Hazard #2

Electrical - Housekeeping - Injury or property damage due to frayed wiring, improperly mounted wiring, missing

Suggested FHSHB Ref:	3.25	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Housekeeping
Mitigated Risk:	LOW	JSAs
Comments:	Requires proper maintenance of wires for tools.	

Hazard #3

Motion - Cuts and scrapes - Injury from moving object impacting skin or eye

Suggested FHSHB Ref:	2.5, 3.22	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	JSAs
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)
Comments:	Injury from tools used to cut/core concrete, wear gloves and safety glasses.	

Hazard #4

Sound - Noise - Injury or illness due to noise exposure

Suggested FHSHB Ref:	3.15	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	H&S Standards
Comments:	Noise from cutting/coring, wear ear plugs, maintain distance from source if possible.	

Hazard #5

Mechanical - Crushing - Injury by crushing body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Field H&S Handbook
Comments:	Relocation of concrete, maintain site awareness and distance from heavy loads in motion.	

Hazard Communication (HAZCOM)/Global Harmonization System (GHS)

	HAZCOM/GHS for this project is managed by the client or contractor
	Project will utilize <=3 Chemical(s)/Product(s) subject to HAZCOM/GHS

List the chemicals anticipated to be used by Arcadis on this project per HAZCOM/GHS requirements.
(Modify quantities as needed)

	Preservatives	Qty
	Not applicable	
X	Hydrochloric acid	<500 ml
	Nitric acid	<500 ml
	Sulfuric acid	<500 ml
	Sodium hydroxide	<500 ml
	Zinc acetate	<500 ml
	Ascorbic acid	<500 ml
	Acetic acid	<500 ml
	Isopropyl alcohol	< 4 gal.
	Formalin (<10%)	< 4 gal.
	Methanol	<500 ml
	Sodium bisulfate	<500 ml

	Decontamination	Qty
	Not applicable	
X	Alconox	≤ 5 lbs
	Liquinox	≤ 1 gal
	Acetone	≤ 1 gal
	Methanol	≤ 1 gal
	Hexane	≤ 1 gal
	Isopropyl alcohol	≤ 4 gal
	Nitric acid	≤ 1 L
	Other:	

	Calibration	Qty.
	Not applicable	
X	Isobutylene/air	1 cyl
	Methane/air	1 cyl
	Pentane/air	1 cyl
	Hydrogen/air	1 cyl
	Propane/air	1 cyl
	Hydrogen sulfide/air	1 cyl
	Carbon monoxide/air	1 cyl
X	pH standards (4,7,10)	≤ 1 gal
X	Conductivity standards	≤ 1 gal
X	Other:	
	ORP Standard	
	Multi-Gas Cal Gas	

	Fuels	Qty.
X	Not applicable	
	Gasoline	≤ 5 gal
	Diesel	≤ 5 gal
	Kerosene	≤ 5 gal
	Propane	1 cyl
	Other:	

	Kits	
X	Not applicable	
	Hach (specify):	
	DTECH (specify):	
	Other:	

		Qty.
		1 kit
		1 kit
		1 kit

	Remediation	Qty.
X	Not applicable	

	Other:	Qty.
	Not applicable	
X	Spray paint	≤ 6 cans
	WD-40	≤ 1 can
	Pipe cement	≤ 1 can
	Pipe primer	≤ 1 can
	Mineral spirits	≤ 1 gal

	DOT(1):	Qty.
	MOT eligible soils	
	MOT eligible water	
	MOT eligible solids	
	MOT eligible liquids	

(1) Attach applicable Materials of Trade (MOT) Quick Form to shipping determination or this HASP. SDS not generally applicable to this category.

SDSs for this project will be available electronically on a designated project field computer. All project workers will be notified of the SDS location in their initial safety briefing.

Air Monitoring

	There are no atmospheric chemical, radiological, or particulate hazards on this project requiring air monitoring.
	Air monitoring is the responsibility of the client or subcontractor.
X	Air monitoring is required for the following tasks:

- Monitor well - Well sounding, water level or product measurements using probes, tapes or downhole water parameter measurements
- Waste - Containment of IDW in small containment devices greater than 10 gallons but less than or equal to 119 gallons capacity
- Waste - Liquid waste sampling using manual methods
- Waste - Solid waste sampling using manual methods
- Monitor well - Well installation, development, or purging contractor oversight
- Sampling - Non-pressurized or passive air sampling using summa canisters, sample canisters, tedlar bags, or passive collection device

Constituents of Interest:

Time Weighted Averages (TWAs) are ACGIH 8 Hr Threshold Limit Values (TLVs) unless noted.

Gas			
TWA	30 ppm, Arcadis administrative limit	LEL/UEL (%):	1.4/7.6
STEL	500 ppm	RGD (Air = 1):	NA
IDLH	NA	VP (mmHg):	38-300

Diesel		Anticipated Breathing Zone Concentration <=	3	mg/m3
TWA	100 mg/m3, skin, (15 ppm Arcadis limit-see PID warning)	LEL/UEL (%):	NA	
STEL	NA	RGD (Air = 1):	NA	
IDLH	NA	VP (mmHg):	NA	

Tetrachloroethene			
TWA	25 ppm	LEL/UEL (%):	NA/NA
STEL	100 ppm	RGD (Air = 1):	NA
IDLH	150 ppm, NIOSH	VP (mmHg):	14

TWA - Time Weighted Average (ACGIH TLV unless noted)
STEL - Short Term Exposure Limit
IDLH - Immediately Dangerous to Life and Health

LEL/UEL - Lower/Upper Explosive Limit
RGD - Relative Gas Density
VP (mmHg) - Vapor Pressure (millimeters mercury)

Notes:
One or more constituents above is listed with a skin notation. Avoid conditions where dusts, mists, or aerosols are created. Avoid skin contact with impacted media.

Required Monitoring Instruments, Action Levels and Monitoring Frequency

Photoionization Detector Select Lamp: 10.6 eV

Diesel/Fuel Oil: The 15 ppm Arcadis recommended exposure limit for diesel/fuel oil is not included in the computation below. Manual action level adjustment may be required. The PID may provide a slow response to diesel fuel/fuel oil.

Action levels are in PID units (1):			Computed action levels have been manually adjusted.
<	19.5		Continue working
	19.5	- 39.1	Levels sustained > 5 minutes, monitor continuously and review engineering controls and PPE. Proceed with caution.
>	39.1		Stop work and contact SSO

(1) Computed action levels are for PIDs which have not been programmed to correct TLVs for specific constituents or mixtures.

Particulate/Aerosol monitoring is required.

Action levels are in mg/m3			Computed action levels have been manually adjusted.
<	1.500		Continue working
	1.5 - 3		Levels sustained > 5 minutes, monitor continuously and review engineering controls and PPE. Proceed with caution.
>	3.000		Stop work and contact SSO

Breathing zone air monitoring using the above instruments will be performed at the following frequency:
Hourly

If manually logging air monitoring results, all results must be documented, including non-detects.

Only LEL/O2 monitoring is required.

LEL/O2 Meter Monitoring Required	0-5% LEL	Continue work
	>5-10% LEL	Continually monitor, review engineering controls, proceed with caution
	>10% LEL	Stop work, evacuate, contact SSO
	19.5%-23.5% O2	Normal, continue work
	<19.5% O2	O2 deficient, stop work, evacuate, contact SSO
	>23.5% O2	O2 enriched, stop work, evacuate, contact SSO

Additional Gas/Vapor Monitoring is Not Required

		1/2 TLV	Stop Work Action Level	Comments
	Ammonia	12.5 ppm	25 ppm	
	Carbon dioxide	2500 ppm	5000 ppm	
	Carbon monoxide	12.5 ppm	25 ppm	
	Chlorine	0.05 ppm	0.1 ppm	
	Hydrogen cyanide	2.35 ppm (skin)	4.7 ppm* (skin)	
	Hydrogen sulfide	0.5 ppm	1 ppm	
	Methane	Simple Asphyxiant		
	Nitrogen dioxide	0.1 ppm	0.2 ppm	
	Phosphine	0.025 ppm	0.05 ppm	
	Sulfur dioxide	0.125 ppm	0.25* ppm	
	Mercury vapor	0.0125 mg/m3	0.025 mg/m3	

* Ceiling or STEL value

All air-monitoring instruments must be calibration checked daily, if used, per manufacturer's instructions. Calibration checks, including calibration gases used, must be documented.

Compound specific monitoring using the device identified below will be required.

Compound specific device:

	≤TWA	Continue work
	>TWA	Stop work, review engineering controls and PPE, contact SSO
Compound(s):		

Indicator tube/chip monitoring frequency: Not applicable

Tick and Poisonous Plant Hazards

For all projects with outdoor work, biological hazards must be addressed in the tailgate safety meeting each day. The following controls must be used to mitigate biological hazards while working and must also be discussed in the tailgate safety meeting. For low risk situations, the discussion must include exposure to weeds/vegetation near fences, buildings, etc.

Controlling Tick Hazards

Risk Guide for Ticks:

Low	Paved areas; parking lots; well manicured lawns and fields; no work taking place within 15 feet of vegetated areas; work in REGIONS with no tick populations; sub-freezing temperatures, snow or ice cover on ground.*
Medium	Brush hogged fields, wetlands, and grasslands; forested areas with little undergrowth; weeds less than knee height; moderately dense foliage; sporadic or moderately vegetated shaded areas; average leaf accumulation and decaying material on the ground; work taking place in fields after application of insecticide; work in REGIONS with a recognized moderate tick populations; outdoor work during spring, summer and fall months.*
High	Uncut fields, wetlands, forested areas, and grasslands; weeds taller than knee height; heavy dense foliage; heavily vegetated shaded areas; excessive accumulations of leaves and decaying material on the ground; work in REGIONS with recognized heavy tick populations; areas with posted tick hazard warnings; outdoor work during spring, summer and fall months.*

*Cold weather does not eliminate risk of exposure to deer ticks as they may be active all year in areas that experience subfreezing temperatures.

Ticks are ranked as a **Low** risk for this project

Care should be taken to avoid walking through or working in tall grasses, overgrown or bushy vegetation to the extent reasonable and practical. No single control is effective against ticks.

Select required controls below:

Engineering Controls

- [ ] Mowing of work area
- [ ] Clearing overgrown vegetation
- [ ] Pesticide application
- [ ] Other: _____

Administrative Controls

- [X] Complete tick check morning/evening
- [ ] Scheduled tick check: _____
- [ ] Inspect backpacks, equipment cases, etc. daily
- [ ] Vehicle cab - maintain good housekeeping
- [ ] Other: _____

Personal Protective Equipment

- [ ] Light colored clothing
- [ ] Light colored hat/hardhat
- [ ] Pants tucked in boots
- [ ] Shirt tucked into pants
- [ ] Long sleeved shirt and long pants
- [ ] White Tyvek pants
- [ ] White coveralls/Tyvek
- [ ] Taped cuffs/pant legs
- [ ] Tick gators
- [ ] Double sided tape/duct tape sticky side out
- [ ] Insect mesh/netting for face/head or whole body suit
- [ ] Other: _____

Repellents

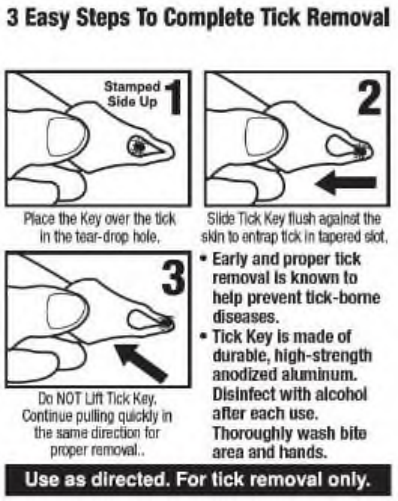
- [X] Repellents will not be used
- [ ] Permethrin impregnated clothing (purchased)
- [ ] Permethrin (0.5% self applied/treated to clothing)
- [ ] Deet 20-40% applied to skin
- [ ] Other: _____

If repellents are not used, additional PPE controls must be considered.

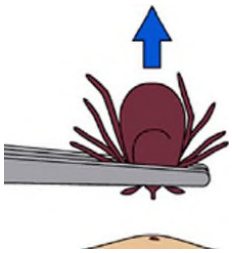
Tick Removal and First Aid

Ticks removed within 24 hours of embedment represent a very low risk for adverse outcomes. Perform tick checks as directed above. To properly remove a tick:

Using a Tick Removal Tool



Using Tweezers



1) Use point tip tweezers, if available, to reduce potential of crushing the ticks body
2) Grasp the tick as close to skin as possible
3) Pull upward with even pressure.

Do not crush tick with fingers

After removal, wash affected area with alcohol or iodine. Wash hands thoroughly after removal.
Document date/time of the removal in field notes, field form or H&S app.
If rash or fever develops, call WorkCare

Poisonous Plants (Poison Ivy, Poison Oak, Poison Sumac)

All work outdoors, regardless of time of year, must address poisonous plant hazards and controls in the tailgate safety meeting. For low risk projects, the discussion should consider potential vegetation exposure near fences, buildings, work near trees, etc.

Controlling Exposure to Poisonous Plants

Poisonous Plants are ranked as a **Low** risk on this project

Select required controls below:

Engineering Controls

- [X] Not applicable
- [ ] Mowing of work area
- [ ] Clearing overgrown vegetation
- [ ] Herbicide application
- [ ] Other: _____

Administrative Controls

- [X] Identify and avoid (see ID Quick Guide below)
- [ ] Watch for signs or symptoms of exposure
- [ ] Vehicle cab - maintain good housekeeping
- [ ] Other: _____

Personal Protective Equipment

- [ ] Gloves
- [ ] Hat/hardhat/head covering
- [ ] Pants tucked in boots
- [ ] Shirt tucked into pants
- [ ] Long sleeved shirt and long pants
- [ ] White coveralls/Tyvek
- [ ] Taped cuffs/pant legs
- [ ] Dust mask (during burning activities, etc.)
- [ ] Other: _____

Repellents

- [ ] Repellents will not be used
- [ ] Barrier creams
- [ ] Other: _____

Skin Decontamination

- [ ] Wash with post-exposure soap and water
- [ ] Wash with soap and water (use hot water if available)
- [ ] Hot shower at end of day
- [ ] Other: _____

Equipment Decontamination

Due to the low risk associated with poisonous plants on this project, portable equipment and tools may still have a potential to be contaminated with urushiol (the oil that causes allergic reactions and dermatitis in poisonous plants covered by this plan). It is recommend to decontaminate handles, grips, and hand holds of tools and equipment with post-exposure soap and water or alcohol spray (if safe to do so for the equipment/tool being decontaminated) as a best practice.

Clothing Decontamination

Wash work clothing in hot water separate from other clothing. Even though there is a low risk for poisonous plants on this project, work boots should be considered potentially contaminated with urushiol. Decontaminate with post-exposure soap and water or hot soap and water. If safe for the boot, consider spraying with alcohol spray of post exposure soap is not available.

First Aid

If skin irritation or other signs of allergic reaction develops contact WorkCare for assistance. Document date and time of exposure, if known, in field notes, field form or H&S app.

Identification Quick Guide

Ticks:

American Dog Tick



Blacklegged (Deer) Tick



Brown Dog Tick



Groundhog Tick



Gulf Coast Tick



Lone Star Tick



Rocky Mountain Wood Tick



Soft Tick



Poison Ivy:







Poison Oak:







Poison Sumac:



For other biological hazards, address the hazards and controls in the JSA for the work task.

Personal Protective Equipment (PPE)

See JSA or Permit for the task being performed for required PPE. If work is not conducted under a JSA or Permit, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for all tasks during field work (outside of field office trailers and vehicles) not covered by a JSA or Permit on this project:

Minimum PPE required to be worn by all staff on project:						Specify Type:
X	Hard hat		Snake chaps/guards		Coveralls:	
X	Safety glasses		Briar chaps		Apron:	
	Safety goggles		Chainsaw chaps		Chem. resistant gloves:	
	Face shield		Sturdy boot		Gloves other:	
	Hearing protection	X	Steel or comp. toe boot		Chemical boot:	
	Rain suit		Metatarsal boot		Boot other:	
	Other:			X	Traffic vest, shirt or coat:	Class II
					Life vest:	

Task specific PPE: Nitrile Gloves, Work Gloves, Hearing Protection

Comments:
Task specific PPE - worn when applicable hazards are present as described in the corresponding JSA.

Medical Surveillance

All Arcadis employees performing field work will be required to be current in HAZWOPER medical surveillance.

Client and DOT mandated drug and alcohol testing is not required for this project and will not be performed.

Hazardous Materials Shipping and Transportation

A shipping determination package has been prepared, reviewed and provided to Arcadis field staff for this project.

Traffic Safety and Traffic Safety Plans (TSPs)

All or portions of the project work will be conducted in a parking lot and/or private roadway. A Non-ROW TSP addressing this work is attached to this HASP.

Arcadis Commercial Motor Vehicles (CMVs)

CMVs operated by Arcadis employees on public roadways will not be utilized on this project. Arcadis defines a CMV as any single vehicle with a gross vehicle weight rating (GVWR) ≥10,001 pounds or a truck and trailer combination with a combined GVWR ≥10,001 pounds (GVWR of truck + GVWR of trailer = ≥10,001 pounds).

Site Control

Site control requirements are addressed in the applicable task JSA for this project. JSAs requiring site control are attached to this HASP.

Decontamination

Decontamination protocols are addressed in the applicable task JSA(s) for this project. The applicable JSAs are attached to this HASP.

Sanitation

The project scope is a mobile work operation. The project field team will have reasonable access to restroom facilities within 10 minutes of the work area where the mobile work activity is actively taking place. Potable water will be carried by the field team in the vehicle used for the project. Unless alternate requirements are stipulated in a plan supplement (i.e. Heat Injury and Illness Prevention Plan), permit or JSA, bottled or water coolers with potable water will be provided to project workers at 1 gallon/worker/day.

Safety Briefings

Arcadis will lead all safety briefings on this project and will document the safety briefing on a Tailgate Safety Briefing form or logbook. Safety briefings will be conducted once at the beginning of each work day unless the Site Safety Officer deems more frequent safety briefings will be required based on work being conducted. All project workers, including Arcadis subcontractors, will be required to attend the safety briefing. Site visitors and project workers not on duty during the morning safety briefing will receive the safety briefing upon their arrival onto the project site for the day.

Employee Health and Safety Engagement

The CPM or APM is responsible for reviewing and establishing H&S engagement goals for the project. These goals are summarized below.

Hazard Observations (via H&S App or TIP) required at the following frequency on this project:
1 PER TASK

Close Call reporting (via H&S app) goals for this project:
1 PER EVENT

Other (specify):

Safety Equipment and Supplies

Safety equipment/supply requirements are addressed in the JSA or Permit for the task being performed. If work is not performed under a JSA or Permit, the following safety equipment is required to be present on site in good condition unless otherwise noted (Check all that apply):

X	First aid kit		Insect repellent:
	Bloodborne pathogens kit	X	Sunscreen
X	Fire extinguisher		Air horn
	Eyewash (ANSI compliant)	X	Traffic cones
X	Eyewash (bottle)		2-way radios
X	Drinking water		Heat stress monitor
	Other:	X	See Tick and Poisonous Plant Hazards section for additional equipment/supply information.

International Travel

International travel is not required for this project.

Spill Control and Containment

Spill control and containment protocols, including required equipment and supplies, are located in the project work plan governing work on this project.

Use of Electronic Devices in Areas of Increased Safety Risk

Use of electronic devices (tablets, laptops, and/or cell phones) to collect data or document work is not anticipated on this project. If electronic devices are used, distraction hazards and use must be addressed and documented in the job briefing/safety briefing.

Signatures

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

Printed Name	Signature	Date

Add additional sheets if necessary

You have an absolute right to STOP WORK if unsafe conditions exist!

Attachment A

JSAs

Job Safety Analysis

General

JSA ID	HASP 1	**Status**	Complete
Job Name	General Industry-Driving - passenger vehicles	**Created Date**	3/15/2025
Task Description	Driving a car, van, or truck on public roadways.	**Completed Date**	03/15/2025

Client / Project

Client	C. Gershon Company, Inc.
Project Number	30147184
Project Name	Horseheads - Grand Central Plaza Site Characterization
Project Manager	Lawrence Brunt

User Roles

Role	Employee	Due Date	Completed Date
Developer	Steve Lemoine	3/15/2025	3/15/2025
HASP Reviewer	Andrea Quimoyog	3/15/2025	3/15/2025
Quality Reviewer			

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Pre-Trip Inspection	1	Failing to perform pre-trip inspections may cause mechanical failure, accident or injury.	Perform walk around of vehicle with particular attention to tire inflation and condition. Check lights, wipers, seatbelts for proper operating condition. Properly adjust seat and mirrors prior to vehicle operation. Use or review vehicle inspection checklist as required under the MVSP.	ARC HSGE024 Motor Vehicle Safety Standard (MVSP)
		2	Scrapes, cuts, burns to hand if inspecting engine fluids and/or tires. Eye splash hazard if inspecting engine fluids. Pinch or crush hazards when opening or closing hood, trunk, or tailgate.	Wear protective gloves and safety glasses as described below when checking under hood or tires. Use TRACK and keep hands clear when opening/closing hood, trunk, or tailgate to avoid crush or pinch hazard.	
		3	Struck by other vehicles while walking around vehicle performing inspections.	Wear high visibility vest, shirt, or coat while performing inspections in parking lots or other areas with a traffic hazard. Remain vigilant of moving vehicles or equipment in area, face oncoming vehicles to extent practical.	
		4	Improperly secured cargo may dislodge creating injury, property damage, or road hazard.	Ensure all cargo is properly secured to prevent movement while the vehicle is in operation. This includes cargo in the cab of the vehicle.	
2	Driving a motor vehicle on public streets	1	Failing to observe traffic flow ahead increases risk of hard braking resulting in potential impact of vehicle ahead, being struck by another vehicle from behind, and decreases decision making time.	Use Smith System Key #1, "Aim High in Steering". **Look ahead (15 seconds if possible) to observe traffic flow and traffic signals.** Adjust speed accordingly to keep vehicle moving and avoid frequent braking. Select lane of least traffic and adjust speed based on observed signal timing when possible. Avoid following directly behind large vehicles that obscure view ahead.	Smith System "5-Keys" is a registered trademark of Smith System Driver Improvement Institute, Inc.
		2	Failing to observe vehicles, pedestrians, bicyclists, and other relevant objects in vicinity of your vehicle increases risk of side swipes, rear ending, and third party injury.	Use Smith System Key #2, "Get the Big Picture". **Maintain 360 degrees of awareness around vehicle.** Check a mirror every 6-8 seconds, maintain space around the vehicle, choose a lane that avoids being boxed in. Look for pedestrian activity ahead in crosswalks or sidewalks. Watch for construction zone approach signs and act early by executing lane changes and reducing speed.	

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
2 (cont.)		3	Failing to keep your eyes moving increases risk of not seeing relevant vehicles, pedestrians, and objects in your vicinity that may impair your ability to make timely and appropriate driving decisions and also increases risk of accident.	Use Smith System Key #3, "Keep Your Eyes Moving". **Move your eyes every 2 seconds and avoid staring while evaluating relevant objects.** Scan major and minor intersections prior to entering them. Check mirrors.	
		4	Failing to maintain space around and in front of your vehicle increases risk of striking another vehicle or being struck by another vehicle. Insufficient space shortens time for effective driving decision making resulting in increased accident risk.	Use Smith System #4, "Leave Yourself an Out". **Use 4 second rule when following a vehicle.** Avoid driving in vehicle clusters by adjusting speed and using lanes that permit maximum space and visibility. When stopped, keep one car length space in front of vehicle ahead or white line.	
		5	Failing to communicate with other drivers and pedestrians increases risk of striking vehicles, pedestrians, or being struck by other vehicles, especially from the rear.	Use Smith System Key #5, "Make Sure They See You". **Brake early and gradually when stopping to reduce potential of being rear ended.** Keep foot on brake while stopped. Use turn signals and horn effectively. Establish eye contact with other drivers and pedestrians to extent practical. Use vehicle positioning that promotes being seen.	
		6	Distractions within the vehicle takes focus off driving, increases risk of accident decreases time for making effective driving decisions.	**Cell phone use (any type or configuration) is prohibited while the vehicle is in motion.** Familiarize yourself with vehicle layout and controls (radio, temperature controls, etc.) prior to operating unfamiliar vehicles. Set controls prior to operating vehicle. Use GPS in unfamiliar areas to avoid use of paper maps/directions while driving. Set GPS prior to vehicle operation. Pull over and stop to modify GPS functions. Avoid consuming food or drink while driving.	
3	Parking	1	Parking vehicle in areas of clustered parked vehicles or near facility entrance may impair visibility to oncoming traffic in lot and increase exposure to pedestrian traffic.	**Use pull through parking or back into parking space when permitted or practical.** When practical and safe to do so, park away from other vehicles and avoid parking near the facility entrance or loading docks. If available, use a spotter to aid in backing activity. Back no further than necessary and back slowly. Get out and look (GOAL) if uncertain of immediate surroundings. Tap horn prior to backing.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses	While checking engine or tires	Required
Hand Protection	work gloves (specify type)	Leather or equivalent checking engine or tires	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
	other	Vehicle kit (applies to company trucks)	Required
Miscellaneous	fire extinguisher	Applies to company trucks	Required
	first aid kit	Applies to company trucks	Required

Job Safety Analysis

General

JSA ID	44	**Status**	(3) Completed
Job Name	Environment-Drilling, soil sampling, well installation	**Created Date**	2/4/2009
Task Description	Drilling, and well installation	**Completed Date**	12/08/2017
Template	True	**Auto Closed**	False

Client / Project

Client	
Project Number	
Project Name	
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	McDonald, Andrew	12/22/2017	12/8/2017	Hubbard, Lauren	☑
Developer	Merkle, Kurt	12/22/2017	12/8/2017	Merkle, Kurt	☐
HASP Reviewer	McDonald, Andrew	12/22/2017	12/8/2017	Hubbard, Lauren	☑
Quality Reviewer	Abou Abdallah, Said	12/11/2017	12/11/2017	Carpenter, Matt	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Set up necessary traffic and public access controls	1	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
2	Utility Clearance	1	Potential to encounter underground or above ground utilities while drilling.	Complete utility clearance in accordance with the ARCADIS Utility Clearance H&S Standard.	ARCADIS H&S Standard ARCHSFS019
3	General drill rig operation	1	Excessive noise is generated by rig operation.	When the engine is used at high RPMs or soil samples are being collected, use hearing protection.	
		2	During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils more readily vaporize generating airborne contaminates.	Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly drill augers. Be careful handling split spoons. Wear proper work gloves. When soils and parts become heated, the COC could volatilize. Air monitoring should always be performed in accordance with the HASP.	
		3	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts.	Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig.	
		4	Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs.	Wear safety glasses and stay as far away from actual drilling operation as practicable. Wear appropriate gloves to protect from COCs.	
		5	Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard.	Keep equipment and trash picked up, and store away from the primary work area.	
		6	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Clearance H&S Standard for guidance.	

4	Mudd rotary drilling	1	The raised derrick can strike overhead utilities, tree limbs or other elevated items.	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	This technology uses fluid, which collects with sediments in large basin. Fluid can splash out and cause slipping/mud hazard. Liquid mixture can splash into your eyes.	Wear rubber boots if needed, and keep clear of muddy/wet area as much as practicable. If area becomes excessively muddy, consider mud spikes or covering the area with a material that improves traction. Wear safety glasses.	
5	Hollow stem auger drilling	1	All hazards in step 3 apply. Additionally,The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	Hands or fingers can get caught and crushed if trying to clean by hand or with tools while the auger is still turning.	Auger should always be stopped and clutch disengaged prior to cleaning.	
6	Air Rotary Drilling	1	This drilling method works with high air pressure and can generate flying debris that can strike your body or get in your eyes.	When the drill rig is being driven into media, it will produce flying debris. The flaps behind the drill rig should stay closed whenever possible to reduce the risk of flying debris. Safety glasses and hard hat should always be worn when the drill rig is operating. When penetrating asphalt, protect surrounding cars that may be present to avoid damage to pain or windshields.	
		2	The raise derrick can strike overhead utilities, tree limbs or other elevated items.	Never move this rig with the derrick up. Ensure there is proper clearance to raise the derrick and that you are far enough away from overhead power lines. See the Utility clearance H&S Standard for guidance.	
		3	When drilling through bedrock prior to groundwater, dust can be produced from pulverization. Inhalation of dusts/powder can occur.	Supplemental water should be used to manage dust and/or dust masks should be used if necessary.	
7	Reverse rotary drilling	1	This method will use fresh water to pump out drill cuttings through the center of the casing. Water/sediment mixture is generated and could cause contact with impacted soils or groundwater.	Ensure the pit construction can hold the amount of cuttings that are anticipated. Air monitoring should also be used of pit area.	
		2	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local municipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		3	Settling pit construction can cause tripping hazard from excavated soils, and plastic sheeting can cause slipping.	Cone off the area to keep the general public/visitors away from the settling pit. Ensure proper sloping of excavation.	
		4	The raised derrick can strike overhead utilities, tree limbs or other elevated items.	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	

8	Rotosonic drilling	1	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		2	This method requires a lot of clearance. The drill head can turn 90 degrees to attach to the next drill flight or casing. This usually requires a large support truck to park directly behind the rig. As the drill head raises the new casing flight is angled down at the same time until it can be turned completely vertical.	Ensure sufficient overhead clearance.	
		3	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
		4	The rotosonic drill head can move very quickly up and down while working on a borehole. Moving parts can strike someone or catch body parts.	The operator and helper must communicate and stay clear of the path of the drill head. The drill utilizes two large hydraulic clamps to continuously hold casings while load/unloading previous casings. Do not wear loose clothing.	
9	Direct push drilling	1	The drill rods will be handled by workers most of the time rather than the rig doing it, therefore pinch points can cause lacerations and crushing of fingers/body parts.	Keep a minimum of 5 feet away from drill rig operation and moving parts.	
		2	The direct push rigs are usually meant to fit in spaces where larger rig can't. Tight spaces can pin workers.	Do not put yourself between the rig and a fixed object. Use Spotters or a tape measure to ensure clearances in tight areas. Pre-plan equipment movement from one location to the next.	
		3	Some direct push equipment is controlled by wireless devices. These controls can fail and equipment can strike workers or cause damage to property.	The drill rig should be used in a large open area to test wireless controls prior to moving to boring locations. The operator of the rig will test the kill switch with wireless remote prior to use. Operator will stay in range of rig while moving so that wireless signal will not be too weak and cause errors to the controls.	
		4	Sampling sleeves must be cut to obtain access to soil. Cutting can cause lacerations.	It's preferable to let the driller cut the sleeves open. Many drillers have holders for the sleeve to allow for stability when cutting. If you cut the sleeves, use a hook blade, change blade regularly, and cut away from the body.	
		5	Soil cores may contain contaminated media.	Wear nitrile gloves and saftey glasses for protection from contaminated media when logging soil borings.	
10	Rock coring	1	Flying debris can hit workers or cause debris to get in eyes.	Rock chips or overburden may become airborne from drilling method. Wear safety glasses and hard hat and remain at a safe distance from back of drill rig.	
		2	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	

11	Sample collection and processing	1	Injuries can result from pinch points on sampling equipment, and from breakage of sample containers.	Care should be taken when opening sampling equipment. Look at empty containers before picking them up, and do not over-tighten container caps. Use dividers to store containers in the cooler so they do not break.	Sample Cooler Handling JSA
		2	Lifting heavy coolers can cause back injuries.	Use two people to move heavy coolers. Use proper lifting techniques.	
12	Monitoring well installation	1	Same hazards as in Step 3 with general drill rig operation	See step 3	
		2	Monitoring well construction materials can clutter the work area causing tripping hazards.	Well construction materials should be picked up during the well installation process.	
		3	Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations.	Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags.	
		4	Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes.	Wear safety glasses for protection from airborne sand and dust.	
		5	Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing.	Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size.	
13	Soil cutting and purge water management	1	Moving full drums can cause back injury, or pinching/crushing injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollies, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	Drum Handling JSA

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	Driller to provide and manage	Recommended
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
	water/fluid replacement		Recommended
Traffic Control	traffic cones		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	McDonald, Andrew HASP Reviewer Approve 12/8/2017	
Employee: **Role** **Review Type** **Completed Date**	Abou Abdallah, Said Quality Reviewer NA 12/11/2017	Useful hints to consider when attending field soil borings for utility type work.

Job Safety Analysis

General

JSA ID	7983	**Status**	(3) Completed
Job Name	Environment-Drum sampling/handling	**Created Date**	7/26/2012
Task Description	Drum Handling, Sampling and Transfer of Drum Contents	**Completed Date**	07/26/2012
Template	True	**Auto Closed**	False

Client / Project

Client	
Project Number	
Project Name	
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Betancourt, Ketzia	8/16/2012	7/26/2012	Betancourt, Ketzia	☐
HASP Reviewer	Hubbard, Lauren	8/9/2012	7/26/2012	McCarthy, John	☑
Quality Reviewer	Hubbard, Lauren	7/27/2012	7/27/2012	McCarthy, John	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Inspect Drums for signs of Bulging, Leaking, Crystals, Temperature, and Odor	1	Exposure to chemicals stored in drum or container.	Read drum labels for information about contents. Review all relevant MSDSs about chemical contents. If labels are not attached, call PM or Local H&S Representative.	None
		2	Contents of the drum can cause fire/explosion hazard.	Use air monitoring meters to screen drums. % LEL and VOCs (PPM). If either of the values are above the action levels described in the HASP or MSDS then Stop Work, move away from the area, and reassess the situation. Call PM and H&S staff for support.	
2	Remove lids or bungs from Drums	1	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools.	Wear appropriate work gloves. When removing ring from drum, fingers can get pinched between ring and drum. Keep fingers clear of this space. Select proper tool for task. If large amount of drums will be encountered, use a speed or drum wrench.	Employee H&S Field book, Section III Subpart II, page 104. Also Section III Subpart L, page 38.
		2	Rapid depressurization from empty or partially full drums can cause flying parts or volatile COCs releasing on staff.	Do not handle or open bulging drums (contact Corp H&S for assistance). Bleed any built up pressure by carefully loosening bung prior to removing ring. Keep face and arms away from bung opening when loosening. Slightly lift lid, insert end of air monitoring device to monitor air inside drum.	
		3	Use of mechanical tools to remove bolts from drum lids causes excessive noise.	Wear hearing protection.	
		4	Splashing can occur if filling drum, or collecting samples.	Wear eye and face protection. Pour liquids into drum slowly to minimize splashing.	
		5	When working with COCs that have fire/explosive properties, sparking or heat could cause fire/explosion.	Use brass or non Spark Hand Tools if such a hazard exists or is suspected.	
3	Sample Contents from Drums	1	Exposure to COCs can occur by contacting impacted contents.	Select proper dermal protection for task, at a minimum nitrile gloves should be worn. Wear appropriate eye face and body protection as outlined in the HASP.	
		2	Staff can be exposed to chemical vapors/fumes when sampling.	Conduct air monitoring as outlined in the HASP, and if required, select appropriate respiratory protection for the task.	
		3	Sharp edges and broken sample containers can cause lacerations.	Discard any broken sample ware or glass properly. Do not over tighten sample containers.	

3	Sample Contents from Drums	4	Chemical burns or skin irritation can occur from contact with sample preservatives.	Wear chemical protective gloves when collecting samples, or when handling damaged sample containers.	
4	Replace drum lids	1	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools.	see step 2 above	
5	Moving and Storing Drums	1	Drum storage areas can be accessed by the general public, or may not be secure.	Calculate how many drums will be stored in new location. Ensure that drums are not easily accessed by the general public. Do not store such that drums impede pedestrian or vehicular traffic.	
		2	Muscle strain can occur when lifting/pulling/pushing drums.	Drums that are full can weigh as much as 800 lbs. Use a lift assist device whenever possible, and use a team lift approach. When moving soil drum generated by drilling, have drillers use their equipment to move the drums. Using dolly, slightly lift drum away from dolly to install forks under drum. Slowly let drum come back down and rest on dolly. Using hook on top of dolly, ensure it latches on top of drum bung.	
		3	Body parts can be pinched between lift device, or drum and the ground.	Be aware of hand and foot placement during drum staging. Do not hurry through task.	
		4	When moving, the drum can tip or the dolly could become unstable from uneven ground surface.	Plan travel route with drum prior to moving. With drum secure on dolly, have one employee pull back on dolly, and other employee slowly push back on drum toward dolly. Have second worker act as spotter for traffic, pedestrians, and any trip hazards along the way.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	chemical protective suit (specify type)		Required
Eye Protection	faceshield		Required
	safety goggles		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)		Required
Hearing Protection	ear plugs		Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	dolly	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Hubbard, Lauren HASP Reviewer Approve 7/26/2012	
Employee: **Role** **Review Type** **Completed Date**	Hubbard, Lauren Quality Reviewer NA 7/27/2012	Reviewed by Corporate H&S Department

Job Safety Analysis

General

JSA ID	19	**Status**	(4) Revise
Job Name	Environment-Geophysical survey	**Created Date**	1/29/2009
Task Description	Geophysical Survey	**Completed Date**	
Template	True	**Auto Closed**	False

Client / Project

Client	
Project Number	
Project Name	
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Hubbard, Lauren	8/20/2019		McCarthy, John	☑
Developer	Jones, Alison	8/20/2019		Abbott, Kathleen	☑
HASP Reviewer	Banach, Katie			Glazewski, Robert	☑
Quality Reviewer	Coppola, Mija	1/30/2009	1/30/2009	Coppola, Mija	☐

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Mobilization of equipment to survey area	1	Lifting hazards (heavy or bulky equipment)	Use TRACK to plan lifts and routes to work location. Use proper lifting techniques.	
		2	Awkward body positions and twisting	Plan activity to avoid twisting of body or awkward body positions. Use buddy system or job rotation to reduce exposure to conditions that cannot be avoided.	
		3	Trip and fall hazards from uneven ground or restricted view when carrying equipment	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or bulky items when carrying.	
		4	Exposure to ticks.	Assess locations for possible tick habitat. When possible, walk over thin, low grasses, dirt or rock paths. Avoid tall grasses, weeds and beds of fallen leaves (likely nest areas). Wear permethrin spray, heavily applied, on clothing (where permitted) and DEET (30% or higher) on exposed skin. Wear light colored clothing to make ticks more visible. Check for ticks on clothing and skin frequently. Tape pant legs to boots if working in potential tick habitat for extended periods. In areas with very high potential for exposure or known infestations, wear disposable coveralls.	
		5	Contact with poison ivy, poison oak or sumac may result in severe skin irritation.	Learn to identify how urushiol-containing plants appear during all seasons. Avoid contact with skin or clothing. Give plants a wide berth as younger plants in the area may be more difficult to recognize and the vines extending from recognized areas also contain urushiol. Consider applying a barrier cream to exposed skin. In areas where the plants are prevalent or in cases where individuals have known allergic responses to urushiol (ie. poison ivy), wear chemically protective disposable coveralls.	
2	Set up survey grid and control	1	Slip trip and fall hazards from wet, uneven ground or over vegetation.	See step one controls.	
		2	Crush hazard or contact stress to hands/fingers from inserting pins or stakes.	Wear leather gloves when inserting pins, flagging, or stakes into the ground. Do not hurry task if hammering.	

2	Set up survey grid and control	3	Struck by hazards by vehicles if working in traffic area.	Establish traffic control and wear a Class II traffic vest if in traffic area. Use vehicles to block work area when practical.	
		4	Repetitive stress from repeated bending or squatting during grid construction	Use job rotation when hazard exists, stretch before performing work activity. Use paint device that allows employee to stand up while spraying.	
		5	Chemical exposure from using spray paint	Stand up wind of paint spraying activities	
3	Performing survey	1	Slips trips and falls on wet, uneven or steep sloped surfaces	See step one controls.	
		2	Scrapes or cuts to hands, arms or legs from equipment or vegetation in area.	Wear leather or other suitable gloves when performing survey, wear long pants, wear heavy long sleeve shirt if arm hazard exists.	
		3	Noise hazards from survey equipment using percussion devices	Wear hearing protection, keep unnecessary workers away from devices when activated.	
		4	Ergonomic injury form improper or prolonged use of carried devices that are long or bulky.	Use job rotation to reduce potential for injury.	
4	Demobilization and clean up	1	Muscle strain from removing pins or stakes	Use devices that maintain neutral body positions to remove pins when practical. Do not bend at waist when removing.	
		2	Pinch hazards to fingers from equipment cases	Identify hazard and avoid, pack equipment properly so that no wires or cables protrude from case requiring fingers to push into case when closing.	
		3	Lifting hazards from demobilizing equipment from work area	See step one controls.	
		4	Slip, trip and falls carrying equipment that obstructs view or on wet or uneven surfaces.	See step one controls.	
5	Preparation and return shipment of equipment	1	Cuts to hands and forearms from cutting strapping tape	Do not hurry during package preparation, Use TRACK, Use the right cutting tool for the task activity, use cutting tools with self retracting blades	
		2	Pinch hazards to fingers from equipment cases and placement of equipment in boxes	See step 4 controls.	
		3	Lifting hazards from completed shipping packages	See step 1 controls	
		4	Fire hazard form improperly packed spare batteries	Cover battery terminals or keep in original packaging when shipping, protect batteries from other metal objects in packages, perform shipping determination for number of spare batteries permitted to be shipped in package or consignment.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	boots	supportive with good tread	Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	first aid kit		Required

Job Safety Analysis

General

JSA ID	45	**Status**	(3) Completed
Job Name	Environment-Groundwater Sampling and free product recovery	**Created Date**	2/4/2009
Task Description	Groundwater sampling	**Completed Date**	02/06/2009
Template	True	**Auto Closed**	False

Client / Project

Client	
Project Number	
Project Name	
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Mason, Greg	6/1/2018	2/4/2009	McDonald, Andrew	☑
HASP Reviewer	Coppola, Mija	2/6/2009	2/6/2009	Coppola, Mija	☐

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	Personnel could be hit by vehicular traffic	Set up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Vehicles parked too close to stationary objects may strike them when driving from location.	Park vehicle so first movement is forward. Park in a location that will be free of stationary objects, such as bollards, monitoring wells, fence posts, etc. when the vehicle pulls forward. Avoid backing! At work locations where space is not restricted, leave a minimum of _____ feet between the work vehicle and the nearest stationary object.	
		3	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess changes.	
2	Open wells to equilibrate and gauge wells	1	When squatting, personnel can be difficult to see by vehicular traffic.	Wear class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	Pinchpoints on well vault can pinch or lacerate fingers	Use correct tools to open well vault/cap. Wear leather gloves when removing well vault lids, and chemical protective gloves while gauging. Wear proper PPE including safety boots, knee pads and safety glasses.	
		3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	
		4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	Purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with absorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	

3	Begin Purging Well and Collecting Parameter Measurements	4	Lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. When possible wear work gloves, leather type.	
		5	Purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses.	
4	Collect GW or Free Product Sample	1	Working with bailer rope can cause rope burns on hands.	Slowly raise and lower the rope or string for the bailer. Wear appropriate gloves for the task.	
		2	Sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves.	
5	Recovery of Free Product from well	1	Exposure to free product	Additional chemical protection may be necessary based on the type of product. Additionally, safety goggles, a faceshield, or respiratory protection may be required. Verify in the HASP.	
6	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JSA for movement of drums.	Drum handling JSA

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Recommended
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Miscellaneous PPE	other	Knee pads	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	alconox, DI water, spray bottle	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)	bottle	Required
	insect repellent		Recommended
	sunscreen		Recommended
Traffic Control	barricades		Recommended
	traffic cones		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Coppola, Mija HASP Reviewer Approve 2/6/2009	

Job Safety Analysis

General

JSA ID	166	**Status**	(3) Completed
Job Name	Environment-Sample cooler handling	**Created Date**	5/1/2009
Task Description	Sample cooler handling	**Completed Date**	05/13/2009
Template	True	**Auto Closed**	False

Client / Project

Client	
Project Number	
Project Name	
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Coppola, Mija	12/19/2011	5/11/2009	Coppola, Mija	☐
HASP Reviewer	Moyers, Samuel	5/25/2009	5/13/2009	Hubbard, Lauren	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	
		4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re-perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	
3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	

3	Pack Samples	2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA HazMat shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	
		2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	Scissors	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Moyers, Samuel HASP Reviewer Revise 5/11/2009	Kevlar is required? Leather work gloves are listed. i suggest just leather gloves.
Employee: **Role** **Review Type** **Completed Date**	Moyers, Samuel HASP Reviewer Approve 5/13/2009	

Attachment B

HASP Forms

Task Improvement Process

General

Observed Company:

Observation Type:

TIP Form: H&S Field Multi-Task (General)

Task Observed:

Observee Name:

Observer Name:

Observation Date:

Project Number: 30147184

Project Name: Horseheads - Grand Central Plaza Site Characterization

Supervisor:

Equipment On Site:

Pertinent Information:

Observation

Task	Correct	Questionable	Comments
General			
PPE worn according to HASP/JLA specifications and inspected before use?			
STOP work authority used where appropriate?			
Body Use/Positioning			
Proper lifting/pushing/pulling techniques used (no awkward positions/posture; no twisting or excessive reaching; no straining; no excessive weight; load under control/stable; etc.)?			
Body parts away from pinch points (clear or protected from being caught between objects/equipment or from contacting sharp objects/edges, etc.)?			
Body parts not in the Line of Fire (protected from being struck by traffic, equipment, falling/flying objects, etc.)?			
Work Procedures/Environment			
Correct type and number of barricades/warning devices/cones?			
Communication with others when necessary (hand signals, flags, etc.)?			
Right tools and equipment selected for the job and inspected before use?			
Tools and equipment used properly?			
Housekeeping performed (work areas and pathways clear of hazards, uneven surfaces addressed, etc.)?			

Observation

Task	Correct	Questionable	Comments
Work Procedures/Environment (cont.)			
Slip/trip/fall hazards addressed (path selected and cleared, eyes on path, speed footing, etc.)?			
Proper energy control (electrical systems grounded, lock out/tag out performed, isolated, cords/fixtures in good condition, GFCI inspected and utilized when appropriate and used properly, etc.)?			
Protected from overhead/underground utilities (proper clearance, properly marked, spotters as necessary, etc.)?			
Safe work on/near water (appropriate flotation device, appropriate boat for body of water and operation of boat, etc.)?			
Chemical/Radiation protection (decontamination zones set up properly, air monitoring, completed, and logged, etc.)?			
Fall from elevated height prevention (maintains 3-points of contact, appropriate ladder, mounting/dismounting vehicle/equipment, fall arrest system, etc.)?			
Any additional safety issues identified:			

Tip Summary

Enter details of the TIP and follow up discussion provide details on how any questionable items were resolved.

Discussion following the TIP led by: _____

Date of follow-up discussion: _____

Positive Comments:

Discussion Summary Completed:

- ☐ Supervisor Led
- ☐ Peer to Peer
- ☐ Arcadis Employee to Subcontractor

Summary of Questionable Items

Action Items (Optional)

Assign appropriate action items based on the observations made. You can add more than one action item if needed.

Item #	Action Item	Responsible Person	Due Date	Comp. Date
1				
2				
3				

Standard Review

Reviews to be performed after entry of this TIP into 4-Sight.

Quality Review

Quality Reviews to be performed after entry of this TIP into 4-Sight.

Field Validation and Verification

Use the 4-Sight generated copy of this TIP to perform field V&V activities.

Air Monitoring Documentation Form

PID Model: _____ Monitor Frequency: _____

LEL/O_2 Model: _____

CIT Model: _____

Dust Mon. Model: _____

Air Monitoring Results

Date	Time	PID (units)	O_2 (%)	LEL (% LEL)	CIT (ppm)	Dusts (mg/m^3)	Location

CIT = Colorimetric Indicator Tube
LEL = Lower Explosive Limit
mg/m3 = Milligram per cubic meter
O2 = Oxygen
ppm = Part per million
% = Percent
PID = Photoionization Detector

LEL/O_2 Calibration Log

ARCADIS

Calibration Gas Source: _____ Instrument Type: _____
Lot Number/Expiration Date: _____ Serial Number: _____
Concentration: _____ Instrument Type: _____ PAGE ____ of ____
Other: _____ Serial Number: _____
Other: _____

Instrument Number	Date	Time		Alarms OK? (Y/N)	Oxygen Reading	Zero Cal. OK? (Y/N)	Span Reading	Calibration OK? (Y/N)	User Initials

PID Calibration Log

ARCADIS

Zero Gas Source: _____ Instrument Type: _____ PAGE ____ of ____

Lot Number/Expiration Date: _____ Serial Number: _____

Calibration Gas Source: _____ Instrument Type: _____

Lot Number/Expiration Date: _____ Serial Number: _____

Concentration: _____ _____

Instrument Number	Date	Time	Zero Cal. OK (Y/N)	Calibration Gas Reading	Comments	Calibration w/in 2% (Y/N)?	Alarms Set (Yes/No)?	User Initials

THIS FORM MUST BE ENTIRELY COMPLETED PRIOR TO BEGINNING ANY INTRUSIVE WORK

Project Name: Horseheads - Grand Central Plaza Site Characterization Start Date:

Project #: 30147184 End Date:

Utility markings valid for 15 days. Initiate clearance renewal 5 days prior to expiration for ongoing work

PRE-FIELD WORK REQUIREMENTS

DigSafe 811 notified 48-72 hrs. in advance of work? ☐ DigSafe Ticket #:

Ticket Expiration Date: State Utility Laws: www.commongroundalliance.com/map

Ticket(s) Attached(Y/N)? ☐ List utility owners notified via DigSafe 811 & response status:

List addt'l. utilities requiring notification not included in DigSafe811 Notice:

Review task details w/ private utility location subcontractor. ID work areas, clearance equipment needed, depth of clearance needed, types of features, utilities, anticipated/known/unknown. Verify DigSafe 811 markings to confirm public utility clearance.

Private Utility Locator Name, if used: AUS onsite meeting (Y/N)? ☐

FIELD WORK REQUIREMENTS

This portion of the checklist must be completed on site. AUS staff must have a minimum of one year of field experience in identifying utilities to complete the checklist. Field staff will review the completed checklist with PM or designee prior to beginning intrusive work.

Heavy equipment/mechanized intrusive work w/in the Arcadis Tolerance Zone (utility or structure present within 30-in. of point of work) REQUIRES pre-approval by Corporate H&S prior to working at all such locations. STOP WORK if the Arcadis Tolerance Zone work has not been approved.

List work type & locations for utility location and clearance as applicable to this checklist:

3 Reliable Lines of Evidence are REQUIRED for EACH INTRUSIVE LOCATION prior to starting any subsurface intrusive work. Check corresponding boxes below to document utility clearance efforts.

☐ OneCall/DigSafe 811 Public Utility Locate (required by State law for subsurface work)

811 is only reliable as a Line of Evidence when working in/adjacent to a public ROW or easement.

Marking type: ☐ Paint ☐ Pin Flags/Stakes ☐ Other: ☐ None

☐ Client provided maps/drawings (Y/N)? ☐ Maps/drawings not provided (Y/N)?

☐ Client Clearance (Y/N)? Name(s)/Affiliation(s):

☐ Interviews (Y/N)? Name(s)/Affiliation(s):

☐ Specific subsurface feature types and depths provided by person interviewed (Y/N)?

Details provided:

☐ Site Inspected (Y/N)? (document on Pg. 2.) Photo Document Marked Utilities & Structures

☐ Public records/Client Dwgs/As-Builts (Y/N)? Type:

List private locator tools used: ☐ Radio Freq. Detection ☐ Electromagnetic ☐ GPR

☐ Metal Detector ☐ Acoustic Pipe Locator ☐ Downhole sonde Other:

☐ Soft Dig Methods used (Y/N)? ☐ Hand auger ☐ Probing ☐ Hand tools (shovel/rake)

☐ Air knife ☐ Hydro Knife ☐ Potholing/Vacuum extraction

☐ Other soft dig tools used (Y/N)? If Yes, list here:

ALL BOXES BELOW MUST BE COMPLETED BEFORE PROCEEDING

Site inspection also requires investigating vicinity outside of the work area for structures and utilities.
Noting "YES" requires addt'l. investigation. Utilities must be field marked prior to intrusive work.

Is the utility present (Y/N)?		Utility Color Code
	Utilities entering/exiting structures?	No Color
	Intrusive work area marked out?	White
	Structural features above or below?	White
	Public natural gas line or meter?	Yellow
	Private natural gas laterals/feeders?	Yellow
	Public electrical service?	Red
	Conduit from meter or on wall?	Red
	Conduit from poles into ground?	Red
	Poles/devices w/ no visible lines?	Red
	Overhead electrical lines?	Red
	Solar arrays or wind turbines?	Red
	Public water line(s)?	Blue
	Private water line(s) or lateral(s)?	Blue
	Water meter onsite?	Blue
	Fire hydrants/post indicator valves?	Blue
	Irrigation system control box/valve?	Blue
	Sprinkler heads, drip lines, vaults?	Blue
	Water dispensers, fill stations?	Blue
	Telecomm. overhead or buried?	Orange
	Telecomm. ground box or relays?	Orange
	Telecomm./security CCTV devices?	Orange
	Public sanitary sewer pipes?	Green
	Combined sanitary/storm pipes?	Green
	Private sanitary laterals/clean outs?	Green
	Restrooms, kitchens, wash bays?	Green

Is the utility present (Y/N)?		Utility Color Code
	Evidence of stormwater network?	Green
	Curb drains/catch basins/manholes?	Green
	Stormwater culverts, outfalls?	Green

ABOVEGROUND Features Present?

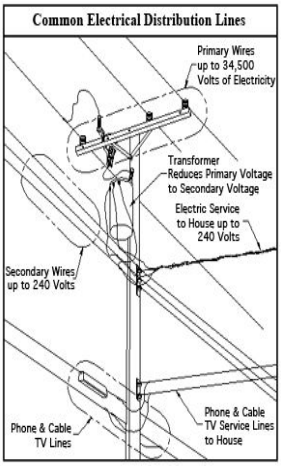
	Transportation tunnels/structures/markers present?	
	Overhead electrical lines?	Red
	< 50 kV w/in 10 ft of work area?	Red
	>50-200 kV w/in 15 ft of work area?	Red
	>200-350 kV w/in 20 ft of work area?	Red
	>350-500 kV w/in 25 ft of work area?	Red
	>500-750 kV w/in 35 ft of work area?	Red
	>750-1000 kV w/in 45 ft of work area?	Red
	Aboveground fire suppression?	Blue
	Aboveground communications?	Orange
	Aboveground chases/racks/trays?	Orange
	Private/Remediation system lines?	Various
	Unclassed utilities/anomalies?	Pink
	Warning signs/stakes/markers present?	
	Heavy Equipment: Mark travel route for overhead, next to route, and/or under route (e.g. crush risk) utilities.	

Signs of other utilities/ground disturbance

	Signs of asphalt or concrete disturbance/repair?
	Any ground subsidence or change in vegetation?
	Unknown manholes or valve covers in work area?

Tips for Thorough Utility Location (HSS Section 5.6):

1. Don't forget to look up for utilities
2. Be on-site with Private Utility Locators.
3. Ask Private Locators to "confirm" other's markings.
4. Also clear alternate/backup locations
5. Mark all known utilities.
6. No hammering, no pickaxes, no digging bars, no shortcutting.
7. No excessive turning or downward force of hand tools, especially hand augers.
8. Utilities may run in or directly under asphalt/concrete
9. Heavy equipment may damage shallow utilities. Especially during clearing and grubbing.
10. Use spotter for heavy equipment near aboveground utilities?



_____ Utilities & Structures Checklist reviewed by the PM or Designee (Y/N)? *If no, STOP WORK call PM*

PM or Designee Name: _____

Name and Signature of person completing the checklist _____

Date of checklist review / update: _____

ALL SUSPECT UTILITY STRIKES REQUIRE CORPORATE H&S NOTIFICATION WITHIN 24 hrs. OF KNOWLEDGE OF STRIKE WITH A CONFIRMED RESPONSE FROM CORPORATE H&S.

Arcadis Weekly Vehicle Inspection Form (Revised 9/28/2022)

ARCADIS

Vehicle # / License Plate # | **Lease Plan # / Last 6 of Vin #**

	Inspection Date												
	Odometer reading												
	Driver / Inspector Name												
	Check the appropriate box and enter repair date for identified repairs:	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date	OK	Needs Repair	Repair Date
Interior	Horn operational												
	Door Locks operational												
	Seat Belts in good repair												
	Seats and Seating Controls												
	Steering Wheel - No Excessive Play												
	Interior Lights and Light Controls												
	Instrument Panel/Gauges												
	Wiper Controls operational												
	Heat/Defrost/Air Conditioning working												
	Rear View Mirror present												
	Backup Camera/Sensors working												
	Jack and Lug Wrench present												
Exterior[1]	Lights and Signals operational												
	Tires properly inflated/good tread depth												
	Spare Tire properly inflated												
	Doors operational												
	Windows Not Cracked/Damaged												
	Side View Mirrors												
	Body Panels and Bumpers												
Engine & Brakes	Engine Start & Running Smoothly												
	Fluid Levels, No Noticeable Leaks												
	Belts tight, no cracks												
	Brakes operational, no squeaking												
Emergency Equipment[2]	First Aid Kit, inspected weekly												
	Fire Extinguisher properly secured												
	Fire Extinguisher inspected weekly												
	Orange/Yellow emergency warning light												
	Roadside Assistance Information												
	Recommend spotter cones available												
Cargo	Cargo Secure and Properly Distributed												
	Securing Devices in Good Condition												
Registration	License Plate /Tags												
	Registration and Insurance												
	City/State Inspection Decal												
	Lease Plan information/Fuel Card												

[1] **Note all damages to the vehicle on the back of this page**

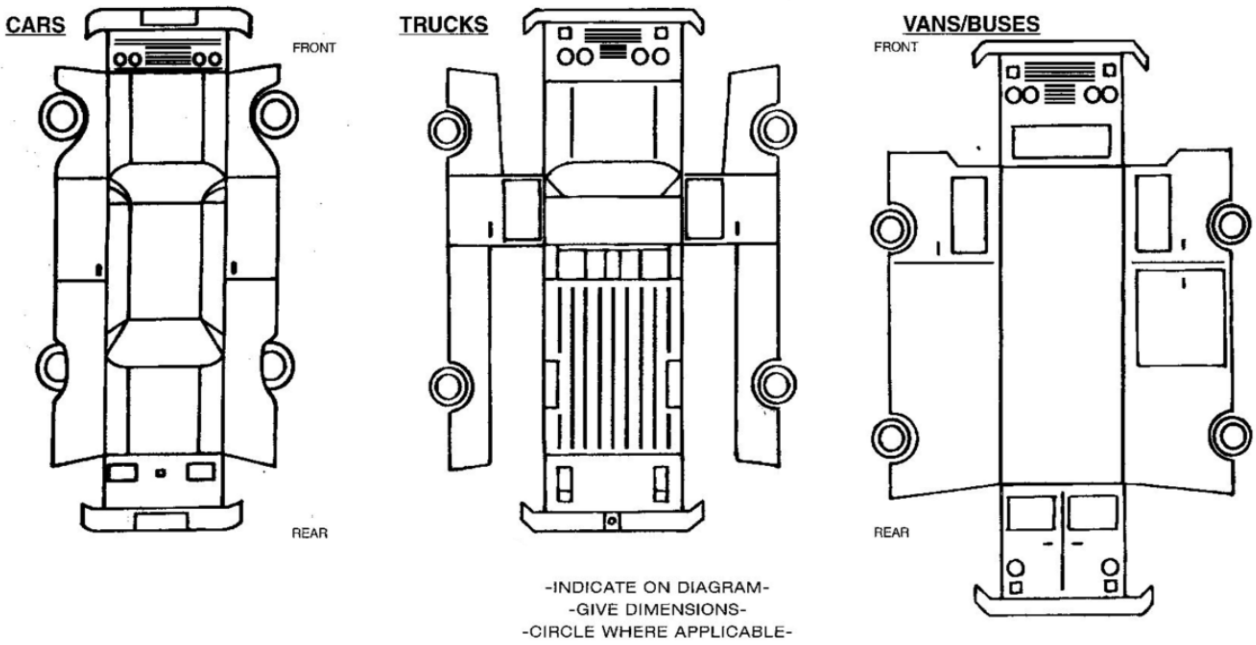
[2] **Emergency Equipment required per Motor Vehicle Standard ARC HSGE024**

Note All Vehicle Damage Below

All Vehicle Damage must be reported to ANA_insuranceinquiries@arcadis.com, Zach Mongan (EF H&S), and Susan Atwood (EF Fleet Manger)

CODES:

B-BENT
BR-BROKEN
BU-BULGE
C-CHAFED
CH-CHIPPED
CPM-COVERED WITH PROTECTIVE MATERIAL-UNABLE TO DETERMINE DEFECTS IF ANY
CSA-CHAFED AND SCRATCHED ALL OVER
CR-CRACKED
D-DENTED
DMC-DUST AND MUD COVERED UNABLE TO DETERMINE OTHER DEFECTS IF ANY
G-GOUGED OR CUT
GC-GLASS CRACKED
HS-HAIRLINE SCRATCH
M-MISSING
P-PUNCTURED
R-RUSTY
S-SCRATCHED
SC-SCRAPED
SM-SMASHED
ST-STAINED AND/OR SOILED
T-TORN



Notes:

Tread guide: If a tread gauge is not available coins may be used to determine remaining tread. 2/32” is the minimum by law in most states (top of Lincoln’s head on penny), 4/32” is minimum recommended for wet surfaces (top of Washington’s head on quarter), 6/32” is minimum recommended for snowy surfaces (top of Lincoln Memorial on penny).Vehicle tires should be replaced if the tread depth is less than 6/32”.



2/32” remaining 4/32” remaining 6/32” remaining

Reference JSA 10907 For Weekly Vehicle Inspection

April 16, 2025

To whom it may concern:

Arcadis and its affiliates (“Arcadis”) is a firm with experienced professionals and staff who support projects, activities, infrastructure and businesses essential to maintaining the public's health, safety and welfare.

Arcadis has been authorized by C. Gershon Company, Inc. to complete the following activities:

Arcadis personnel will be identifiable by:

- ☐ Branded hard hat and/or safety vest
- ☐ Branded vehicle
- ☐ Business card or ID badge
- ☐ Other: _____

If you have any questions related to the work being completed or Arcadis’ presence at this location, please contact the following:

Lawrence Brunt	Arcadis Project Manager	at	908-685-7878
Andrew Korik	C. Gershon Company, Inc.	at	315-671-9323

Attachment C

Traffic Safety Plan

Traffic Safety Plan (TSP)

1.0 General

Plan type	Non-Right of Way (Non-ROW)
Project Name:	Horseheads - Grand Central Plaza Site Characterization
Project Number:	30147184
Developer Name:	Nathan Smith
Duration of Project (in hours or days):	7 days
Time Restrictions (Y/N, if Y describe below):	None
Not Applicable	
Not Applicable	
Not Applicable	NA
Not Applicable	
Not Applicable	NA

☐ Working on multiple roads?

Comments:

2.0 Work Description

Provide a brief description of scope of work:

Advancing soil borings in concrete and/or asphalt parking area.

3.0 Type and Duration

Work locations on this project will be: Intermediate work (1-8 hours per location)

Non-ROW work will be performed in: Active parking lot

Special traffic conditions may include (select most prevalent): Not applicable

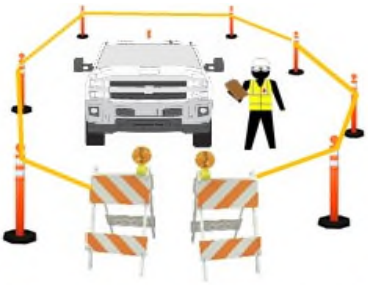
4.0 Traffic Control Layout, Number of Devices Required, and Phasing

The following Non-ROW requirements in the Traffic Safety Handbook applies:

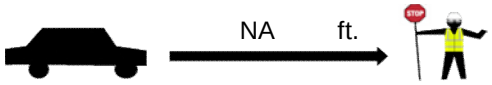
The menu below will be blank and is not applicable.

The menu below will be blank and is not applicable.

Non-ROW configuration:
An example non-ROW traffic control configuration for this project is illustrated below. The actual type and number of devices required are specified below. Don't leave vehicle doors open. Don't establish controls within 25 ft of the front or rear of parked large vehicles/rolling equipment without coordinating with the vehicle/equipment operator.



Intermediate Term (1-8 Hours)
Channelizing Cones, Caution Tape and
Type II Barricades

ROW minimum sign spacing distances for "A", "B" and "C" (as applicable) in referenced DOT Facts.	ROW oncoming traffic minimum site distance required to see Flagger and properly decelerate and stop.
A NA ft. B NA ft. C NA ft.	 NA ft.

ROW Cone Calculation (Values are default. Light grey fields may be modified based on actual road conditions)

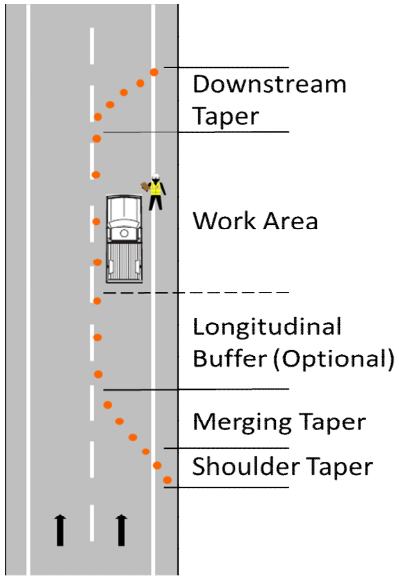
	Active work area length (feet)	
☐	Apply Optional Longitudinal Buffer (ft)?	
	Lane width of offset (feet)	
	Shoulder width of offset (feet)	
	Posted speed limit	NA

☐ **Shoulder Taper**

Taper Length (feet)	NA
Cones Required	NA
Cones Spacing (max., ft)	NA

☐ **Merging Taper**

Taper Length (feet)	NA
Cones Required	NA
Cones Spacing (max., ft)	NA



☐ **Work Area**

Cone Spacing (max., ft)	NA
Cones Required	NA

☐ **Downstream Taper**

Taper Length (feet)	NA
Cones Required	NA
Cone Spacing (max., ft)	NA

Note: Review taper configuration and cone spacing after ROW implementation to ensure traffic is moving efficiently without motorist confusion in the RWZ.

Cones Required (minimum) NA

Select the traffic control devices to be used and enter number each required:

Check all that apply:		*Wording or Pictogram*	*Number:*
☐	Warning signs		
☐	Warning signs		
☐	Warning signs		
☐	Stop/Slow paddle		
☐	Red flag		
☐	Drums		
X	Channelizer cone (42 inch height, 10 lb base)		7
☐	Channelizer cone (42 inch height, 30 lb base)		
☐	Traffic cones (≥ 18 inches tall)		NA
☐	Barricade:		
X	Flags for cones		7
☐	Lights (for night work)		
☐	Plastic fencing (rolls)		
X	Caution tape (rolls)		1
☐	Other (specify):		

Non-ROW Phasing:

1) Position truck as shield, if practical

2) Deploy traffic control devices

3) Affix flags, caution tape or fencing

4) Unload project equipment

5) Commence work

6) SSO to maintain controls

7) Remove controls in reverse order

Electronic Device Use Safety

Electronic devices (tablets, laptops and cell phones) used for data collection or work documentation are not anticipated to be used on this project. If these devices are used for data collection or work documentation, their use and distraction hazards must be addressed in the safety briefing.

Reviewed By:

HASP Reviewer: _____

_____

Attachment D

Safety Data Sheets

SAFETY DATA SHEET

Nonflammable Anesthetic Calibration Gas Mixture: Carbon Dioxide / Nitrogen / Oxygen / Sevoflurane

Section 1. Identification

GHS product identifier : Nonflammable Anesthetic Calibration Gas Mixture: Carbon Dioxide / Nitrogen / Oxygen / Sevoflurane

Other means of identification : Not available.

Product use : Synthetic/Analytical chemistry.

SDS # : 005212

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Emergency telephone number (with hours of operation) : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :



Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.
May increase respiration and heart rate.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Use and store only outdoors or in a well ventilated place.

Response : Not applicable.

Storage : Protect from sunlight. Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Powered by IHS

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

CAS number : Not applicable.

Product code : 005212

Ingredient name	%	CAS number
Nitrogen	46.5 - 96	7727-37-9
oxygen	1 - 23.5	7782-44-7
Carbon Dioxide	2 - 20	124-38-9
sevoflurane	1 - 10	28523-86-6

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Powered by IHS

Section 4. First aid measures

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides
halogenated compounds
carbonyl halides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk.

Powered by IHS

Section 6. Accidental release measures

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Powered by IHS

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas.

Color : Not available.

Melting/freezing point : -210.01°C (-346°F) This is based on data for the following ingredient: nitrogen. Weighted average: -211.66°C (-349°F)

Critical temperature : Lowest known value: -146.95°C (-232.5°F) (nitrogen).

Odor : Not available.

Odor threshold : Not available.

pH : Not available.

Flash point : Not available.

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Not available.

Vapor pressure : Not available.

Vapor density : Highest known value: 1.5 (Air = 1) (Carbon dioxide). Weighted average: 1.07 (Air = 1)

Gas Density (lb/ft ^{3}) : Weighted average: 0.08

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : Not available.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

SADT : Not available.

Viscosity : Not applicable.

Powered by IHS

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatibility with various substances : Not considered to be reactive according to our database.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Powered by IHS

Section 11. Toxicological information

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Powered by IHS

Section 12. Ecological information

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	-	**Explosive Limit and Limited Quantity Index** 0.125 **Passenger Carrying Road or Rail Index** 75	-	-	-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Powered by IHS

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): Not determined.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Sudden release of pressure

Composition/information on ingredients

No products were found.

State regulations

Massachusetts : The following components are listed: NITROGEN; OXYGEN (LIQUID); CARBON DIOXIDE

New York : None of the components are listed.

New Jersey : The following components are listed: NITROGEN; OXYGEN; CARBON DIOXIDE; CARBONIC ACID GAS

Pennsylvania : The following components are listed: NITROGEN; OXYGEN; CARBON DIOXIDE

Canada inventory : Not determined.

International regulations

International lists : **Australia inventory (AICS)**: Not determined.
China inventory (IECSC): Not determined.
Japan inventory: Not determined.
Korea inventory: Not determined.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): Not determined.
Philippines inventory (PICCS): Not determined.
Taiwan inventory (CSNN): Not determined.

Chemical Weapons Convention List Schedule I Chemicals : Not listed

Chemical Weapons Convention List Schedule II Chemicals : Not listed

Powered by IHS

Section 15. Regulatory information

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

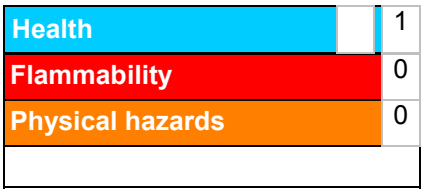
WHMIS (Canada) : Class A: Compressed gas.

CEPA Toxic substances: The following components are listed: Carbon dioxide
Canadian ARET: None of the components are listed.
Canadian NPRI: None of the components are listed.
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 1/21/2015.

Date of issue/Date of revision : 1/21/2015.

Date of previous issue : No previous validation.

Version : 0.01

Powered by IHS

Section 16. Other information

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United NationsACGIH – American Conference of Governmental Industrial Hygienists
AIHA – American Industrial Hygiene Association
CAS – Chemical Abstract Services
CEPA – Canadian Environmental Protection Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CFR – United States Code of Federal Regulations
CPR – Controlled Products Regulations
DSL – Domestic Substances List
GWP – Global Warming Potential
IARC – International Agency for Research on Cancer
ICAO – International Civil Aviation Organisation
Inh – Inhalation
LC – Lethal concentration
LD – Lethal dosage
NDSL – Non-Domestic Substances List
NIOSH – National Institute for Occupational Safety and Health
TDG – Canadian Transportation of Dangerous Goods Act and Regulations
TLV – Threshold Limit Value
TSCA – Toxic Substances Control Act
WEEL – Workplace Environmental Exposure Level
WHMIS – Canadian Workplace Hazardous Material Information System

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Powered by IHS

SAFETY DATA SHEET

Version 6.4
Revision Date 04/20/2020
Print Date 08/29/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Hydrochloric acid

Product Number : 320331
Brand : SIGALD
Index-No. : 017-002-01-X
CAS-No. : 7647-01-0

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Corrosive to metals (Category 1), H290
Skin corrosion (Category 1B), H314
Serious eye damage (Category 1), H318
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word Danger

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Hazard statement(s)

H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H335	May cause respiratory irritation.

Precautionary statement(s)

P234	Keep only in original container.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/doctor.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P406	Store in corrosive resistant container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Formula : HCl
Molecular weight : 36.46 g/mol

Component		Classification	Concentration
Hydrochloric Acid			
CAS-No. EC-No. Index-No. Registration number	7647-01-0 231-595-7 017-002-01-X 01-2119484862-27-XXXX	Met. Corr. 1; Skin Corr. 1B; Eye Dam. 1; STOT SE 3; H290, H314, H318, H335 Concentration limits: >= 0.1 %: Met. Corr. 1, H290; >= 10 %: Skin Corr. 1B, H314; 10 - < 25 %: Eye Irrit. 2, H319; >= 10 %: STOT SE 3, H335;	>= 30 - < 50 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.Continue rinsing eyes during transport to hospital.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Hydrogen chloride gas

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Storage class (TRGS 510): 8A: Combustible, corrosive hazardous materials

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Hydrochloric Acid	7647-01-0	C	2 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Not classifiable as a human carcinogen		
		C	5 ppm 7 mg/m3	USA. NIOSH Recommended Exposure Limits
		Often used in an aqueous solution.		
		C	5 ppm 7 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate. Ceiling limit is to be determined from breathing-zone air samples.		

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

		PEL	0.3 ppm 0.45 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		C	2 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.4 mm
Break through time: 480 min
Material tested:Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 69 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: light yellow
b)	Odour	pungent
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	-30 °C (-22 °F)
f)	Initial boiling point and boiling range	> 100 °C > 212 °F
g)	Flash point	()Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	226.636 hPa at 21.1 °C (70.0 °F) 546.596 hPa at 37.7 °C(99.9 °F)
l)	Vapour density	No data available
m)	Relative density	1.18 g/mL at 25 °C (77 °F)
n)	Water solubility	soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Bases, Amines, Alkali metals, Metals, permanganates, for example potassium permanganate, Fluorine, metal acetylides, hexalithium disilicide

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
No data available
Inhalation: Cough Difficulty in breathing (Hydrochloric Acid)
LCLo Inhalation - Human - 30 min - 1,970 mg/m3 (Hydrochloric Acid)
Remarks: (RTECS)
Inhalation: absorption (Hydrochloric Acid)
Inhalation: Corrosive to respiratory system. (Hydrochloric Acid)
Dermal: No data available
No data available

Skin corrosion/irritation
Skin - reconstructed human epidermis (RhE) (Hydrochloric Acid)
Result: Corrosive
(OECD Test Guideline 431)

Serious eye damage/eye irritation
Eyes - Bovine cornea (Hydrochloric Acid)
Result: Corrosive
(OECD Test Guideline 437)

Respiratory or skin sensitisation
Maximisation Test - Guinea pig (Hydrochloric Acid)
Result: negative
(OECD Test Guideline 406)

Germ cell mutagenicity
Chromosome aberration test in vitro (Hydrochloric Acid)

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Chinese hamster ovary cells
Result: Conflicting results have been seen in different studies.

Carcinogenicity
Carcinogenicity - Did not show carcinogenic effects in animal experiments. (IUCLID)
(Hydrochloric Acid)

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
May cause respiratory irritation. (Hydrochloric Acid)
The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation. (Hydrochloric Acid)
Acute inhalation toxicity - mucosal irritations, Cough, Shortness of breath, Inhalation may lead to the formation of oedemas in the respiratory tract., Possible damages:, damage of respiratory tract, tissue damage (Hydrochloric Acid)

Specific target organ toxicity - repeated exposure
The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Aspiration hazard
No aspiration toxicity classification (Hydrochloric Acid)

Additional Information
RTECS: MW4025000

Inhalation of vapors may cause:, burning sensation, Cough, wheezing, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema (Hydrochloric Acid)
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated. (Hydrochloric Acid)

After uptake of large quantities: (Hydrochloric Acid)
Cyanosis, Circulatory collapse, respiratory arrest (Hydrochloric Acid)
Systemic effects: (Hydrochloric Acid)
rise in blood pressure, bradycardia (Hydrochloric Acid)
This substance should be handled with particular care. (Hydrochloric Acid)

SECTION 12: Ecological information

12.1 Toxicity
No data available

Toxicity to fish	LC50 - Gambusia affinis (Mosquito fish) - 282 mg/l - 96 h (Hydrochloric Acid) Remarks: (IUCLID)

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

12.2 Persistence and degradability
The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available (Hydrochloric Acid)

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
May be harmful to aquatic organisms due to the shift of the pH. Do not empty into drains.
Harmful effect due to pH shift.
Discharge into the environment must be avoided.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

DOT (US)
UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid
Reportable Quantity (RQ):
Poison Inhalation Hazard: No

IMDG
UN number: 1789 Class: 8 Packing group: II EMS-No: F-A, S-B
Proper shipping name: HYDROCHLORIC ACID

IATA
UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid

SECTION 15: Regulatory information

SARA 302 Components
This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

Hydrochloric Acid	7647-01-0	2013-02-08

SARA 311/312 Hazards
No SARA Hazards

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Hydrochloric Acid	7647-01-0	2013-02-08

No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
water	7732-18-5	
Hydrochloric Acid	7647-01-0	2013-02-08

New Jersey Right To Know Components

	CAS-No.	Revision Date
water	7732-18-5	
Hydrochloric Acid	7647-01-0	2013-02-08

SECTION 16: Other information

Further information

Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.4 Revision Date: 04/20/2020 Print Date: 08/29/2020

The life science business of Merck KGaA, Darmstadt, Germany
operates as MilliporeSigma in the US and Canada

SAFETY DATA SHEET

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

SDS # : 001031

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

Product code : 001031

CAS number/other identifiers

CAS number : 115-11-7

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Isobutylene	**ACGIH TLV (United States, 3/2017).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]

Color : Colorless.

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Melting point : -140.7°C (-221.3°F)

Boiling point : -6.9°C (19.6°F)

Critical temperature : 144.75°C (292.6°F)

Flash point : Closed cup: -76.1°C (-105°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.8%
Upper: 9.6%

Vapor pressure : 24.3 (psig)

Vapor density : 1.94 (Air = 1)

Specific Volume (ft ^{3}/lb) : 6.6845

Gas Density (lb/ft ^{3}) : 0.1496 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.26 g/l

Partition coefficient: n-octanol/water : 2.34

Auto-ignition temperature : 465°C (869°F)

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 56.12 g/mole

Aerosol product

Heat of combustion : -45029034 J/kg

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Section 11. Toxicological information

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Isobutylene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Section 12. Ecological information

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Limited quantity** Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 19, T50

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 3000
Passenger Carrying Ship Index Forbidden
Passenger Carrying Road or Rail Index Forbidden
Special provisions 29

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Air Act (CAA) 112 regulated flammable substances: Isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): Not determined.

Malaysia : Not determined.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Section 15. Regulatory information

Taiwan : This material is listed or exempted.

Thailand : Not determined.

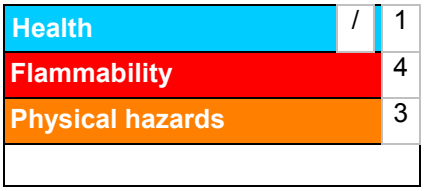
Turkey : Not determined.

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Liquefied gas	Expert judgment Expert judgment

History

Date of printing : 5/10/2018

Date of issue/Date of revision : 5/10/2018

Date of previous issue : 7/11/2016

Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973

Section 16. Other information

as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

HI 7021
ORP Solution for Platinum and Gold Electrodes

Safety Data Sheet

According to Regulation (EC) No. 1907/2006
OSHA Regulation 29 CFR 1910.1200
Canadian Regulation SOR/88-66

Revision Date: 2013-06-14
Reason for Revision: Regulation (EC) No. 1272/2008 Compliance

SECTION 1: IDENTIFICATION OF THE PRODUCT AND COMPANY

Product Name: HI 7021 ORP Solution

Application: ORP Solution for Platinum and Gold Electrodes.
240 mV @ 25°C/77°F

Additional Product Codes: HI 7021L
HI 7021M
HI 7021/G

Company Information (USA):
Hanna Instruments, Inc.
584 Park East Dr, Woonsocket, Rhode Island, USA 02895

Technical Service Contact Information:
1-800-426-6287 (8:30AM - 5:00PM ET)
+1-401-766-4260 (8:30AM - 5:00PM ET)

USA Emergency Contact Information: 1-800-424-9300 (Chemtrec 24Hr. Emergency)

International Emergency Contact Information: +1-703-527-3887 (Chemtrec 24Hr. Emergency)

E-mail Address: tech@hannainst.com

SECTION 2: HAZARD IDENTIFICATION

Non-hazardous product as specified in Directives 67/548/EEC and 1999/45/EC.
Non-hazardous product as specified in OSHA Regulation 29 CFR 1910.1200.
Non-hazardous product as specified in Canadian Regulation SOR/88-66.
Non-hazardous product as specified in Regulation (EC) 1272/2008.

SECTION 3: COMPOSITION AND COMPONENT INFORMATION

Aqueous Solution

SECTION 4: FIRST AID MEASURES

After Inhalation: Remove to fresh air.

After Skin Contact: Wash affected area with plenty of water.

After Eye Contact: Rinse out with water.

After Swallowing: Wash out mouth thoroughly with water and give plenty of water to drink. In severe cases obtain medical attention.

General Information: Remove contaminated, soaked clothing immediately and dispose of safely.

SECTION 5: FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:
Water spray, Carbon Dioxide, Dry Chemical Powder, Appropriate Foam.

Special Risks:
Non-combustible.

Special Protective Equipment:
Do not stay in dangerous zone without suitable chemical protection clothing and self-contained breathing apparatus.

Additional Information:
NA

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:

Avoid formation of dusts. Do not inhale dusts. Avoid substance contact.

Environmental Precautions:

Do not discharge into the drains/surface waters/groundwater.

Additional Notes:

Take up with liquid-absorbent material. Clean up affected area and dispose according to local regulation. Avoid generation of dusts.

SECTION 7: HANDLING AND STORAGE

Handling:

Cannot be stored indefinitely.

Storage:

Tightly closed. Store at room temperature (+15 to +25 °C recommended). Protect from light.

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Engineering:

Maintain general industrial hygiene practice.

Personal Protective Equipment:

Protective clothing should be selected specifically for the working place, depending on concentration and quantity of the hazardous substances handled.

Respiratory Protection:	***Protective Gloves:***	***Eye Protection:***
Required when vapors/aerosols are generated. Work under hood.	Rubber or plastic	Goggles or face mask

Industrial Hygiene:

Change contaminated clothing. Wash hands after working with substance.

SECTION 9: PHYSICAL/CHEMICAL PROPERTIES

Appearance:	Yellow liquid	***Odor:***	Odorless	***Density at 20°C:***	~ 1 g/cm³
Melting Point:	NA	***Boiling Point:***	ND	***Solubility:***	Soluble
pH at 20°C:	~ 7	***Explosion Limit:***	NA	***Flash Point:***	NA
Thermal Decomp.:	NA				

SECTION 10: STABILITY AND REACTIVITY

Conditions to be Avoided:

Strong Heating

Hazardous Decomposition Products:

None

Hazardous Polymerization:

Will not occur.

Substances to be Avoided:

The generally known reaction partners of water

Further Information:

Not available

SECTION 11: TOXICOLOGICAL INFORMATION

Product Toxicity

No toxic effects are to be expected when the product is handled appropriately.

Component Toxicity

Acute Toxicity:

Not Available

Chronic Toxicity:

Not Available

Additional Data:

Not Available

SECTION 12: ECOLOGICAL INFORMATION

No environmental hazard.

Further Data: Can be safely disposed off as ordinary refuse.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal:

SECTION 14: TRANSPORTATION INFORMATION

Land:	***Sea:***	***Air:***
Not subject to transport regulations	Not subject to transport regulations	Not subject to transport regulations

SECTION 15: REGULATORY INFORMATION

Complies with European Regulations (EC) No. 1907/2006 and No. 1272/2008.
Complies with European Council Directives 67/548/EEC and 1999/45/EC.
Complies with OSHA Regulation 29 CFR 1910.1200.
Complies with Canadian Regulation SOR/88-66

SECTION 16: OTHER INFORMATION

Text of phrases under Section 3

NA

Revision Information

Revision Date:	2013-06-14
Supersedes edition of:	2012-06-01
Reason for revision:	Regulation (EC) No. 1272/2008 Compliance
Legend	NA: Not Applicable ND: Not Determined

THE INFORMATION CONTAINED HEREIN IS BASED ON THE PRESENT STATE OF OUR KNOWLEDGE. IT CHARACTERIZES THE PRODUCT WITH REGARD TO THE APPROPRIATE SAFETY PRECAUTIONS. IT DOES NOT REPRESENT A GUARANTEE OF THE PROPERTIES OF THE PRODUCT.

Safety Data Sheet

According to OSHA Hazard Communication Standard, 29 CFR 1910.1200

Initial preparation date: 08.24.2016

Revision date: 12.08.2017

Buffer Solution pH 4.00

SECTION 1: Identification

Product identifier

Product name: Buffer Solution pH 4.00

Product code: 40460

Recommended use of the product and restriction on use

Relevant identified uses: Laboratory

Uses advised against: Not determined or not applicable.

Reasons why uses advised against: Not determined or not applicable.

Manufacturer or supplier details

Manufacturer:	**Supplier:**
United States	**United States**
AquaPhoenix Scientific	USABlueBook
860 Gitts Run Road	3781 Bur Wood Dr.
Hanover	Waukegan
PA 17331	IL 60085
(717) 632-1291	(847) 689-3000

Emergency telephone number:

United States

Emergency Telephone No.: (800) 255-3924

SECTION 2: Hazard(s) identification

GHS classification: Not a hazardous substance or mixture

Label elements

Hazard pictograms: None

Signal word: None

Hazard statements: None

Precautionary statements: None

Hazards not otherwise classified: None

SECTION 3: Composition/information on ingredients

Identification	Name	Weight %
CAS number: 110-44-1	Sorbic Acid	0.01
CAS number: 877-24-7	Potassium hydrogen phthalate	1.02
CAS number: 7732-18-5	Water	98.97
CAS number: 6625-46-3	Pontacyl Carmine 2B	<0.01

Additional Information: None

SECTION 4: First aid measures

Description of first aid measures

General notes:
Not determined or not applicable.

After inhalation:
Loosen clothing as necessary and position individual in a comfortable position
Maintain an unobstructed airway
Get medical advice/attention if you feel unwell

After skin contact:
Wash affected area with soap and water
Seek medical attention if symptoms develop or persist

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes
Remove contact lens(es) if able to do so during rinsing
Seek medical attention if irritation persists or if concerned

After swallowing:
Rinse mouth and then drink plenty of water
Do not induce vomiting
Get medical advice/attention if you feel unwell

Most important symptoms and effects, both acute and delayed

Acute symptoms and effects:
Not determined or not applicable.

Delayed symptoms and effects:
Not determined or not applicable.

Immediate medical attention and special treatment

Specific treatment:
Not determined or not applicable.

Notes for the doctor:
Not determined or not applicable.

SECTION 5: Firefighting measures

Extinguishing media

Suitable extinguishing media:
Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition

Unsuitable extinguishing media:
Not determined or not applicable.

Specific hazards during fire-fighting:

Thermal decomposition can lead to release of irritating gases and vapors

Special protective equipment for firefighters:

Wear protective eye wear, gloves and clothing
Refer to Section 8
Use typical firefighting equipment, self-contained breathing apparatus, special tightly sealed suit

Special precautions:

Heating causes a rise in pressure, risk of bursting and combustion
Shut off sources of ignition
Carbon monoxide and carbon dioxide may form upon combustion

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures:
Ensure adequate ventilation
Ensure air handling systems are operational
Wear protective eye wear, gloves and clothing

Environmental precautions:
Should not be released into the environment
Prevent from reaching drains, sewer or waterway

Methods and material for containment and cleaning up:
Absorb with non-combustible liquid-binding material (sand, diatomaceous earth (clay), acid binders, universal binders)
Dispose of contents / container in accordance with local regulations

Reference to other sections:
Not determined or not applicable.

SECTION 7: Handling and storage

Precautions for safe handling:
Do not eat, drink, smoke or use personal products when handling chemical substances.
Avoid breathing mist or vapor.
Use only with adequate ventilation.

Conditions for safe storage, including any incompatibilities:
Store in a cool, well-ventilated area.
Store away from foodstuffs.

SECTION 8: Exposure controls/personal protection

Only those substances with limit values have been included below.

Occupational Exposure limit values:
No occupational exposure limits noted for the ingredient(s).

Biological limit values:
No biological exposure limits noted for the ingredient(s).

Information on monitoring procedures:
Not determined or not applicable.

Appropriate engineering controls:
Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor and mists below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above.

Personal protection equipment

Eye and face protection:
Safety goggles or glasses, or appropriate eye protection.

Skin and body protection:
Select glove material impermeable and resistant to the substance.

Respiratory protection:
When necessary, use NIOSH-approved breathing equipment.

General hygienic measures:
Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.
Wash contaminated clothing before reusing.

SECTION 9: Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Clear colorless liquid
Odor	Not available
Odor threshold	Not available
pH	4
Melting point/freezing point	Not available
Initial boiling point/range	Approx. 100°C
Flash point (closed cup)	Not available
Evaporation rate	Not available
Flammability (solid, gas)	Not available
Upper flammability/explosive limit	Not available
Lower flammability/explosive limit	Not available
Vapor pressure	Not available
Vapor density	Not available
Density	Not available
Relative density	Not available
Solubilities	Infinite solubility in water.
Partition coefficient (n-octanol/water)	Not available
Auto/Self-ignition temperature	Not available
Decomposition temperature	Not available
Dynamic viscosity	Not available
Kinematic viscosity	Not available
Explosive properties	Not determined or not available.
Oxidizing properties	Not determined or not available.

Other information

SECTION 10: Stability and reactivity

Reactivity:
Does not react under normal conditions of use and storage.

Chemical stability:
Stable under normal conditions of use and storage.

Possibility of hazardous reactions:
None under normal conditions of use and storage.

Conditions to avoid:
None known.

Incompatible materials:
None known.
Hazardous decomposition products:
None known.

SECTION 11: Toxicological information

Acute toxicity
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data: No data available.

Skin corrosion/irritation
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data:

Name	Result
Sorbic Acid	Causes skin irritation.

Serious eye damage/irritation
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data:

Name	Result
Sorbic Acid	Causes serious eye irritation.

Respiratory or skin sensitization
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data: No data available.

Carcinogenicity
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data: No data available.
International Agency for Research on Cancer (IARC): None of the ingredients are listed.
National Toxicology Program (NTP): None of the ingredients are listed.

Germ cell mutagenicity
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data: No data available.

Reproductive toxicity
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data: No data available.

Specific target organ toxicity (single exposure)
Assessment: Based on available data, the classification criteria are not met.
Product data: No data available.
Substance data: No data available.

Specific target organ toxicity (repeated exposure)

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Aspiration toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Information on likely routes of exposure: No data available.

Symptoms related to the physical, chemical and toxicological characteristics: No data available.

Other information: No data available.

SECTION 12: Ecological information

Acute (short-term) toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Chronic (long-term) toxicity

Product data: No data available.

Substance data: No data available.

Persistence and degradability

Product data: No data available.

Substance data: No data available.

Bioaccumulative potential

Product data: No data available.

Substance data: No data available.

Mobility in soil

Product data: No data available.

Substance data: No data available.

Other adverse effects: No data available.

SECTION 13: Disposal considerations

Disposal methods:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11)

SECTION 14: Transport information

United States Transportation of dangerous goods (49 CFR DOT)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	
Special precautions for user	None

International Maritime Dangerous Goods (IMDG)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	
Special precautions for user	None

International Air Transport Association Dangerous Goods Regulations (IATA-DGR)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	
Special precautions for user	None

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	
Bulk Name	None
Ship type	None
Pollution category	None

SECTION 15: Regulatory information

United States regulations

Inventory listing (TSCA):

877-24-7	Potassium hydrogen phthalate	Listed
7732-18-5	Water	Listed
6625-46-3	Pontacyl Carmine 2B	Listed
110-44-1	Sorbic Acid	Listed

Significant New Use Rule (TSCA Section 5): Not determined.

Export notification under TSCA Section 12(b): Not determined.

SARA Section 311/312 hazards:

Acute	Chronic	Fire	Pressure	Reactive
No	No	No	No	No

SARA Section 302 extremely hazardous substances: Not determined.

SARA Section 313 toxic chemicals: Not determined.

CERCLA: Not determined.

RCRA: Not determined.

Section 112(r) of the Clean Air Act (CAA): Not determined.

Massachusetts Right to Know:

110-44-1	Sorbic Acid	Not Listed

Buffer Solution pH 4.00

6625-46-3	Pontacyl Carmine 2B	Not Listed
7732-18-5	Water	Not Listed
877-24-7	Potassium hydrogen phthalate	Not Listed

New Jersey Right to Know:

110-44-1	Sorbic Acid	Not Listed
6625-46-3	Pontacyl Carmine 2B	Not Listed
7732-18-5	Water	Not Listed
877-24-7	Potassium hydrogen phthalate	Not Listed

New York Right to Know:

110-44-1	Sorbic Acid	Not Listed
6625-46-3	Pontacyl Carmine 2B	Not Listed
7732-18-5	Water	Not Listed
877-24-7	Potassium hydrogen phthalate	Not Listed

Pennsylvania Right to Know:

110-44-1	Sorbic Acid	Not Listed
6625-46-3	Pontacyl Carmine 2B	Not Listed
7732-18-5	Water	Not Listed
877-24-7	Potassium hydrogen phthalate	Not Listed

California Proposition 65: Not determined.

SECTION 16: Other information

Abbreviations and Acronyms: None

Disclaimer:

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations. The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.

Initial preparation date: 08.24.2016

Revision date: 12.08.2017

End of Safety Data Sheet

Buffer Solution pH 7.00

SECTION 1: Identification

Product identifier

Product name: Buffer Solution pH 7.00
Product code: 40470

Recommended use of the product and restriction on use

Relevant identified uses: Laboratory
Uses advised against: Not determined or not applicable.
Reasons why uses advised against: Not determined or not applicable.

Manufacturer or supplier details

Manufacturer:	**Supplier:**
United States	**United States**
AquaPhoenix Scientific	USABlueBook
860 Gitts Run Road	3781 Bur Wood Dr.
Hanover	Waukegan
PA 17331	IL 60085
(717) 632-1291	(847) 689-3000

Emergency telephone number:

United States

Emergency Telephone No.: (800) 255-3924

SECTION 2: Hazard(s) identification

GHS classification: Not a hazardous substance or mixture

Label elements

Hazard pictograms: None

Signal word: None

Hazard statements: None
Precautionary statements: None
Hazards not otherwise classified: None

SECTION 3: Composition/information on ingredients

Identification	Name	Weight %
CAS number: 6359-83-7	Mordant Yellow 8	<0.1
CAS number: 1310-73-2	Sodium hydroxide	0.12
CAS number: 7732-18-5	Water	99.16
CAS number: 52-51-7	Bioban Plus	0.05

Buffer Solution pH 7.00

CAS number: 7778-77-0	Potassium Phosphate	0.68

Additional Information: None

SECTION 4: First aid measures

Description of first aid measures

General notes:
Not determined or not applicable.

After inhalation:
Loosen clothing as necessary and position individual in a comfortable position
Maintain an unobstructed airway
Get medical advice/attention if you feel unwell

After skin contact:
Rinse affected area with soap and water
If symptoms develop or persist, seek medical attention

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes
Remove contact lenses, if present and easy to do
Continue rinsing
Get medical advice/attention

After swallowing:
Rinse mouth and then drink plenty of water
Do not induce vomiting
Get medical advice/attention if you feel unwell

Most important symptoms and effects, both acute and delayed

Acute symptoms and effects:
Not determined or not applicable.

Delayed symptoms and effects:
Not determined or not applicable.

Immediate medical attention and special treatment

Specific treatment:
Not determined or not applicable.

Notes for the doctor:
Not determined or not applicable.

SECTION 5: Firefighting measures

Extinguishing media

Suitable extinguishing media:
Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition

Unsuitable extinguishing media:
Not determined or not applicable.

Specific hazards during fire-fighting:

Thermal decomposition can lead to release of irritating gases and vapors

Special protective equipment for firefighters:

Wear protective eye wear, gloves and clothing
Refer to Section 8

Use typical firefighting equipment, self-contained breathing apparatus, special tightly sealed suit

Special precautions:

Heating causes a rise in pressure, risk of bursting and combustion
Shut off sources of ignition
Carbon monoxide and carbon dioxide may form upon combustion

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation
Ensure air handling systems are operational
Wear protective eye wear, gloves and clothing

Environmental precautions:

Should not be released into the environment
Prevent from reaching drains, sewer or waterway

Methods and material for containment and cleaning up:

Absorb with non-combustible liquid-binding material (sand, diatomaceous earth (clay), acid binders, universal binders)
Dispose of contents / container in accordance with local regulations

Reference to other sections:

Not determined or not applicable.

SECTION 7: Handling and storage

Precautions for safe handling:

Do not eat, drink, smoke or use personal products when handling chemical substances.
Avoid breathing mist or vapor.
Use only with adequate ventilation.

Conditions for safe storage, including any incompatibilities:

Store in a cool, well-ventilated area.
Store away from foodstuffs.

SECTION 8: Exposure controls/personal protection

Only those substances with limit values have been included below.

Occupational Exposure limit values:

Country (Legal Basis)	Substance	Identifier	Permissible concentration
ACGIH	Sodium hydroxide	1310-73-2	ACGIH TLV C 2.0 mg/m³
United States (OSHA)	Sodium hydroxide	1310-73-2	OSHA PEL TWA 2.0 mg/m³
NIOSH	Sodium hydroxide	1310-73-2	NIOSH REL C 2.0 mg/m³
	Sodium hydroxide	1310-73-2	NIOSH IDLH 10.0 mg/m³

Biological limit values:

No biological exposure limits noted for the ingredient(s).

Information on monitoring procedures:

Not determined or not applicable.

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor and mists below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above.

Personal protection equipment

Eye and face protection:

Safety goggles or glasses, or appropriate eye protection.

Skin and body protection:

Select glove material impermeable and resistant to the substance.

Respiratory protection:

When necessary, use NIOSH-approved breathing equipment.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.
Perform routine housekeeping.
Wash contaminated clothing before reusing.

SECTION 9: Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Clear, yellow liquid
Odor	Odorless
Odor threshold	Not available
pH	7
Melting point/freezing point	Approx. 0°C
Initial boiling point/range	Approx. 100°C
Flash point (closed cup)	Not available
Evaporation rate	Not available
Flammability (solid, gas)	Not available
Upper flammability/explosive limit	Not available
Lower flammability/explosive limit	Not available
Vapor pressure	Not available
Vapor density	Not available
Density	Not available
Relative density	Approx. 1
Solubilities	Not determined or not available.
Partition coefficient (n-octanol/water)	Not available
Auto/Self-ignition temperature	Not available
Decomposition temperature	Not available
Dynamic viscosity	Not available
Kinematic viscosity	Not available
Explosive properties	Not determined or not available.
Oxidizing properties	Not determined or not available.

Other information

SECTION 10: Stability and reactivity

Reactivity:

Does not react under normal conditions of use and storage.

Chemical stability:

Stable under normal conditions of use and storage.

Possibility of hazardous reactions:

None under normal conditions of use and storage.

Conditions to avoid:

None known.

Incompatible materials:

None known.

Hazardous decomposition products:

None known.

SECTION 11: Toxicological information

Acute toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data:

Name	Route	Result
Bioban Plus	dermal	LD50 Rat: 2,000 mg/kg
	inhalation	Derived no effect level (DNEL), Acute: 12.3 mg/m³
		Derived no effect level (DNEL), Long-term: 4.1 mg/m³
		LC50 Rat: 588 mg/m³(4hr)
	oral	LD50 Rat: 254 - 354 mg/kg

Skin corrosion/irritation

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data:

Name	Result
Sodium hydroxide	Causes severe skin burns and eye damage.

Serious eye damage/irritation

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Respiratory or skin sensitization

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Carcinogenicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

International Agency for Research on Cancer (IARC): None of the ingredients are listed.

National Toxicology Program (NTP): None of the ingredients are listed.

Germ cell mutagenicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Reproductive toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Specific target organ toxicity (single exposure)

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Specific target organ toxicity (repeated exposure)

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Aspiration toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Information on likely routes of exposure: No data available.

Symptoms related to the physical, chemical and toxicological characteristics: No data available.

Other information: No data available.

SECTION 12: Ecological information

Acute (short-term) toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data:

Name	Result
Bioban Plus	LC50 (3.2 months): 35.7 mg/L
	NOEC (4 days): 20 mg/L
	EC50 (48 h): 1.4 mg/L
	EC50 (72 h): 250 - 370 µg/L

Chronic (long-term) toxicity

Product data: No data available.

Substance data: No data available.

Persistence and degradability

Product data: No data available.

Substance data: No data available.

Bioaccumulative potential

Product data: No data available.

Substance data: No data available.

Mobility in soil

Product data: No data available.

Substance data: No data available.

Other adverse effects: No data available.

SECTION 13: Disposal considerations

Disposal methods:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11)

SECTION 14: Transport information

United States Transportation of dangerous goods (49 CFR DOT)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	None
Special precautions for user	None

International Maritime Dangerous Goods (IMDG)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	None
Special precautions for user	None

International Air Transport Association Dangerous Goods Regulations (IATA-DGR)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	None
Special precautions for user	None

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	
Bulk Name	None
Ship type	None
Pollution category	None

SECTION 15: Regulatory information

United States regulations

Inventory listing (TSCA):

7778-77-0	Potassium Phosphate	Listed
7732-18-5	Water	Listed
1310-73-2	Sodium hydroxide	Listed
52-51-7	Bioban Plus	Listed
6359-83-7	Mordant Yellow 8	Listed

Significant New Use Rule (TSCA Section 5): Not determined.

Export notification under TSCA Section 12(b): Not determined.

Buffer Solution pH 7.00

SARA Section 311/312 hazards:

Acute	Chronic	Fire	Pressure	Reactive
No	No	No	No	No

SARA Section 302 extremely hazardous substances: Not determined.

SARA Section 313 toxic chemicals: Not determined.

CERCLA:

1310-73-2	Sodium hydroxide	Listed	1000

RCRA: Not determined.

Section 112(r) of the Clean Air Act (CAA): Not determined.

Massachusetts Right to Know:

1310-73-2	Sodium hydroxide	Listed
52-51-7	Bioban Plus	Not Listed
6359-83-7	Mordant Yellow 8	Not Listed
7732-18-5	Water	Not Listed
7778-77-0	Potassium Phosphate	Not Listed

New Jersey Right to Know:

1310-73-2	Sodium hydroxide	Listed
52-51-7	Bioban Plus	Not Listed
6359-83-7	Mordant Yellow 8	Not Listed
7732-18-5	Water	Not Listed
7778-77-0	Potassium Phosphate	Not Listed

New York Right to Know:

1310-73-2	Sodium hydroxide	Listed
1310-73-2	Sodium hydroxide	Listed
52-51-7	Bioban Plus	Not Listed
6359-83-7	Mordant Yellow 8	Not Listed
7732-18-5	Water	Not Listed
7778-77-0	Potassium Phosphate	Not Listed

Pennsylvania Right to Know:

1310-73-2	Sodium hydroxide	Listed
52-51-7	Bioban Plus	Not Listed
6359-83-7	Mordant Yellow 8	Not Listed

Buffer Solution pH 7.00

7732-18-5	Water	Not Listed
7778-77-0	Potassium Phosphate	Not Listed

California Proposition 65: Not determined.

SECTION 16: Other information

Abbreviations and Acronyms: None

Disclaimer:

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations. The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.

NFPA: 1-0-0

HMIS: 1-0-0

Initial preparation date: 11.23.2016

End of Safety Data Sheet

Buffer Solution pH 10.00

SECTION 1: Identification

Product identifier

Product name: Buffer Solution pH 10.00
Product code: 40480

Recommended use of the product and restriction on use

Relevant identified uses: Laboratory
Uses advised against: Not determined or not applicable.
Reasons why uses advised against: Not determined or not applicable.

Manufacturer or supplier details

Manufacturer:	**Supplier:**
United States	**United States**
AquaPhoenix Scientific	USABlueBook
860 Gitts Run Road	3781 Bur Wood Dr.
Hanover	Waukegan
PA 17331	IL 60085
(717) 632-1291	(847) 689-3000

Emergency telephone number:

United States

Emergency Telephone No.: (800) 255-3924

SECTION 2: Hazard(s) identification

GHS classification: Not a hazardous substance or mixture

Label elements

Hazard pictograms: None

Signal word: None

Hazard statements: None
Precautionary statements: None
Hazards not otherwise classified: None

SECTION 3: Composition/information on ingredients

Identification	Name	Weight %
CAS number: 144-55-8	Sodium hydrogencarbonate	<2
CAS number: 34722-90-2	Bromothymol Blue, Sodium Salt	<2
CAS number: 7732-18-5	Water	>90
CAS number: 497-19-8	Sodium Carbonate	<2

Additional Information: None

SECTION 4: First aid measures

Description of first aid measures

General notes:
Not determined or not applicable.

After inhalation:
Loosen clothing as necessary and position individual in a comfortable position
Maintain an unobstructed airway
Get medical advice/attention if you feel unwell

After skin contact:
Wash affected area with soap and water
Seek medical attention if symptoms develop or persist

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes
Remove contact lens(es) if able to do so during rinsing
Seek medical attention if irritation persists or if concerned

After swallowing:
Rinse mouth and then drink plenty of water
Do not induce vomiting
Get medical advice/attention if you feel unwell

Most important symptoms and effects, both acute and delayed

Acute symptoms and effects:
Not determined or not applicable.

Delayed symptoms and effects:
Not determined or not applicable.

Immediate medical attention and special treatment

Specific treatment:
Not determined or not applicable.

Notes for the doctor:
Not determined or not applicable.

SECTION 5: Firefighting measures

Extinguishing media

Suitable extinguishing media:
Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition

Unsuitable extinguishing media:
Not determined or not applicable.

Specific hazards during fire-fighting:

Thermal decomposition can lead to release of irritating gases and vapors

Special protective equipment for firefighters:

Wear protective eye wear, gloves and clothing
Refer to Section 8
Use typical firefighting equipment, self-contained breathing apparatus, special tightly sealed suit

Special precautions:

Heating causes a rise in pressure, risk of bursting and combustion
Shut off sources of ignition
Carbon monoxide and carbon dioxide may form upon combustion

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures:
Ensure adequate ventilation
Ensure air handling systems are operational
Wear protective eye wear, gloves and clothing

Environmental precautions:
Should not be released into the environment
Prevent from reaching drains, sewer or waterway

Methods and material for containment and cleaning up:
Absorb with non-combustible liquid-binding material (sand, diatomaceous earth (clay), acid binders, universal binders)
Dispose of contents / container in accordance with local regulations

Reference to other sections:
Not determined or not applicable.

SECTION 7: Handling and storage

Precautions for safe handling:
Do not eat, drink, smoke or use personal products when handling chemical substances.
Avoid breathing mist or vapor.
Use only with adequate ventilation.

Conditions for safe storage, including any incompatibilities:
Store in a cool, well-ventilated area.
Store away from foodstuffs.

SECTION 8: Exposure controls/personal protection

Only those substances with limit values have been included below.

Occupational Exposure limit values:
No occupational exposure limits noted for the ingredient(s).

Biological limit values:
No biological exposure limits noted for the ingredient(s).

Information on monitoring procedures:
Not determined or not applicable.

Appropriate engineering controls:
Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor and mists below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above.

Personal protection equipment

Eye and face protection:
Safety goggles or glasses, or appropriate eye protection.

Skin and body protection:
Select glove material impermeable and resistant to the substance.

Respiratory protection:
When necessary, use NIOSH-approved breathing equipment.

General hygienic measures:
Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.
Perform routine housekeeping.
Wash contaminated clothing before reusing.

SECTION 9: Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Clear, blue liquid
Odor	Odorless
Odor threshold	Not available
pH	10
Melting point/freezing point	Approx. 0°C
Initial boiling point/range	Approx. 100°C
Flash point (closed cup)	Not available
Evaporation rate	Not available
Flammability (solid, gas)	Not available
Upper flammability/explosive limit	Not available
Lower flammability/explosive limit	Not available
Vapor pressure	Not available
Vapor density	Not available
Density	Not available
Relative density	Approx. 1
Solubilities	Infinite solubility in water.
Partition coefficient (n-octanol/water)	Not available
Auto/Self-ignition temperature	Not available
Decomposition temperature	Not available
Dynamic viscosity	Not available
Kinematic viscosity	Not available
Explosive properties	Not determined or not available.
Oxidizing properties	Not determined or not available.

Other information

SECTION 10: Stability and reactivity

Reactivity:
Does not react under normal conditions of use and storage.

Chemical stability:
Stable under normal conditions of use and storage.

Possibility of hazardous reactions:
None under normal conditions of use and storage.

Conditions to avoid:

None known.

Incompatible materials:

None known.

Hazardous decomposition products:

None known.

SECTION 11: Toxicological information

Acute toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Skin corrosion/irritation

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Serious eye damage/irritation

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data:

Name	Result
Sodium Carbonate	Causes eye irritation

Respiratory or skin sensitization

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Carcinogenicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

International Agency for Research on Cancer (IARC): None of the ingredients are listed.

National Toxicology Program (NTP): None of the ingredients are listed.

Germ cell mutagenicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Reproductive toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Specific target organ toxicity (single exposure)

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Specific target organ toxicity (repeated exposure)

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Aspiration toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data: No data available.

Information on likely routes of exposure: No data available.

Symptoms related to the physical, chemical and toxicological characteristics: No data available.

Other information: No data available.

SECTION 12: Ecological information

Acute (short-term) toxicity

Assessment: Based on available data, the classification criteria are not met.

Product data: No data available.

Substance data:

Name	Result
Sodium Carbonate	LC50 - Lepomis macrochirus (Bluegill) - 300 mg/l - 96 h
	EC50 - Daphnia magna (Water flea) - 265 mg/l - 48 h

Chronic (long-term) toxicity

Product data: No data available.

Substance data: No data available.

Persistence and degradability

Product data: No data available.

Substance data: No data available.

Bioaccumulative potential

Product data: No data available.

Substance data: No data available.

Mobility in soil

Product data: No data available.

Substance data: No data available.

Other adverse effects: No data available.

SECTION 13: Disposal considerations

Disposal methods:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11)

SECTION 14: Transport information

United States Transportation of dangerous goods (49 CFR DOT)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	

Special precautions for user	None

International Maritime Dangerous Goods (IMDG)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	
Special precautions for user	None

International Air Transport Association Dangerous Goods Regulations (IATA-DGR)

UN number	Not Regulated
UN proper shipping name	Not Regulated
UN transport hazard class(es)	None
Packing group	None
Environmental hazards	
Special precautions for user	None

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	
Bulk Name	None
Ship type	None
Pollution category	None

SECTION 15: Regulatory information

United States regulations

Inventory listing (TSCA):

34722-90-2	Bromothymol Blue, Sodium Salt	Listed
7732-18-5	Water	Listed
144-55-8	Sodium hydrogencarbonate	Listed
497-19-8	Sodium Carbonate	Listed

Significant New Use Rule (TSCA Section 5): Not determined.

Export notification under TSCA Section 12(b): Not determined.

SARA Section 311/312 hazards:

Acute	Chronic	Fire	Pressure	Reactive
No	No	No	No	No

SARA Section 302 extremely hazardous substances: Not determined.

SARA Section 313 toxic chemicals:

144-55-8	Sodium hydrogencarbonate	Not Listed

CERCLA: Not determined.

RCRA: Not determined.

Section 112(r) of the Clean Air Act (CAA): Not determined.

Massachusetts Right to Know:

144-55-8	Sodium hydrogencarbonate	Not Listed
34722-90-2	Bromothymol Blue, Sodium Salt	Not Listed
497-19-8	Sodium Carbonate	Not Listed
7732-18-5	Water	Not Listed

New Jersey Right to Know:

144-55-8	Sodium hydrogencarbonate	Not Listed
34722-90-2	Bromothymol Blue, Sodium Salt	Not Listed
497-19-8	Sodium Carbonate	Not Listed
7732-18-5	Water	Not Listed

New York Right to Know:

144-55-8	Sodium hydrogencarbonate	Not Listed
34722-90-2	Bromothymol Blue, Sodium Salt	Not Listed
497-19-8	Sodium Carbonate	Not Listed
7732-18-5	Water	Not Listed

Pennsylvania Right to Know:

144-55-8	Sodium hydrogencarbonate	Not Listed
34722-90-2	Bromothymol Blue, Sodium Salt	Not Listed
497-19-8	Sodium Carbonate	Not Listed
7732-18-5	Water	Not Listed

California Proposition 65: Not determined.

SECTION 16: Other information

Abbreviations and Acronyms: None

Disclaimer:

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations. The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The

information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.

Initial preparation date: 11.24.2016
Revision date: 12.08.2017

End of Safety Data Sheet

SAFETY DATA SHEET

51601

Section 1. Identification

Product name : KRYLON® ColorMaster™ with Covermax™ Technology Paint + Primer Gloss Black

Product code : 51601

Other means of identification : Not available.

Product type : Aerosol.

Relevant identified uses of the substance or mixture and uses advised against

Paint or paint related material.

Manufacturer : Krylon Products Group
101 W. Prospect Avenue
Cleveland, OH 44115

Emergency telephone number of the company : US / Canada: (216) 566-2917
Mexico: SETIQ 01-800-00-214-00 / (52) 55-5559-1588 24 hours / 365 days a year

Product Information Telephone Number : US / Canada: (800) 457-9566
Mexico: Not Available

Regulatory Information Telephone Number : US / Canada: (216) 566-2902
Mexico: Not Available

Transportation Emergency Telephone Number : US / Canada: (216) 566-2917
Mexico: SETIQ 01-800-00-214-00 / (52) 55-5559-1588 24 hours / 365 days a year

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE AEROSOLS - Category 1
GASES UNDER PRESSURE - Compressed gas
SKIN CORROSION/IRRITATION - Category 2
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2A
SKIN SENSITIZATION - Category 1
CARCINOGENICITY - Category 2
TOXIC TO REPRODUCTION (Unborn child) - Category 2
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2
ASPIRATION HAZARD - Category 1

Percentage of the mixture consisting of ingredient(s) of unknown acute oral toxicity: 13.8%
Percentage of the mixture consisting of ingredient(s) of unknown acute dermal toxicity: 27.5%
Percentage of the mixture consisting of ingredient(s) of unknown acute inhalation toxicity: 25.9%

GHS label elements

Section 2. Hazards identification

Hazard pictograms :



Signal word : Danger

Hazard statements : Extremely flammable aerosol.
Contains gas under pressure; may explode if heated.
Causes serious eye irritation.
Causes skin irritation.
May cause an allergic skin reaction.
Suspected of damaging the unborn child.
Suspected of causing cancer.
May be fatal if swallowed and enters airways.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May cause damage to organs through prolonged or repeated exposure.

Precautionary statements

General : Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not spray on an open flame or other ignition source. Use only outdoors or in a well-ventilated area. Do not breathe dust or mist. Wash hands thoroughly after handling. Contaminated work clothing must not be allowed out of the workplace. Pressurized container: Do not pierce or burn, even after use.

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN: Wash with plenty of soap and water. Wash contaminated clothing before reuse. If skin irritation or rash occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store locked up. Protect from sunlight. Do not expose to temperatures exceeding 50 °C/122 °F. Store in a well-ventilated place.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Supplemental label elements

DELAYED EFFECTS FROM LONG TERM OVEREXPOSURE. Contains solvents which can cause permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents can be harmful or fatal. WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Please refer to the SDS for additional information. Keep out of reach of children. Keep upright in a cool, dry place. Do not discard empty can in trash compactor.

Hazards not otherwise classified : DANGER: Rags, steel wool, other waste soaked with this product, and sanding residue may spontaneously catch fire if improperly discarded. Immediately place rags, steel wool, other waste soaked with this product, and sanding residue in a sealed, water-filled, metal container. Dispose of in accordance with local fire regulations.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

Ingredient name	% by weight	CAS number
Acetone	≥25 - ≤50	67-64-1
Propane	≥10 - ≤25	74-98-6
Butane	≥10 - ≤25	106-97-8
Toluene	≥10 - ≤25	108-88-3
Isobutyl Acetate	≥10 - ≤25	110-19-0
Ethyl 3-Ethoxypropionate	≤3	763-69-9
Carbon Black	≤1	1333-86-4
Methyl Ethyl Ketoxime	≤0.3	96-29-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. In the event of any complaints or symptoms, avoid further exposure. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye irritation.

Section 4. First aid measures

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness. May cause respiratory irritation.

Skin contact : Causes skin irritation. May cause an allergic skin reaction.

Ingestion : Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness
reduced fetal weight
increase in fetal deaths
skeletal malformations

Skin contact : Adverse symptoms may include the following:
irritation
redness
reduced fetal weight
increase in fetal deaths
skeletal malformations

Ingestion : Adverse symptoms may include the following:
nausea or vomiting
reduced fetal weight
increase in fetal deaths
skeletal malformations

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Section 5. Fire-fighting measures

Specific hazards arising from the chemical : Extremely flammable aerosol. Runoff to sewer may create fire or explosion hazard. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Gas may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back, causing fire or explosion. Bursting aerosol containers may be propelled from a fire at high speed.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. In the case of aerosols being ruptured, care should be taken due to the rapid escape of the pressurized contents and propellant. If a large number of containers are ruptured, treat as a bulk material spillage according to the instructions in the clean-up section. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Persons with a history of skin sensitization problems should not be employed in any process in which this product is used. Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50°C. Do not pierce or burn, even after use. Avoid exposure - obtain special instructions before use. Avoid exposure during pregnancy. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not swallow. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Protect from sunlight. Store locked up. Eliminate all ignition sources. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits (OSHA United States)

Ingredient name	CAS #	Exposure limits
Acetone	67-64-1	**ACGIH TLV (United States, 3/2019).** TWA: 250 ppm 8 hours. STEL: 500 ppm 15 minutes. **NIOSH REL (United States, 10/2016).** TWA: 250 ppm 10 hours. TWA: 590 mg/m³ 10 hours. **OSHA PEL (United States, 5/2018).** TWA: 1000 ppm 8 hours. TWA: 2400 mg/m³ 8 hours.
Propane	74-98-6	**NIOSH REL (United States, 10/2016).** TWA: 1000 ppm 10 hours. TWA: 1800 mg/m³ 10 hours. **OSHA PEL (United States, 5/2018).** TWA: 1000 ppm 8 hours. TWA: 1800 mg/m³ 8 hours. **ACGIH TLV (United States, 3/2019). Oxygen Depletion [Asphyxiant]. Explosive potential.**
Butane	106-97-8	**NIOSH REL (United States, 10/2016).** TWA: 800 ppm 10 hours. TWA: 1900 mg/m³ 10 hours. **ACGIH TLV (United States, 3/2019). Explosive potential.** STEL: 1000 ppm 15 minutes.
Toluene	108-88-3	**OSHA PEL Z2 (United States, 2/2013).**

Section 8. Exposure controls/personal protection

		TWA: 200 ppm 8 hours. CEIL: 300 ppm AMP: 500 ppm 10 minutes. **NIOSH REL (United States, 10/2016).** TWA: 100 ppm 10 hours. TWA: 375 mg/m³ 10 hours. STEL: 150 ppm 15 minutes. STEL: 560 mg/m³ 15 minutes. **ACGIH TLV (United States, 3/2019).** TWA: 20 ppm 8 hours.
Isobutyl Acetate	110-19-0	**NIOSH REL (United States, 10/2016).** TWA: 150 ppm 10 hours. TWA: 700 mg/m³ 10 hours. **OSHA PEL (United States, 5/2018).** TWA: 150 ppm 8 hours. TWA: 700 mg/m³ 8 hours. **ACGIH TLV (United States, 3/2019).** STEL: 150 ppm 15 minutes. TWA: 50 ppm 8 hours.
Ethyl 3-Ethoxypropionate	763-69-9	None.
Carbon Black	1333-86-4	**NIOSH REL (United States, 10/2016).** TWA: 3.5 mg/m³ 10 hours. TWA: 0.1 mg of PAHs/cm³ 10 hours. **ACGIH TLV (United States, 3/2019).** TWA: 3 mg/m³ 8 hours. Form: Inhalable fraction **OSHA PEL (United States, 5/2018).** TWA: 3.5 mg/m³ 8 hours.
Methyl Ethyl Ketoxime	96-29-7	**AIHA WEEL (United States, 7/2018). Skin sensitizer.** TWA: 10 ppm 8 hours.

Occupational exposure limits (Canada)

Ingredient name	CAS #	Exposure limits
Acetone	67-64-1	**CA Alberta Provincial (Canada, 6/2018).** 8 hrs OEL: 1200 mg/m³ 8 hours. 15 min OEL: 1800 mg/m³ 15 minutes. 8 hrs OEL: 500 ppm 8 hours. 15 min OEL: 750 ppm 15 minutes. **CA British Columbia Provincial (Canada, 5/2019).** TWA: 250 ppm 8 hours. STEL: 500 ppm 15 minutes. **CA Ontario Provincial (Canada, 1/2018).** TWA: 250 ppm 8 hours. STEL: 500 ppm 15 minutes. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 500 ppm 8 hours. TWAEV: 1190 mg/m³ 8 hours. STEV: 1000 ppm 15 minutes. STEV: 2380 mg/m³ 15 minutes. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 750 ppm 15 minutes. TWA: 500 ppm 8 hours.
Normal propane	74-98-6	**CA Alberta Provincial (Canada, 6/2018).**

Section 8. Exposure controls/personal protection

		8 hrs OEL: 1000 ppm 8 hours. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 1000 ppm 8 hours. TWAEV: 1800 mg/m³ 8 hours. **CA Ontario Provincial (Canada, 1/2018).** TWA: 1000 ppm 8 hours. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 1250 ppm 15 minutes. TWA: 1000 ppm 8 hours. **CA British Columbia Provincial (Canada, 5/2019). Oxygen Depletion [Asphyxiant]. Explosive potential.**
Butane	106-97-8	**CA Alberta Provincial (Canada, 6/2018).** 8 hrs OEL: 1000 ppm 8 hours. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 800 ppm 8 hours. TWAEV: 1900 mg/m³ 8 hours. **CA Ontario Provincial (Canada, 1/2018).** TWA: 800 ppm 8 hours. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 1250 ppm 15 minutes. TWA: 1000 ppm 8 hours. **CA British Columbia Provincial (Canada, 5/2019). Explosive potential.** STEL: 1000 ppm 15 minutes.
Toluene	108-88-3	**CA Alberta Provincial (Canada, 6/2018). Absorbed through skin.** 8 hrs OEL: 50 ppm 8 hours. 8 hrs OEL: 188 mg/m³ 8 hours. **CA British Columbia Provincial (Canada, 5/2019).** TWA: 20 ppm 8 hours. **CA Ontario Provincial (Canada, 1/2018).** TWA: 20 ppm 8 hours. **CA Quebec Provincial (Canada, 1/2014). Absorbed through skin.** TWAEV: 50 ppm 8 hours. TWAEV: 188 mg/m³ 8 hours. **CA Saskatchewan Provincial (Canada, 7/2013). Absorbed through skin.** STEL: 60 ppm 15 minutes. TWA: 50 ppm 8 hours.
Isobutyl acetate	110-19-0	**CA Alberta Provincial (Canada, 6/2018).** 8 hrs OEL: 150 ppm 8 hours. 8 hrs OEL: 713 mg/m³ 8 hours. **CA British Columbia Provincial (Canada, 5/2019).** TWA: 150 ppm 8 hours. **CA Ontario Provincial (Canada, 1/2018).** TWA: 150 ppm 8 hours. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 150 ppm 8 hours. TWAEV: 713 mg/m³ 8 hours. **CA Saskatchewan Provincial (Canada, 7/2013).**

Section 8. Exposure controls/personal protection

		STEL: 188 ppm 15 minutes. TWA: 150 ppm 8 hours.
Carbon black	1333-86-4	**CA British Columbia Provincial (Canada, 5/2019).** TWA: 3 mg/m³ 8 hours. Form: Inhalable **CA Ontario Provincial (Canada, 1/2018).** TWA: 3 mg/m³ 8 hours. Form: Inhalable fraction. **CA Alberta Provincial (Canada, 6/2018).** 8 hrs OEL: 3.5 mg/m³ 8 hours. **CA Quebec Provincial (Canada, 1/2014).** TWAEV: 3.5 mg/m³ 8 hours. **CA Saskatchewan Provincial (Canada, 7/2013).** STEL: 7 mg/m³ 15 minutes. TWA: 3.5 mg/m³ 8 hours.
Methyl Ethyl Ketoxime	96-29-7	**AIHA WEEL (United States, 7/2018). Skin sensitizer.** TWA: 10 ppm 8 hours.

Occupational exposure limits (Mexico)

	CAS #	Exposure limits
Acetone	67-64-1	**NOM-010-STPS-2014 (Mexico, 4/2016).** TWA: 500 ppm 8 hours. STEL: 750 ppm 15 minutes.
Propane	74-98-6	**NOM-010-STPS-2014 (Mexico, 4/2016).** TWA: 1000 ppm 8 hours.
Butane	106-97-8	**NOM-010-STPS-2014 (Mexico, 4/2016).** TWA: 1000 ppm 8 hours.
Toluene	108-88-3	**NOM-010-STPS-2014 (Mexico, 4/2016).** TWA: 20 ppm 8 hours.
Isobutyl Acetate	110-19-0	**NOM-010-STPS-2014 (Mexico, 4/2016).** TWA: 150 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Contaminated work clothing should not be allowed out of the workplace. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid.

Color : Not available.

Odor : Not available.

Odor threshold : Not available.

pH : Not available.

Melting point/freezing point : Not available.

Boiling point/boiling range : Not available.

Flash point : Closed cup: -29°C (-20.2°F) [Pensky-Martens Closed Cup]

Evaporation rate : 5.6 (butyl acetate = 1)

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Lower: 1%
Upper: 12.8%

Vapor pressure : 101.3 kPa (760 mm Hg) [at 20°C]

Vapor density : 1.55 [Air = 1]

Relative density : 0.74

Solubility : Not available.

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Kinematic (40°C (104°F)): <0.205 cm^2/s (<20.5 cSt)

Molecular weight : Not applicable.

Aerosol product

Type of aerosol : Spray

Heat of combustion : 27.905 kJ/g

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame).

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Acetone	LD50 Oral	Rat	5800 mg/kg	-
Butane	LC50 Inhalation Vapor	Rat	658000 mg/m³	4 hours
Toluene	LC50 Inhalation Vapor	Rat	49 g/m³	4 hours
	LD50 Oral	Rat	636 mg/kg	-
Isobutyl Acetate	LD50 Dermal	Rabbit	>17400 mg/kg	-
	LD50 Oral	Rat	13400 mg/kg	-
Ethyl 3-Ethoxypropionate	LD50 Oral	Rat	3200 mg/kg	-
Carbon Black	LD50 Oral	Rat	>15400 mg/kg	-
Methyl Ethyl Ketoxime	LD50 Oral	Rat	930 mg/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Acetone	Eyes - Mild irritant	Human	-	186300 ppm	-
	Eyes - Mild irritant	Rabbit	-	10 Ul	-
	Eyes - Moderate irritant	Rabbit	-	24 hours 20 mg	-
	Eyes - Severe irritant	Rabbit	-	20 mg	-
	Skin - Mild irritant	Rabbit	-	24 hours 500 mg	-
	Skin - Mild irritant	Rabbit	-	395 mg	-
Toluene	Eyes - Mild irritant	Rabbit	-	0.5 minutes 100 mg	-
	Eyes - Mild irritant	Rabbit	-	870 ug	-
	Eyes - Severe irritant	Rabbit	-	24 hours 2 mg	-
	Skin - Mild irritant	Pig	-	24 hours 250 Ul	-
	Skin - Mild irritant	Rabbit	-	435 mg	-
	Skin - Moderate irritant	Rabbit	-	24 hours 20 mg	-
	Skin - Moderate irritant	Rabbit	-	500 mg	-
Isobutyl Acetate	Eyes - Moderate irritant	Rabbit	-	24 hours 500 mg	-
	Skin - Mild irritant	Rabbit	-	500 mg	-
	Skin - Moderate irritant	Rabbit	-	24 hours 500	-

Section 11. Toxicological information

Ethyl 3-Ethoxypropionate	Skin - Mild irritant	Rabbit	-	mg 24 hours 500 mg	-
Methyl Ethyl Ketoxime	Eyes - Severe irritant	Rabbit	-	100 Ul	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
Toluene	-	3	-
Carbon Black	-	2B	-

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
Acetone	Category 3	Not applicable.	Narcotic effects
	Category 3	Not applicable.	Respiratory tract irritation
Propane	Category 3	Not applicable.	Narcotic effects
	Category 3	Not applicable.	Respiratory tract irritation
Butane	Category 3	Not applicable.	Narcotic effects
	Category 3	Not applicable.	Respiratory tract irritation
Toluene	Category 3	Not applicable.	Narcotic effects
	Category 3	Not applicable.	Respiratory tract irritation
Isobutyl Acetate	Category 3	Not applicable.	Narcotic effects

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Acetone	Category 2	Not determined	Not determined
Propane	Category 2	Not determined	Not determined
Butane	Category 2	Not determined	Not determined
Toluene	Category 2	Not determined	Not determined

Aspiration hazard

Name	Result
Propane	ASPIRATION HAZARD - Category 1
Butane	ASPIRATION HAZARD - Category 1
Toluene	ASPIRATION HAZARD - Category 1

Section 11. Toxicological information

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness. May cause respiratory irritation.

Skin contact : Causes skin irritation. May cause an allergic skin reaction.

Ingestion : Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain or irritation
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing
nausea or vomiting
headache
drowsiness/fatigue
dizziness/vertigo
unconsciousness
reduced fetal weight
increase in fetal deaths
skeletal malformations

Skin contact : Adverse symptoms may include the following:
irritation
redness
reduced fetal weight
increase in fetal deaths
skeletal malformations

Ingestion : Adverse symptoms may include the following:
nausea or vomiting
reduced fetal weight
increase in fetal deaths
skeletal malformations

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure. Once sensitized, a severe allergic reaction may occur when subsequently exposed to very low levels.

Section 11. Toxicological information

Carcinogenicity : Suspected of causing cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : Suspected of damaging the unborn child.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Oral	4531.01 mg/kg

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Acetone	Acute EC50 7200000 µg/l Fresh water	Algae - Selenastrum sp.	96 hours
	Acute LC50 6000000 µg/l Fresh water	Crustaceans - Gammarus pulex	48 hours
	Acute LC50 6900 mg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 5600 ppm Fresh water	Fish - Poecilia reticulata	96 hours
	Chronic NOEC 4.95 mg/l Marine water	Algae - Ulva pertusa	96 hours
	Chronic NOEC 0.016 ml/L Fresh water	Crustaceans - Daphniidae	21 days
	Chronic NOEC 0.1 ml/L Fresh water	Daphnia - Daphnia magna - Neonate	21 days
	Chronic NOEC 5 µg/l Marine water	Fish - Gasterosteus aculeatus - Larvae	42 days
Toluene	Acute EC50 12500 µg/l Fresh water	Algae - Pseudokirchneriella subcapitata	72 hours
	Acute EC50 11600 µg/l Fresh water	Crustaceans - Gammarus pseudolimnaeus - Adult	48 hours
	Acute EC50 6000 µg/l Fresh water	Daphnia - Daphnia magna - Juvenile (Fledgling, Hatchling, Weanling)	48 hours
	Acute LC50 5500 µg/l Fresh water	Fish - Oncorhynchus kisutch - Fry	96 hours
	Chronic NOEC 1000 µg/l Fresh water	Daphnia - Daphnia magna	21 days
Methyl Ethyl Ketoxime	Acute LC50 843000 µg/l Fresh water	Fish - Pimephales promelas	96 hours

Persistence and degradability

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
Acetone	-	-	Readily
Toluene	-	-	Readily

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Toluene	-	90	low
Methyl Ethyl Ketoxime	-	2.5 to 5.8	low

Mobility in soil

Section 12. Ecological information

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT Classification	TDG Classification	Mexico Classification	IATA	IMDG
UN number	UN1950	UN1950	UN1950	UN1950	UN1950
UN proper shipping name	AEROSOLS	AEROSOLS	AEROSOLS	AEROSOLS, flammable	AEROSOLS
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.
Additional information	- **ERG No.** 126	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **ERG No.** 126	- **ERG No.** 126	-	**Emergency schedules** F-D, S-U

Special precautions for user : Multi-modal shipping descriptions are provided for informational purposes and do not consider container sizes. The presence of a shipping description for a particular mode of transport (sea, air, etc.), does not indicate that the product is packaged suitably for that mode of transport. All packaging must be reviewed for suitability prior to shipment, and compliance with the applicable regulations is the sole responsibility of the person offering the product for transport. People loading and unloading dangerous goods must be trained on all of the risks deriving from the substances and on all actions in case of emergency situations.

Section 14. Transport information

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Proper shipping name : Not available.

Ship type : Not available.

Pollution category : Not available.

Section 15. Regulatory information

SARA 313

SARA 313 (40 CFR 372.45) supplier notification can be found on the Environmental Data Sheet.

California Prop. 65

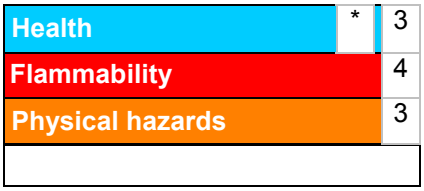
WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

International regulations

International lists : **Australia inventory (AICS)**: Not determined.
China inventory (IECSC): Not determined.
Japan inventory (ENCS): Not determined.
Japan inventory (ISHL): Not determined.
Korea inventory (KECI): Not determined.
New Zealand Inventory of Chemicals (NZIoC): Not determined.
Philippines inventory (PICCS): Not determined.
Taiwan Chemical Substances Inventory (TCSI): Not determined.
Thailand inventory: Not determined.
Turkey inventory: Not determined.
Vietnam inventory: Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE AEROSOLS - Category 1	On basis of test data
GASES UNDER PRESSURE - Compressed gas	Calculation method
SKIN CORROSION/IRRITATION - Category 2	Calculation method
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2A	Calculation method
SKIN SENSITIZATION - Category 1	Calculation method
CARCINOGENICITY - Category 2	Calculation method
TOXIC TO REPRODUCTION (Unborn child) - Category 2	Calculation method
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3	Calculation method

Section 16. Other information

SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3	Calculation method
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2	Calculation method
ASPIRATION HAZARD - Category 1	Calculation method

History

Date of printing : 3/3/2020

Date of issue/Date of revision : 3/3/2020

Date of previous issue : 2/9/2020

Version : 18.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
N/A = Not available
SGG = Segregation Group
UN = United Nations

Indicates information that has changed from previously issued version.

Notice to reader

It is recommended that each customer or recipient of this Safety Data Sheet (SDS) study it carefully and consult resources, as necessary or appropriate, to become aware of and understand the data contained in this SDS and any hazards associated with the product. This information is provided in good faith and believed to be accurate as of the effective date herein. However, no warranty, express or implied, is given. The information presented here applies only to the product as shipped. The addition of any material can change the composition, hazards and risks of the product. Products shall not be repackaged, modified, or tinted except as specifically instructed by the manufacturer, including but not limited to the incorporation of products not specified by the manufacturer, or the use or addition of products in proportions not specified by the manufacturer. Regulatory requirements are subject to change and may differ between various locations and jurisdictions. The customer/buyer/user is responsible to ensure that his activities comply with all country, federal, state, provincial or local laws. The conditions for use of the product are not under the control of the manufacturer; the customer/buyer/user is responsible to determine the conditions necessary for the safe use of this product. The customer/buyer/user should not use the product for any purpose other than the purpose shown in the applicable section of this SDS without first referring to the supplier and obtaining written handling instructions. Due to the proliferation of sources for information such as manufacturer-specific SDS, the manufacturer cannot be responsible for SDSs obtained from any other source.

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name	Traceable® Conductivity Standard
Product Number(s)	4066, 4067, 4068, 4068, 4161, 4162, 4173, 4174, 4176, 4177, 4178, 4179, 4561, 4562, 4566, 4567, 4568, 4569, 4573, 4580, 4581
Pure Substance/mixture	Mixture

093283
093284
093281
093282
093285
0932811

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use	Calibration and storage of conductivity meters/probes
Uses advised against	Any use which involves bodily contact or ingestion.

Manufacture/Supplier

Traceable® Products
12554 Old Galveston Rd. Suite B230
Webster, TX 77598

E-mail address	sales@control3.com
Made In	USA

Product Information 281-482-1714

2. HAZARDS IDENTIFICATION

Classification according to Regulation (EC) No. 1272/2008 [CLP]
This mixture is classified as not hazardous according to regulation (EC) 1272/2008 [GHS]

Label Elements

The product contains no substances which at their given concentration, are considered hazardous to health.

Appearance Clear **Physical State** Liquid **Odor** None

EUH210 - Safety data sheet available upon request.

Precautionary Statements
P202 - Do not handle until all safety information has been read and understood.

Hazards not otherwise classified (HNOC)
No information available

Other Information
No information available

Additional advice on labeling
Classification according to EU Directives 67/548/EEC or 1999/45/EC.

OSHA Regulatory Status
This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

3. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous ingredients

Component	Chemical Formula	EC-No.	CAS-No	Classification according Regulation (EC) No. 1272 [CLP]	Weight %	Trade Secret
Water	-	-	7732-18-5	-	>86 %	*
Potassium chloride	KCL	231-211-8	7447-40-7	-	0.01-13.5 %	*
N-Propanol	-	200-746-9	71-23-8	-	0.01-1.6 %	*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

First Aid Measures

General Advice	Use first aid treatment according to the nature of the injury. For further assistance, contact your local Poison Control Center. Show this safety data sheet to the doctor in attendance.
Eye Contact	In case of eye contact, remove contact lens and rinse thoroughly with plenty of water, also under the eyelids, for at least 15 minutes. Obtain medical attention.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothing and shoes. If skin reactions occur, contact a physician.

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. If symptoms persist, obtain medical attention.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Do not include vomiting. Call a physician or Poison Control Center immediately.
Production of First-Aiders	Use personal protective equipment. See Section 8 for more detail. Do not use mouth to mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical devices.

Most important symptoms and effects, both acute and delayed
Most important symptoms/effects No information available

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media
No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

Personal Precautions	Avoid breathing, mist or vapors. Ensure adequate ventilation. Use personal protective equipment. Refer to Section 8. Evacuate personnel to safe areas.
Environmental Precautions	Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Method and Material for Containment and Cleaning Up

Methods for Containment	Prevent further leakage or spillage if safe to do so.
Methods for Cleaning Up	Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for Safe Handling

Handling	To avoid risks to human health and the environment, comply with the instructions for use. Wear personal protective equipment. Avoid breathing dust/fume/gas/mist/vapors/spray Ensure adequate ventilation, especially in confined areas. Prevent the buildup of electrostatic charge.
Hygiene Considerations	Handle in accordance with good industrial hygiene and safety practice.

Conditions for Safe Storage, Including any Incompatibilities

Storage	Keep container tightly closed in a dry and well-ventilated place. Containers which have been opened must be resealed and kept upright to prevent leakage. Store at room temperature in the original container. Keep away from direct sunlight.
Incompatible Products	No information available.

Specific end use(s)

Specific use	Calibration and storage of pH meters/probes.
Risk Management Methods (RMM)	The information required is contained in this Safety Data Sheet.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
1-Propanol 71-23-8	200 ppm	200 ppm	

Appropriate Engineering Controls
Engineering Measures Showers
Eyewash stations
Ventilation systems

Individual protection measures, such as personal protective equipment

Eye/face Protection	Wear chemical splash goggles. If splashes are likely to occur, wear: Face-shield.
Skin and Body Protection	Wear protection gloves/clothing
Respiratory Protection	None required under normal usage. In case of inadequate ventilation wear respiratory protection.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties.

Physical State	Liquid
Appearance	Clear
Odor	Slight alcohol
Odor Threshold	No information available
pH Range	~4-6

Property	**Values**	**Remarks * Method**
Melting point/freezing point	No information available	
Boiling Point/Range	No information available	
Flash Point (High in °C)	Does not flash.	
Evaporation Rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit:	No information available	
Vapor pressure	No information available	
Vapor Density	No information available	
Specific Gravity	No information available	
Water Solubility	Totally soluble in water at 20°C	
Solubility in other solvents	No information available	
Partition coefficient	No information available	
Autoignition Temperature	No information available	
Decomposition Temperature	No information available	
Kinematic Viscosity	No information available	
Dynamic Viscosity	No information available	
Explosive Properties	No information available	
Oxidizing Properties	No information available	

Other Information

Softening Point	No information available
Molecular Weight	No information available
VOC Content (%)	No information available
Density	No information available
Bulk Density	No information available

10. STABILITY AND REACTIVITY

Reactivity
No information available

Chemical Stability
Stable under normal conditions

Possibility of Hazardous Reactions
None known

Conditions to Avoid
No dangerous conditions known.

Incompatible Materials
No common materials present a hazard

Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	No information available
Eye Contact	No information available
Skin Contact	No information available
Ingestion	No information available

Component		LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	7732-18-5	LD50 > 90 ml/kg (Rat)	-	-
1-Propanol	71-23-8	LD50 8,038 mg/kg (Rat)	LD50 4,000 mg/kg (Rabbit)	20000 ppm, 1 hr (Rat)

Information on Toxicological Effects

Symptoms No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available
Mutagenic Effects No information available
Carcinogenicity No component >0.1% is listed by NTP, IARC, OSHA or ACGIH as a suspect or potential carcinogen.
Reproductive Effects No information available
STOT – single exposure Central nervous system depression
STOT – repeated exposure Nausea, dizziness, narcosis or drowsiness
Aspiration hazard No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

This material is not expected to be harmful to aquatic life.

Component	Freshwater Algae	Freshwater Fish	Water Flea
1-Propanol	-	LC50: - Pimephales promelas (fathead minnow) – 4,555 mg/l – 96 h	EC50 – Daphnia magna (Water flea) – 3,642 mg/l – 48 h
Potassium chloride	-	LC50: - Pimephales promelas (fathead minnow) – 880 mg/l – 96 h	-

Persistence and Degradability

This product is expected to be inherently biodegradable.

Bioaccumulation/Accumulation

There is no evidence to suggest bioaccumulation will occur.

Mobility

No information available

Results of PBT and vPvB assessment

No information available

Other adverse effects

No information available

Endocrine Disruptor Information

No information available

13. DISPOSAL CONSIDERATIONS

Waste Treatment Methods

Waste Disposal Methods Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated Packaging Improper disposal or reuse of this container may be dangerous and illegal.

14. TRANSPORT INFORMATION

DOT Not regulated
TDG Not regulated
MEX Not regulated
ICAO Not regulated
IATA Not regulated
IMDG/IMO Not regulated
RID Not regulated
ADR Not regulated
ADN Not regulated

15. REGULATORY INFORMATION

European Union Regulations

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

International Inventories

USINV Component listed
CANINV Component listed
EINECS/ELINCS Component listed

ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Component listed

USINV/ TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
CANINV/ DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
ENCS - Japanese Existing and New Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

U.S. Federal Regulations

This product is not known to be a "Hazardous Chemical" as defined by the OSHA Hazardous Communication Standard, 29 CFR 1910.1200.

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40n of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Not applicable

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional or state level pertaining to releases of this material.

U.S. State Regulations

California Proposition 65

This product is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

State Right-to-Know

Massachusetts Right-to-Know Act – Substance List	n-Propanol
New Jersey Worker and Community Right-to-Know Act	n-Propanol
Pennsylvania Right-to-Know Act – Hazardous Substance	n-Propanol
Rhode Island Right-to-Know Act	Not regulated

U.S. EPA Label Information

No information available

16. OTHER INFORMATION

Revision Date: 26-April-2018

Hazard Categories:	Health	Fire	Pressure	Reactivity	Reference 49 CFR 171.8,
Immediate	Yes	No	No	No	OSHA 29 CFR 1910.1200 and
Delayed	No	No	XXX	XXX	SARA 302/311/312/313.

HMIS Hazard ratings: Health 1 Fire 0 Instability 0 Other B (Goggles, gloves)

Hazard Ratings: Least: 0 Slight: 1 Moderate: 2 High: 3 Extreme: 4

This SDS is in accordance to Regulation (EC) No. 1907/2006.

Disclaimer:

IMPORTANT: The information contained in this SDS is correct to the best of our knowledge as of the issue date (or subsequent revision date, if any), and is to be used only as a guide. This SDS does not constitute a guarantee (express or implied) of any kind and we make no warranties of any kind as to the accuracy or completeness of the information contained herein or the merchantability or fitness of the product or this information for a purpose. It is the responsibility of each individual buyer/user to determine the suitability of this information and the product for its intended purposes. This information relates only to the designated product as shipped and may not be valid if the product is used in combination with any other materials or is not used in accordance with our instructions, or is altered in any way. It is the responsibility of the buyer/user to ensure that its activities comply with all applicable government requirements. Since conditions of use of the product are not under direct control of Traceable® Products, it is the duty of the buyer/user to determine the necessary conditions for the safe use of the product. Traceable® Products will not be liable for any injuries or damages resulting from handling, use, misuse or contact with the product.

Attachment E

HS Standards

Implementation Date	ARCADIS HS Standard Name	ARCADIS Design & Consultancy for natural and built assets
31 August 2011	Heat Stress Prevention	
Revision Date	ARCADIS HS Standard No.	Revision Number
17 February 2020	ARC HSIH013	09

Table of Contents

QUICK SHEET **3**

1. POLICY **5**

2. PURPOSE AND SCOPE **5**

2.1 Purpose 5

2.2 Scope 5

3. DEFINITIONS **5**

4. RESPONSIBILITIES **6**

4.1 Project Managers, Associate Project Managers, and Task Managers 6

4.2 Supervisory Personnel 6

4.3 Affected Employees 6

4.4 Corporate Health & Safety 7

5. PROCEDURE **7**

5.1 Safe Work Practices 7

5.2 Risk Factors for Heat-Related Illnesses 8

5.2.1 Personal Risk Factors 8

5.2.2 Environmental Risk Factors 9

5.3 Administrative and Engineering Controls 9

5.3.1 Procedure for Acclimatization 10

5.3.2 Provisions for Water at the Site 10

5.3.3 Access to Shade 12

5.3.4 Monitoring of Weather and Procedures for Heat Waves 13

5.4 Heat Index Table, Heat Index Action Levels, and Recommended Hazard Controls 13

5.4.1 Procedures for High Heat 15

5.4.2 Procedures for Heat Waves 16

5.4.3 Work/Rest Cycle Duration and Frequency Procedures 17

5.4.4 Monitoring Personnel Vital Signs for Determining Work/Rest Cycles 18

5.5 Heat Exhaustion and Heat Stroke Symptoms, First Aid and Emergency Procedures 18

5.5.1 Heat Exhaustion and Heat Stroke Symptoms 18

5.5.2 First Aid Procedures for Heat Exhaustion 19

5.5.3 First Aid and Emergency Procedures for Heat Stroke 19

6. TRAINING 19

6.1 Supervisory Personnel 20

6.2 Affected Employees 20

7. REFERENCES 21

8. RECORDS 21

9. APPROVALS AND HISTORY OF CHANGE 22

EXHIBIT 1 - DEFINITIONS 1

EXHIBIT 2 - ACRONYMS AND ABBREVIATIONS 3

EXHIBIT 3 – Heat Illness Links 4

EXHIBIT 4 – Heat Illness Prevention Plan HASP Supplement Template 5

QUICK SHEET

Applicability

Heat related illnesses (also referred to as “Heat Stress”) are caused by working in hot environments. The hazards associated with working in hot environments can be controlled and minimized by using safe work practices such as applying administrative controls, engineering controls, and providing the appropriate personal protective equipment (PPE).

Need To Know

Project personnel are responsible for understanding the conditions, signs, and symptoms that can lead to heat illness and adhering to the prescribed control and mitigation and methods.

Personal risk factors for heat illness include poor health, age, excessive weight, and pre-existing medical conditions; inadequate acclimation to working in the heat; and a previous episode of heat illness. Environmental risk factors include workload severity and duration, high temperature and humidity, direct sun exposure, and insufficient air movement. If left unchecked, heat illness will progress to the heat stroke stage, which is a life-threatening condition, and emergency personnel should be contacted immediately.

Preventive safe work practices involve avoidance of working in the heat when possible; taking regularly scheduled shade breaks; acclimatization; rotating personnel; avoiding beverages containing caffeine or sugar; staying appropriately nourished; maintaining hydration; and providing readily available fresh, pure, and suitably cool potable water access at all times.

Engineering controls that should be implemented include monitoring and measuring temperature and heat index factors, designing appropriate work/rest cycles, and choosing clothing that allows for wicking of perspiration.

Personnel will report any signs and symptoms of heat illness exhibited by themselves or by other personnel.

Training

Training for heat illness prevention will be provided to all supervisory employees before project assignment. Topics will include the importance of acclimatizing, risk factors, signs and symptoms of various heat illnesses, and procedures to follow in the event of an emergency. Staff working in California, Washington, or other states with specific heat illness standards must receive documented training before assignment. Other affected employees not working in these states must be familiar with this HSS and the information detailed in the Field Health & Safety Handbook. Corporate H&S recommends that all staff that might reasonably be anticipated to be exposed to the risk of heat illness complete the online heat illness training course.

Equipment

Equipment required for work in hot environments may include but is not limited to cooling devices, shade structures and weather monitoring devices. Refer to the Heat Plan H&S Plan Supplement for project or task specific equipment required.

Permits or Forms Required

The Heat Plan H&S Plan Supplement will be prepared during project planning to document and communicate the site-specific heat illness prevention provisions for projects in California and Washington State (best management practice [BMP] for other states).

1. POLICY

It is Arcadis policy that the project team and field staff will work together to protect on-site personnel from the hazards of heat illness when employees are required to work in hot, outdoor places of employment or in other areas where the environmental risk factors for heat illness are present.

Heat-related illnesses may be prevented by using safe work practices including administrative controls, engineering controls, and/or appropriate personal protective equipment (PPE).

2. PURPOSE AND SCOPE

2.1 Purpose

The purpose of this Health & Safety Standard (HSS) is to promote employee awareness regarding heat illness symptoms, direction on the controls and prevention of heat-related illnesses, and guidance on appropriate response actions if symptoms do occur.

2.2 Scope

This HSS applies to Arcadis projects that include, but are not limited to: indoor operations in hot environments or outdoor operations conducted in hot weather such as construction, refining, oil and gas extraction, asbestos removal, and hazardous waste site activities, especially those that require employees to wear semipermeable or impermeable chemical protective clothing (CPC) that are likely to cause heat illness among the exposed. California and Washington State enforce specific occupational heat illness prevention requirements, which are addressed in this HSS. Project teams are advised that, for all other states and U.S. territories, the information provided in this HSS will be used as best management practices (BMPs) for addressing heat-related illness prevention.

Project sites located in California and Washington State must comply with the requirements set forth in this HSS, which has been developed to comply with the California Occupational Safety and Health Administration (Cal/OSHA) Title 8 California Code of Regulations (CCR) 3395 Heat Illness Prevention Standard and the Washington State Outdoor Heat Exposure Regulations 296-62-09510 thru 09560. Project sites in California and Washington State must complete the HASP Supplement and include this HSS as an attachment to the field copy of the HASP, along with the completed HASP Supplement.

3. DEFINITIONS

There are a number of definitions associated with this standard. These definitions are presented in Exhibit 1 of this document. A list of acronyms and abbreviations used in this HSS is provided in Exhibit 2.

4. RESPONSIBILITIES

4.1 Project Managers, Associate Project Managers, and Task Managers

Project Managers (PMs), Associate Project Managers (APMs) and Task Managers (TMs) are responsible for ensuring that heat illness is considered and addressed in project task hazard analysis, risk assessment, and project planning.

Ensure that the project Health & Safety Plan (HASP) addresses the need for adequate water, provisions for shade are available at a job site, and that time is available for staff to eat when the environmental risk factors for heat illness are present.

Ensure that the HASP addresses the need for affected employees to receive applicable training on heat illness prevention and that staff are provided time to complete the training before starting work.

4.2 Supervisory Personnel

Supervisory personnel (e.g., Site Safety Officers [SSOs], PMs, APMs, and/or TMs who are supervising employees working on site and in the heat) must review this HSS and complete training in the prevention of heat related illnesses before supervising employees that work in the heat (risk of heat illness). Supervisory personnel will be trained in heat illness prevention methods and provided procedures in this HSS to follow when an employee exhibits symptoms consistent with possible heat illness including emergency response procedures. Supervisory personnel must ensure that personal risk factors that contribute to heat-related illness are considered before assigning a task where there is the possibility of a heat-related illness occurring (See Section 5.2 for risk factors) and plan for and implement preventive measures and controls when heat advisories are issued for those areas in which staff will be working.

Ensure that effective communication by voice, observation, or electronic means is maintained so that site employees can contact a supervisor, WorkCare, or emergency medical services when necessary. Devices, such as radios or mobile phones or satellite phones, may be used for this purpose only if reception in the area is reliable. If an electronic device does not provide reliable communication in the work area, the project team must ensure that a suitable means of summoning emergency medical services is available.

Ensure that affected employees working on site have received proper training on heat illness prevention.

Ensure that the requirements in this HSS are documented and followed.

Ensure that staff working in the heat have constant access to suitably cool, fresh, pure potable water; are provided routine breaks; and have access to shade.

4.3 Affected Employees

Employees are responsible for understanding the conditions, signs, and symptoms that can lead to heat illness and for using and adhering to the prescribed control and mitigation and methods. Personnel will report to the SSO and/or PM any signs and symptoms of heat illness exhibited by themselves or by other personnel on the project site.

If site personnel have not received heat illness training before conducting work, then site personnel will be educated on heat illness prevention by reviewing this HSS, reading the site HASP (including the site-specific Heat Illness Prevention Plan [HIPP] HASP Supplement as required for California and Washington States), and by attending the daily tailgate meeting.

Employees must review and comply with the provisions of this HSS.

Employees must ensure that they have suitably cool, fresh, pure (potable) water available at all times and that they eat before starting work and during the day when the environmental risk factors for heat illness are present.

Employees will ensure that they have constant access to a shaded area to prevent or recover from heat-related symptoms.

4.4 Corporate Health & Safety

Corporate H&S is responsible for keeping this HSS up to date with regulatory requirements and best work practices.

As requested, provide training to potentially impacted employees and their supervisors on the risks and prevention of heat illness, including how to recognize symptoms and how to respond when they appear.

5. PROCEDURE

5.1 Safe Work Practices

Arcadis staff will follow these general safe work practices when working in hot environments:

- Where determined by regulation, the project site will implement heat illness prevention measures when temperatures in the work area exceed an equivalent heat index temperature of 80 degrees (°) Fahrenheit (F) or 26.6° Celsius (C), accounting for ambient air temperature, humidity, use of semi-permeable and impermeable PPE, and the degree of exertion by the workers.
- Staff will avoid working during periods of high heat ($\geq$ 95°F / 35°C) when possible. This can be accomplished by avoiding scheduling work during the hottest parts of the day, working in cooled enclosures, or providing cooling units in the work area. Severe heat conditions can be cause for stopping or not starting work.
- Allow personnel to acclimatize and adapt to the heat; specifically, those employees new to the project, wearing semi-permeable/impermeable PPE, conducting strenuous tasks, or working in high heat areas.
- The SSO will be particularly watchful of the condition of new employees and stay alert to the onset of heat-related symptoms. New employees will be assigned a “buddy” or experienced co-worker for monitoring each other closely for symptoms of heat illness.
- Whenever possible, rotate personnel in/out of working conditions where heat is a hazard.
- Personnel will have constant access to suitably cool, fresh, pure (“fresh and pure” is defined as being free of odors) water. Where the supply of water is not plumbed or otherwise continuously supplied, water will be provided at no cost to the employee(s) (or employee will be reimbursed) in sufficient quantity at the beginning of the work shift and for the shift duration.

Note: *Thirst cannot be relied on as a guide for hydration. Employees need to drink cool, fresh water throughout the day (four 8 oz cups per hour) during hot weather. Electrolyte replacement drinks or "Sports Drinks" can be used to replace essential minerals lost during sweating. Generally, such drinks should supplement water intake such as one "sports drink" to every three bottles of water. One teaspoon of salt added to every gallon of water could also be used.*

Electrolyte replacement and "Sport Drinks" should not be used as the primary source of hydration or as a substitute for food or water.

- Employees will be notified of the location(s) of the closest drinking water supplies.
- Employees should be advised to choose non-carbonated water over sodas and other beverages containing caffeine or sugar.
- Employees should eat before work and then during the work rotation.
- Employees and the SSO must understand the individual, pre-disposing susceptibilities to heat illness (e.g., previous exposure to heat illness or when taking certain medications).
- Employees must understand the signs and symptoms of heat illness including discomfort, excessive sweating, headache, poor concentration, muscle pain, cramping, dizziness, fatigue, irritability, loss of coordination, vomiting, blurry vision, confusion, lack of sweating, fainting, and seizures.
- Employees must understand first aid and emergency response procedures associated with heat illness.
- If an emergency arises, it is critical that employees understand the process and contact information for requesting emergency medical support. The reception coverage for the site must be evaluated to ensure that adequate communication is in place across the project site and for contacting emergency responders.
- See Exhibit 3 for more safe work practices information.
- See Exhibit 4 for a link to the HASP Supplement, contained in the Standard Excel® HASP template.

5.2 Risk Factors for Heat-Related Illnesses

The personal and environmental risk factors for heat-related illnesses must be evaluated as part of the TRACK process before performing a task.

5.2.1 Personal Risk Factors

Risk factors applicable to the individual employee must be considered when evaluating a working environment for potential exposure to heat illness. The following risk factors should be considered for each individual employee, as these may vary among individuals.

- No recent exposure to high heat work areas is a risk factor because the individual's body is not acclimatized to working in the heat.
- Individual susceptibilities, such as age, weight, degree of physical fitness, use of medications, and certain medical conditions (such as hypertension and diabetes), all affect the potential to experience a heat-related illness.
- A person is at greater risk for heat illness when they are in poor health, are dehydrated, have not eaten, have not been acclimated to working in the heat, or have experienced previous heat illness.

- Working in a hot environment tends to lower the mental alertness and physical performance of an individual. Increased body temperature and physical discomfort promote irritability, anger, and other emotional states that have the potential to cause personnel to overlook safety procedures or to divert attention from hazardous tasks.
- Wearing PPE that increases the potential for the onset of heat illness symptoms is also considered a risk factor for the onset of heat illness.

5.2.2 Environmental Risk Factors

Some risk factors are considered environmental, and therefore apply to all individuals working in a specific area. These are additional to any personal risk factors identified for individual employees. The following risk factors should also be considered when determining the potential for the occurrence of heat illness.

- High temperature and humidity
- Working in direct sun
- No breeze or wind
- Radiant heat or heated air movement
- Conducting strenuous tasks and long duration work.

Working in the heat tends to increase the likelihood of accidents due to the slipperiness of sweaty palms, dizziness, or the fogging of safety glasses. The frequency of accidents, in general, appears to be higher in hot work environments (> 80°F/26.6°C) than in environments involving moderate temperatures.

5.3 Administrative and Engineering Controls

When feasible, Arcadis staff will implement the following administrative and engineering controls:

- Avoid scheduling work during the hottest parts of the day when possible. Alternatively, schedule more strenuous tasks or tasks that require use of semi-permeable or impermeable (e.g. non-breathable, non-venting) PPE early in the morning when conditions are typically cooler than midday or afternoon conditions.
- Monitor the temperature and humidity at the site. These comprise the heat index factors, which convey the magnitude of the heat hazard. Discussion during the daily safety briefings is critical to ensure that this hazard is understood by on-site personnel. Monitoring can be accomplished with on-site instrumentation, especially when working indoors or in enclosed spaces, or by monitoring outdoor weather conditions through the internet, radio, or local weather bureaus. See Section 5.3.4.
- Encourage personnel to wear appropriate clothing that allows for the wicking away of perspiration as a form of evaporative cooling to help cool the wearer.
- Develop and implement appropriate work/rest cycles to allow for adequate cool-down periods.
- Employees suffering from heat illness related symptoms must be allowed, and will be encouraged, to take a preventive cool-down rest in an area with shade that is either open to the air or provided with ventilation or cooling (e.g., cooling stations, misters, air-conditioned spaces). While taking a preventive rest, the employee will be monitored for heat illness symptoms by the SSO and encouraged to remain in the shade and not allowed to return to work until the symptoms are gone. Access to shade will always be permitted.

5.3.1 Procedure for Acclimatization

Supervisors, SSOs, and employees will be trained on the importance of acclimatization, how it is developed, and how to implement an acclimatization process consistent with applicable regulations and the guidelines set forth in this HSS. An employee is at risk of heat illness during a sudden increase in the ambient temperatures of the work environment if not given time to adjust to the changing conditions. Acclimatization (the physiological process of becoming accustomed to changing conditions) is necessary especially in conditions of high heat and for tasks requiring strenuous physical exertion. In addition to acclimatization, other factors can affect employees working at sites where high temperatures are anticipated, such as: poor general health, age, weight, pre-existing medical conditions, and having previously experienced heat illness. Employees are not required to share personal health information such as pre-existing medical conditions. However, including a discussion of how these factors can contribute to the onset of heat illness in the Tailgate Safety Meeting discussion raises individual awareness of the risks involved with heat illness.

A gradual acclimatization period will be implemented for new employees that have not been exposed to a work environment where high temperatures are present (e.g., employees not accustomed to the conditions of the work site will be given slower paced, less physically strenuous tasks during the hot parts of the day and given the more physically strenuous tasks during cooler parts of the day). New employees will be closely monitored during their acclimatization period, which can last up to 2 weeks. The steps taken to reduce the workload intensity for employees not yet acclimated to working in high heat conditions will be documented in the field copy of the HASP Supplement.

The SSO or designee is responsible for implementing the following procedures for acclimatization. These procedures include, but are not limited to, the following:

- Observing employees closely for signs of heat illness. Specific site conditions warranting close observation include, but are not limited to, any day when the temperature is 80°F/26.6°C or greater and is at least 10°F (6°C) higher than the average daily temperature for the preceding 5 days.
- Providing effective acclimatization procedures for employees during exposure to a sudden increase in temperature. The SSO will be aware of those employees who are not yet acclimatized to sudden changes in temperature and will attend to those employees to prevent heat illness.
- Monitoring weather daily. The SSO will be on the lookout for sudden heat wave(s) or increases in temperatures that employees haven't been exposed to for several weeks or longer per Section 5.3.4 Weather Monitoring Procedures, detailed in this HSS.
- Implementing specific Work/Rest Cycles based on monitoring vital signs of on-site personnel, see Section 5.4.3.

5.3.2 Provisions for Water at the Site

At the start of work, the importance of drinking water, the signs and symptoms of heat illness, the location(s) of the water/water coolers, and the schedule of water/rest breaks will be communicated to all staff during each Tailgate Safety Meeting. The SSO or the designated alternate will provide for distribution of suitably cool, fresh, clean potable (drinking) water at the project site. An adequate supply of suitably cool, fresh, clean potable water will always be maintained on site to allow each employee to consume 1 quart (1 liter [1 L]) of water per hour (i.e., 2 gallons [8 L] per employee for an 8-hour shift).

Where unlimited drinking water is not immediately available from a plumbed system or otherwise continuously supplied, water will be provided to staff via coolers containing bottled water or insulated drinking water dispensers (verify that coolers/dispensers are of a sufficient capacity to support the amount of field staff present) accompanied with disposable cups to maintain sanitary conditions for potable water consumption. When conditions are anticipated to exceed 80°F/26.6°C, SSOs and/or supervisors will encourage employees to drink water before they "feel" thirsty. Ideally, drinking 8 ounces of water every 15 minutes will allow the body to remain properly hydrated while working in high temperature conditions.

If the decision is made not to provide all site employees the full-shift quantity of drinking water at the start of a work shift (i.e., 2 gallons [8 L] per employee for an 8-hour shift), then effective procedure(s) must be documented and implemented to ensure drinking water replenishment to allow each employee to drink 1 quart (1 L) per hour. This means that a sufficient quantity of water must always be present and readily accessible to allow every employee to consume at least 1 quart of water per hour until the water supply has been replenished.

- Coolers containing bottled water or drinking water coolers should be maintained to provide for a minimum of 3 hours of water per employee (at least 1 quart [1 L] of water will be made available per employee per hour) to account for a sufficient quantity of water to always be present.
- Water supplies will be positioned as close as reasonably possible to site workers. Ideally, water supplies will be positioned within 50 feet of employee activity or in vehicles used by employees to gain access to individual work areas; however, coolers will be stationary when employees are essentially stationary. Placing water only in shaded areas or by toilet facilities is not sufficient, particularly at large work sites or at multi-story construction sites. Drinking water sources need to be close enough to workers to allow for routine consumption.
- Coolers will be inspected and replenished with water and ice for cooling periodically (e.g., every 30 minutes, or based on site temperature and number of employees present) by the SSO or designee.
- Ice will be added to the coolers, as necessary, during the required inspections.

  ***Note**: When the temperature exceeds 90°F (32°C), inspections will be increased in frequency and ice will be added as needed to keep water cool*.

- Ice will be distributed from a separate cooler or service and added to coolers to ensure that the drinking water remains potable and appropriately cool for employee consumption. Ice used to chill the water will be stored separately to remain sanitary. Sanitary ice storage can include storage of ice in bags when bottled water is used or use of separate storage coolers when using drinking water dispensers.
- Coolers will be inspected and cleaned after each work shift or before starting work each shift. The SSO will oversee cooler maintenance and provide appropriate cleaning supplies.
- The SSO or designee will document the weekly review of the HASP Supplement and make the necessary adjustments each week for weather changes or when new employees are introduced to the project. The reminder may include water ordering information if purchased in bulk from an appropriate supplier.

5.3.3 Access to Shade

The project team is responsible for making sure that the necessary equipment to provide shade is available at the project site. The temperature threshold for shade to be in place is when site temperatures exceed 80°F/26.6°C. The SSO or designee is responsible for directing how shade will be coordinated and placed. The term "shade," for the purposes of complying with applicable regulations, will be defined as "The blockage of sunlight to the extent that no shadow is cast while sitting in the designated area." Flecks of sunlight are acceptable as long as, overall, the shade provides substantially complete blockage of sunlight. Where trees or other vegetation are used to provide shade, the thickness and shape of the canopy must cast sufficient shadow, given the changing angles of the sun, to protect employees from the sun during the entire shift.

At the start of each shift, the importance of taking shade breaks, recognizing the signs and symptoms of heat illness, the duration of shade breaks (> 5 minutes per break), and the shade location will be addressed during each Tailgate Safety Meeting. Access to shade must be allowed at all times.

> ***Note**: Where required by regulation, shade breaks will be taken at a minimum rate of 15 minutes of shade for every 2-hour work period. As temperature increases shade breaks will increase in frequency. See the Heat Index table in Section 5.4 for Heat Index specific Action Levels defining shade break frequency and duration.*

Establishing adequate shaded areas for employees involves:

- If the temperature at the site exceeds 80°F, shade structures will be opened and made available to employees.
- Shaded areas must be able to accommodate all employees taking a recovery or rest break including those employees who are on meal breaks. This does not mean that the shaded area(s) must provide shade to accommodate all employees on a site or working a shift *at the same time.* An example includes rotating routine breaks among employees. Also, additional portable shade structures can be erected as needed.
- Employees must have enough shaded space to sit comfortably while fully shaded and to allow for sitting without being in physical contact with each other.

  > ***Note**: When establishing shade, it is important to ensure that employees who desire access to shade will not be deprived of it due to lack of space. One such procedure to address this point would be to rotate employees in and out of shaded areas to ensure that all have sufficient access for the 15-minute interval required. Another option would be to have additional shade structures on hand to deploy as needed.*

- Shade structures will be relocated to follow the crew for moving tasks.
- Shade structures will be placed within 50 feet of the work area if practical. A key consideration when placing a shade structure is that it is a short walk away (e.g., 2 to 3 minutes) from the work area. This consideration becomes critical as the temperature rises above 80°F/26.6°C.
- Where it is not safe or feasible to provide shade, notes will be made to the HASP Supplement of the unsafe or unfeasible conditions. The SSO will also document the steps taken to provide alternative cooling measures equivalent to providing shade, such as vehicles equipped with air conditioning or air-conditioned office trailers.
- An employee who takes a preventive cool-down rest:

- Will be monitored by the SSO and asked if they are experiencing symptoms of heat illness.
- Will be encouraged to remain in the shade.
- Will not be ordered back to work until any signs or symptoms of heat illness have abated.
- If an employee exhibits signs or symptoms of heat illness while taking a preventive cool-down rest, the SSO will provide appropriate first aid or emergency response.

5.3.4 Monitoring of Weather and Procedures for Heat Waves

The SSO or designee will be trained in consulting weather forecasting resources and is responsible for checking the extended weather forecast before work. Work schedules will be adjusted in advance, considering whether high temperatures or a heat wave is expected. The SSO will be responsible for obtaining thermometers before the start of the project and ensuring that they are readily accessible or posted on site for ease of monitoring throughout the workday. The following web pages are considered accurate and reliable sources for checking weather forecasts:

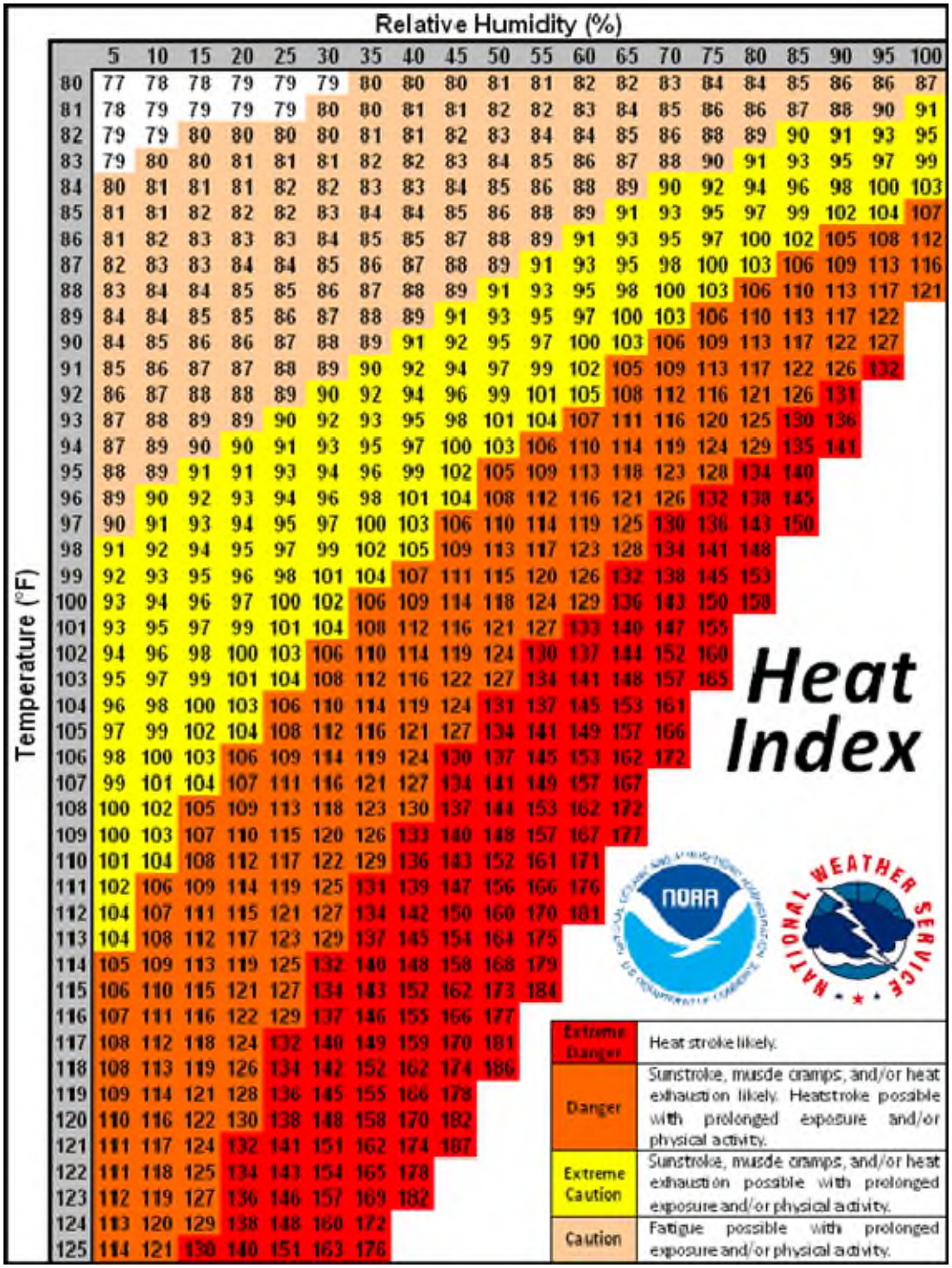
- http://www.noaa.gov/
- https://www.weather.gov/

Before starting each shift, the SSO or designee will review the forecasted temperature and humidity for the work site and compare conditions against the National Weather Service Heat Index (See Table 1) to evaluate the risk level for heat illness. A “heat wave,” as defined by the National Oceanic and Atmospheric Administration (NOAA), is a period of abnormally and uncomfortably hot and unusually humid weather.” Typically, a heat wave lasts 2 or more days.

5.4 Heat Index Table, Heat Index Action Levels, and Recommended Hazard Controls

The following action levels and controls information are intended to be used as recommended guidance by project teams for work conducted in all states except where heat-related illness hazard controls are required by regulation.

Table 1 – Heat Index Table



During the planning stages for future field work, develop a communications plan where field staff will contact the project team when conditions are expected that will trigger Heat Index Action Levels.

Use the information in Table 1 to determine if employees will be exposed to a combination of temperature and humidity that pose a risk for heat illness. If the site conditions are characterized as falling inside the ranges for “Extreme Caution,” "Danger," or “Extreme Danger” for heat illness, additional steps must be taken. It is important to note that the NOAA Heat Index was developed with an understanding that partial shade and light wind conditions are present. Work conducted in direct/full sunlight without light wind conditions (e.g., no partial shade or no breeze) adds up to 15°F (8°C) to the Heat Index value.

Each Heat Index level detailed below is additive.

- If the Heat Index indicates "CAUTION" 80° to 90°F (26° to 32°C), implement one or more of the following:
  - Provide and direct hydration, schedule rest breaks, ensure lightweight clothing is worn, provide break areas with shade / ventilation / air conditioning.
- If the Heat Index indicates "EXTREME CAUTION" 90° to 105°F (32° to 40.5°C), implement all the above and add one or more of the following:
  - Provide light-duty PPE, cooled break areas, and shaded work areas.

    Note: *“Light-duty PPE” includes items such as hard hat sunshades, sun hats, dry or wet evaporative cooling vests, microfiber cooling towels, scarves, headbands, hard hat neck shades, hard hat suspension inserts, and sweatbands.*

- If the Heat Index indicates "DANGER" 105° to 130°F (40.5° to 54.4°C.), implement all the above and add one or more of the following:
  - Provide cooled work areas, modify work schedule, provide heavy-duty PPE,and personnel physiological monitoring.

    Note: *“Heavy-duty PPE” includes phase-change cooling vests, and gel pack and ice pack equipped cooling vests. Ice pack vests generally offer the coldest option and should not be worn directly against the skin. Consider engineering controls such as forced ventilation.*

- If the Heat Index indicates "EXTREME DANGER" +130°F (+54.4°C) or greater, Stop Work until conditions change or hazards are effectively controlled using items listed above. At this range of temperatures it is critical to implement personnel vital sign monitoring for determining the appropriate frequency and duration of Work / Rest cycles.

5.4.1 Procedures for High Heat

High heat procedures will be implemented when the temperature rises above 95°/35°C. High heat procedures include:

- Hold a Tailgate Safety Meeting to review the high heat procedures, encourage employees to drink plenty of water, and remind employees of the importance of taking a preventive or recovery cool-down rest when necessary.
- Arcadis will ensure that effective employee observation and monitoring procedures are put in place including:

  - SSO or designee will supervise 20 or fewer employees.
  - The “Buddy System” is mandatory.
  - Regular communication with SSO or designee will be implemented via mobile phone or radio.
  - One or more employees will be designated as authorized to contact emergency medical services and communicating that, if no designate is identified and the SSO is unavailable, any employee can call for emergency medical assistance.
- Employees will be reminded throughout the shift to drink plenty of water.
- The “Buddy System” must be implemented for worker monitoring. Particular attention will be paid to new employees or employees who have yet to acclimate to high heat conditions. Additionally, frequent communication will be maintained with employees working by themselves (via cell phone or two-way radio), to be on the lookout for possible symptoms of heat illness.
- During high heat conditions, employees will be provided with a minimum 10-minute cool-down period every 2 hours.
- Employees will be regularly observed for alertness and signs and symptoms of heat illness to be documented in the field book or field log.
- When the SSO is not available, an alternate responsible person must be assigned to look for signs and symptoms of heat illness. Such a designated observer will be trained to know what steps to take if heat illness occurs.

5.4.2 Procedures for Heat Waves

A “heat wave,” as defined by NOAA, is a period of abnormally and uncomfortably hot and unusually humid weather. Typically, a heat wave lasts 2 or more days. A "heat wave," as defined for the purposes of this HSS, is when temperatures are sustained above 80°F (26°C), or if site conditions indicate the potential for “Extreme Caution,” "Danger," or “Extreme Danger” per Table 1, the following steps will be taken:

- The SSO or designee, in coordination with the project team, will use their Stop Work Authority; evaluate the following actions; and document the action in the daily field log:
  - Modify the work shift or cut the work day short (e.g., 12:00 pm).
  - Reschedule the work (e.g., conduct the remaining work during cooler times of the day) or suspend strenuous tasks.
  - Use Stop Work Authority to cease work for the day.
- If schedule modifications are not possible, the Heat Illness HASP Supplement will be reviewed before work resumes. At a minimum, procedures for heat illness prevention, the provisions for high heat procedures, the weather forecast, and emergency response protocols will be reviewed.
- Employees will be provided with additional water and rest breaks and will be observed more frequently. They will also be reminded throughout the shift to drink plenty of water.
- During work activities and rest breaks, employees will be observed for signs and symptoms of heat illness.
- All employees will maintain frequent communication with the SSO or designee, who will be monitoring employees for possible symptoms of heat illness.

***Note**: At large project sites where the SSO is unable to be near the employees (to directly observe or communicate with them), communication via a cell phone or radio may be used for this purpose if reception in the area is reliable.*

5.4.3 Work/Rest Cycle Duration and Frequency Procedures

The occurrence of heat illness depends on a variety of factors. All workers, regardless if they are wearing permeable or semi-permeable clothing, should be monitored when conditions warrant monitoring (e.g., when temperatures exceed 80°F/26.6°C). If semi-permeable clothing is worn (e.g., not standard cotton or synthetic work clothing), it is recommended to begin monitoring those workers when temperatures exceed 70°F in the work area and prioritize workers completing strenuous tasks. Personnel monitoring becomes particularly important when work is conducted indoors, includes strenuous tasks, and additional PPE is worn (such as Level C respiratory protection or CPC). If semi-permeable clothing, Level C PPE, or CPC is not worn, follow the Heat Index table instructions and prepare to implement monitoring as part of the high heat measures discussed in Section 5.4.1. Table 2 below details procedures to be followed to determine an appropriate work/rest cycle with the default rest cycle duration beginning with a 15-minute period every hour when working in temperatures exceeding 90°F.

***Note:** Warning signs include: When a person's sustained (e.g., several minutes) heart rate exceeds 180 beats per minute (bpm) minus their age (e.g., 180 - age = X) for individuals with normal cardiac performance per their physician; or a body core temperature exceeds 101.3°F/38.5°C for acclimatized workers or 100°F/38°C for unacclimated workers; a recovery heart rate at 1 minute after a peak work effort is greater than 120 bpm; or there are symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.*

Table 2 - Suggested Frequency and Duration of Work/Rest Cycles Applying Physiological Monitoring of Acclimatized Personnel

Adjusted Air Temp. [1]	Wearing Permeable PPE [2]	Wearing Impermeable PPE [3]
> 90°F/32°C	After ea. 45 mins. of work	After ea. 15 mins. working
87.5 to 90°F/30.8 to 32.2°C	After ea. 60 mins. of work	After ea. 30 mins. working
82.5 to 87.5°F/28.1 to 30.8°C	After ea. 90 mins. of work	After ea. 60 mins. working
77.5 to 82.5°F/25.3 to 28.1°C	After ea.120 mins. of work	After ea. 90 mins. working
72.5 to 77.5°F/22.5 to 25.3°C	After ea.150 mins. of work	After ea. 120 mins. working

Notes:

[1] - Adjusted air temp (ta adj) calculation: ta adj F = ta F + (13 x % sunshine). Measure the air temperature (ta) with a thermometer (shielded from radiant heat). Estimate the percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[2] - Permeable PPE consists of cotton clothing with long sleeves and pants or breathable coveralls.

[3] - Add 1.8 °F for Tyvek coveralls; add 5.4 °F for heavy clothing; add 19.8 °F for impermeable/semi-impermeable PPE - Level A/B suits)

5.4.4 Monitoring Personnel Vital Signs for Determining Work/Rest Cycles

To conduct heart rate monitoring, first collect and record a resting heart rate to establish the baseline value for each individual to be monitored. Count the heartbeats at the radial pulse (located on the inside of the wrist below the base of the thumb) during a 30-second interval. During rest cycles, count and record the heart rate as early as possible at the beginning of the rest cycle and again 3-5 minutes later. The pulse rate should fall rapidly and soon approach the individuals baseline heart rate level. The heart rate will remain elevated for a worker experiencing onset of heat illness.

- If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest period the same.
- If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one third.

Body temperature monitoring is used in conjunction with heart rate monitoring to evaluate an individual's condition and ability to sufficiently cool down during breaks when working in hot environments. Monitor and record body temperature orally using a clinical thermometer (3 minutes under the tongue and before drinking liquids) or using an infrared forehead swipe thermometer per manufacturer's directions. Take temperatures at the end of the work period before the rest cycle.

- If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one third without changing the rest period.
- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one third.
- Do not permit a worker to wear a semi-permeable or impermeable garment when the oral temperature exceeds 100.6°F (38.1°C).

5.5 Heat Exhaustion and Heat Stroke Symptoms, First Aid and Emergency Procedures

Emergency procedures include recognizing the more serious symptoms associated with the third and fourth stages of heat-related illness: heat exhaustion and heat stroke. A critical step to having effective emergency procedures involves ensuring that effective communication has been established and maintained to contact emergency responders.

5.5.1 Heat Exhaustion and Heat Stroke Symptoms

Signs of heat exhaustion include:

- Cool, moist, pale, or flushed skin
- Heavy sweating
- Headache
- Nausea, dizziness, and exhaustion
- Normal or below normal body temperature.

Signs of heat stroke include:

- Hot, red skin, which can be dry or moist from exercise
- Changes in consciousness
- Rapid, weak pulse

- Rapid, shallow breathing, vomiting
- A person experiencing heat stroke can have a very high body temperature—sometimes as high as 106°F (41°C).

5.5.2 First Aid Procedures for Heat Exhaustion

If an employee is determined to be suffering from heat exhaustion, perform the following steps:

1. Move the person to a cooler place.
2. Remove or loosen tight clothing and apply cool, wet cloths, such as towels or sheets soaked in water.
3. If the person is conscious, give him or her cool water to drink. Make sure the person drinks slowly. Give a half glass of cool water every 15 minutes.
4. Contact the employees' supervisor, the project manager, and Work Care 1-888-449-7787 (US & Canada).
5. Let the person rest in a comfortable position.
6. Watch carefully for changes in his or her condition.

Do not give liquids that contain alcohol or caffeine because they can cause further dehydration, making conditions worse.

5.5.3 First Aid and Emergency Procedures for Heat Stroke

Heat stroke is a life-threatening situation. If you suspect that someone is suffering from heat stroke, call 9-1-1 or the local emergency number immediately.

1. Move the person to a cool place.
2. Loosen tight clothing.
3. Remove perspiration-soaked clothing.
4. Apply cool, wet cloths to the skin.
5. Fan the person.
6. If conscious, give small amounts of cool water to drink.
7. Place the person on his or her side.
8. Contact the employees' supervisor, the project manager, and Work Care 1-888-449-7787 (US & Canada).
9. Continue to cool the person using ice or cold packs on the wrists, ankles, groin, and neck and in the armpits.
10. Continue to check breathing and circulation.

Do not give liquids that contain alcohol or caffeine because they can cause further dehydration, making conditions worse. Ensure that 911 or the local emergency number is called if the person refuses water, vomits, or starts to lose consciousness.

Emergency contact telephone numbers and hospital directions/map must be included in each site-specific HASP for employee reference.

6. TRAINING

The Arcadis Heat Illness Prevention online training offered through the Arcadis Learning Center is required to be completed before Supervisory Personnel and Affected Employees working in California or Washington States will be permitted to begin work. Project teams conducting work in

locations other than California or Washington States are expected to complete the training before conducting work as defined in the H&S training matrices specific to each Business Line. Completion of the training once is generally considered sufficient to satisfy the training requirement; however, the training may be required to be completed again as determined by Arcadis policy or management, or by client or specific state requirements. Refresher training is encouraged for all staff that infrequently conducts or supervises work where heat illness is a hazard.

6.1 Supervisory Personnel

Personnel supervising staff on a California or Washington State site who might reasonably be anticipated to be exposed to the risk of heat illness will be provided training in the following topics before assignment:

- The environmental and personal risk factors for heat illness
- The importance of frequent consumption of small quantities of water; consuming 8 fl. oz. every 15 minutes or 32 fl. oz. per hour, when the work environment temperature exceeds 80°F/26.6°C because employees are more likely to be sweating more than usual in the performance of their duties.
- The importance of staying appropriately nourished and hydrated
- The importance of acclimatizing before work
- The different types of heat illness and the common signs and symptoms
- The importance for employees to immediately report to the employer, directly or through the employee's supervisor, symptoms or signs of heat illness in themselves or in co-workers
- The procedures to follow for responding to symptoms of possible heat illness, including how emergency medical services will be provided should they become necessary
- The procedures for contacting emergency medical services, and if necessary, for transporting employees to a point where they can be reached by an emergency medical service provider
- The procedures for ensuring that, in the event of emergency, clear and precise directions to the work site can and will be provided as needed to emergency responders.

In addition, these supervisory personnel must review and understand:

- This Heat Illness Prevention HSS and the associated HASP Supplement
- How to implement the emergency response procedures detailed in the site-specific HASP when an employee exhibits symptoms consistent with possible heat illness
- Weather monitoring reports as detailed in the field Health & Safety Handbook
- How to monitor weather reports and how to plan for and respond to hot weather advisories.

This training will be documented within the Learning Center database along with details on the subject matter covered and date of training recorded.

6.2 Affected Employees

For those employees who work in California or Washington State, or when using this HSS as a BMP in any other state and might reasonably be anticipated to be exposed to the risk of heat illness, training in the following topics is required before assignment:

- The environmental and personal risk factors for heat illness
- The importance of frequent consumption of small quantities of water; 8 fl. oz. every 15 minutes or 32 fl. oz. per hour when the work environment temperature exceeds 80°F/26.6°C and employees are more likely to be sweating more than usual in the performance of their duties
- The importance of acclimatizing
- The different types of heat illness and the common signs and symptoms
- The importance for employees to immediately report to the employer, directly or through the employee's supervisor, symptoms or signs of heat illness in themselves or in co-workers
- The procedures for responding to symptoms of possible heat illness, including how emergency medical services will be provided should they become necessary
- The procedures for contacting emergency medical services, and if necessary, for transporting employees to a point where they can be reached by an emergency medical service provider
- The procedures for ensuring that, in the event of emergency, clear and precise directions to the work site can and will be provided as needed to emergency responders.

This training will be documented within the Learning Center database along with details on the subject matter covered and date of training recorded.

Note: *For those staff who are not working in California, Washington State, or other states that have specified heat illness training requirements, staff that might reasonably be anticipated to be exposed to the risk of heat illness will (at a minimum) review the information detailed in the Field Health & Safety Handbook and this HSS. Corporate H&S recommends that all staff that might be reasonably be anticipated to be exposed to the risk of heat illness complete the online heat illness training course through the Learning Center.*

7. REFERENCES

- Occupational Safety and Health Administration (OSHA) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities Section 8 "Heat Stress and Other Physiological Factors" OSHA, National Institute for Occupational Safety and Health (NIOSH), United States Environmental Protection Agency (USEPA), U.S. Coast Guard (USCG). Chapter 8. 1985.
- OSHA Technical Manual – Section III Chapter 4
- National Institute of Occupational Safety and Health (NIOSH) Publication Number 86-112
- American Conference of Governmental Industrial Hygienists (ACGIH) "Guidelines for Limiting Heat Strain" 2018
- American Red Cross 2007
- Cal/OSHA Title 8 CCR 3395 Heat Illness Prevention Standard and Title 8 CCR 3202 Injury and Illness Prevention Program
- Washington State Outdoor Heat Exposure Regulations 296-62-09510 thru 09560
- See Exhibit 3 for links to additional regulatory resources.

8. RECORDS

Heat illness training records will be maintained by the Arcadis Training Team.

Heat Plan H&S Plan Supplement will be maintained with project files.

9. APPROVALS AND HISTORY OF CHANGE

Approved by: Julie Santaniello, CSP – Corporate H&S Manager of Technical Programs



History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
31 August 2011	01	Tony Tremblay & Mija Coppola	Original document
13 March 2012	02	Tony Tremblay	Detailed Supervisory Personnel requirement to plan/detail preventive measures/controls when heat advisories are issued; clarified training requirements for staff and supervisory personnel; inserted heat advisory and excessive heat warning definitions
19 June 2012	03	Pat Vollertsen	Information added about nourishment
16 June 2014	04	Pat Vollertsen & Alec MacAdam/Tony Tremblay	Revised standard format and History of Change Section. Updated to include specific prescriptive language to address Cal OSHA and Washington State requirements. Inclusion of HASP supplement and preparation guidance. Clarification of the use of sports/electrolyte drinks
7 August 2014	05	Alec MacAdam	Update guidance for use of “Sports Drinks”

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
6 April 2015	06	Alec MacAdam	Revise temperature threshold from 85° to 80°F, provisions for shade, guidance for preventative rest breaks, revised high heat procedures and clarification of acclimatization procedures
15 March 2017	07	Alec MacAdam & Denis Balcer/ Tony Tremblay & Julie Santaniello	Updated brand. Updated links to Exhibits 2 & 3, Revised Admin. Controls in Section 5.3, Additional regulatory detail in Sections 5.3.2 and 5.3.3. Added Section 5.4 Heat Index Action Levels and Recommended Hazard Controls. Revised the HIPP HASP Supplement to reflect changes in the HSS.
2 January 2020	08	Alec MacAdam	Updated format. Clarifications in Roles & Responsibilities § 4; Updated Safe Work Practices in § 5.1; Updated Administrative and Engineering Controls in § 5.3; Updated Heat Index Table 1 § 5.4; Added Work/Rest Cycle Guidance § 5.4.3; and Personnel Vital Signs Monitoring § 5.4.4; Revised Heat Exhaustion and Heat Stroke Emergency Procedures; Updated References; Updated HASP Supplement with above noted revisions on 6 May 2019.
17 February 2020	09	Julie Santaniello	Updated Heat Index ranges in Section 5.4 so text matches Table 1.

EXHIBIT 1 - DEFINITIONS

Acclimation – A process by which the body adjusts to increased heat exposure. The body needs time to adapt when working in hotter environments. Employees working in a hot environment are more likely to develop heat illness if not allowed or encouraged to allow their body to acclimate when a heat wave strikes or when starting a job that newly exposes them to heat. Acclimatization is fully achieved in most people within 4 to 14 days of regular work involving at least 2 hours per day in the heat.

Excessive Heat Warning - Extreme Heat Index making it feel very hot, typically above 110°F (43°C) for 3 hours or more during the day for two consecutive days or above 110°F (43°C) at any time. Specific criteria vary over different county warning areas.

Heat Advisory - Issued when the Heat Index is expected to exceed 105°F (40°C) during the day and 80°F (27°C) during the night for at least two consecutive days.

Heat Cramps – Normally caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. Salt tablets should not be taken.

Heat Collapse – Commonly known as “Heat Stress,” technically referred to as heat syncope. Heat collapse or syncope (fainting) is the condition where the brain does not receive enough oxygen because blood pools in the extremities. To prevent heat collapse, the employee should gradually acclimatize to the hot environment.

Heat Exhaustion – Less severe than heat stroke, but the victim must be treated as soon as possible. Symptoms include clammy and moist skin; pale or flushed complexion; sweating along with extreme weakness or fatigue, giddiness, nausea, or headache; and (in more serious cases) vomiting or loss of consciousness.

Heat Fatigue – The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the person from the heat before a more serious heat-related condition develops.

Heat Index – an “apparent temperature” that is a measure of how hot it feels when relative humidity is added to the actual air temperature.

Heat Rashes – Also referred to as prickly heat, is the most common problem in hot work environments. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive.

Heat Stress – A physiological condition induced when high temperatures and humidity compromise the body’s ability to cool itself, resulting in heat-related illness.

Heat Stroke – The body's system of temperature regulation fails, and body temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. **Heat stroke is a medical emergency.** The primary signs and symptoms of heat stroke include confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature.

Heat Wave - A “heat wave,” as defined by NOAA, is a period of abnormally and uncomfortably hot and unusually humid weather. Typically, a heat wave lasts 2 or more days. A "heat wave," as defined for the purposes of this HSS, is when temperatures are sustained above 80°F.

Provision of Water - Employees will have access to potable drinking water meeting the requirements of Section 5.3.2 of this HSS including but not limited to the requirements that it be fresh, pure (water must be potable and free of odors), suitably cool (the water must be cooler than the ambient temperature but not so cool as to cause discomfort), and provided to employees free of charge. The water will be located as close as practicable to the areas where employees are working. Where drinking water is not plumbed or otherwise continuously supplied, it will be provided in sufficient quantity at the beginning of the work shift to provide 1 quart per employee per hour for drinking for the entire shift. Employers may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow employees to drink 1 quart or more per hour. The frequent drinking of water will be encouraged. The purpose of requiring that water is “fresh, pure, suitably cool, and provided to employees free of charge” and “located as close as practicable to the areas where employees are working” is to encourage workers to drink water often and avoid making the workers interrupt their work in order to do so. To ensure that water is fresh, pure, and suitably cool, Cal/OSHA advises that employers or supervisors visually examine the water and pour some on their skin.

Shade - The blockage of direct sunlight. Canopies, umbrellas, and other temporary structures or devices may be used to provide shade. One indicator that blockage is sufficient is when objects do not cast a shadow in the area of blocked sunlight. Shade is not adequate when heat in the area of shade defeats the purpose of shade, which is to allow the body to cool. For example, a car sitting in direct sunlight does not provide acceptable shade to a person inside it unless the car engine is operating with air conditioning on. Shade may be provided by any natural or artificial means that does not expose employees to unsafe or unhealthy conditions and that does not deter or discourage access or use.

Transient Heat Fatigue – The temporary state of discomfort and mental or psychological strain arising from prolonged heat exposure. Employees unaccustomed to the heat are particularly susceptible and can suffer, to varying degrees, a decline in task performance, coordination, alertness, and vigilance.

EXHIBIT 2 - ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ANA	Arcadis North America
APM	Assistant Project Manager
Arcadis	Arcadis U.S. Inc.
BMP	Best Management Practice
BPM	Beats Per Minute
°C	Degrees Celsius
Cal/OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations
CPC	Chemical Protective Clothing
°F	Degrees Fahrenheit
HASP	Health & Safety Plan
HIPP	Heat Illness Prevention Plan
HS	Health and Safety
H&S	Health and Safety
HSS	Health and Safety Standard
L	Liter
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
OSHA	Occupational Safety and Health Administration
Oz	Ounce
PM	Project Manager
PPE	Personal Protective Equipment
SSO	Site Safety Officer
TM	Task Manager

EXHIBIT 3 – Heat Illness Links

CDC / NIOSH Occupational Exposure to Heat and Hot Environments - 2016

Heat Illness Symptoms

Heat Illness Thermometer and PPE

OSHA Working Outdoors Fact Sheet

OSHA Worker Protection from Heat Stress

California Heat Illness Prevention Enforcement Q&A

Washington State Outdoor Heat Exposure Enforcement Procedures

EXHIBIT 4 – Heat Illness Prevention Plan HASP Supplement Template

The Heat Plan HASP Supplement is contained in the Standard Excel® HASP template. The most current version of the HASP template is located on the ANA H&S Intranet site on the "Forms and Templates" page.

Link to the H&S "Forms and Templates" page:
https://arcadiso365.sharepoint.com/sites/naintranet/en-us/HealthandSafety/FormsTemplates

The Heat Plan supplement can be accessed by right clicking on the lower toolbar of the excel HASP template and selecting "Unhide" and selecting the "Heat Illness Prevention Plan."

EXECUTIVE SUMMARY

It is the policy of Arcadis to prevent or minimize all occupational exposure to respirable crystalline silica, through the use of engineering and administrative controls, and personal protective equipment (PPE). Respirable crystalline silica particles are typically at least 100 times smaller than ordinary sand found on beaches or playgrounds, and is generated by high-energy operations including but not limited to cutting, sawing, grinding, drilling and crushing stone, rock, concrete, brick, block and mortar, or when abrasive blasting with sand. “Silica-containing dust” in this Health & Safety Standard (HSS) refers to “Respirable Crystalline Silica” unless otherwise specified.

The following personal exposure limits are established for silica-containing dust by inhalation:

- OSHA ACTION LEVEL
    - Time Weighted Average (TWA) – 25 micrograms per cubic meter of air (µg/m^3) silica in air averaged over an 8-hour period
- OSHA PERMISSIBLE EXPOSURE LEVELS (PELs)
    - TWA – 50 µg/m^3 silica in air averaged over an 8-hour period.
- ACGIH THRESHOLD LIMIT VALUES (TLVs)
    - TWA – 0.025 mg/m^3 silica-in-air averaged over an 8-hour period for the respirable crystalline silica fraction which are those particles that enter deep into the lung where gas exchange takes place.

The Action Level, PEL, and TLV apply to three forms of silica-containing dust: Quartz, Cristobalite, and Trydimite. Quartz is by far the most common form of silica-containing dust found at construction workplaces.

This HSS applies to all occupational exposures to silica-containing dust, except where employee exposure will remain below 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions. Projects where exposure to silica-containing dust will occur will comply specified exposure control methods or alternative exposure control methods.

Initial silica awareness training is required for all employees who must comply with this HSS and/or are assigned to a work area where silica-containing dust is likely to be generated. A written Exposure Control Plan is required when exposure to silica-containing dust is or can reasonably be expected to exceed 25 µg/m^3 of silica-containing dust in air averaged over an 8-hour period. A Competent Person will implement the written plan and make frequent and regular inspection of job sites, material, and equipment.

Initial and Annual Medical Surveillance is required if:

- If employee personal exposures are reasonably expected to exceed the Action Level on at least 30 calendar days per year.
- If work is to be conducted where silica-containing dust concentrations are reasonably expected to exceed the PEL.
- All air monitoring and personal exposure monitoring records shall be kept for 30 years.

1. POLICY

Arcadis understands the hazards of personal exposure to respirable crystalline silica (silica-containing dust), and will implement the appropriate controls to minimize or eliminate the hazards associated with silica-containing dust. These controls will focus first on engineering controls to mitigate silica-containing dust hazards where appropriate and practical. In most circumstances, dust suppression (wetting cutting surface) is effective in managing silica-containing dust. Work practices (administrative controls) may also be implemented as appropriate and practical. Wherever engineering and administrative controls are not sufficient to reduce employee exposure to or below the OSHA Permissible Exposure Limit (PEL), Arcadis will nonetheless use the controls to reduce employee exposure to the lowest feasible level and will supplement them with the use of respiratory protection that complies with the requirements of Section 5.5.

2. PURPOSE AND SCOPE

2.1 Purpose

This Health & Safety Standard (HSS) meets the Title 29 Code of Federal Regulations (CFR) Part 1926.1153 (Construction) requirements of the U.S. Occupational Safety and Health Administration (OSHA) regulation.

2.1.1 Exposure to Silica-Containing Dust

This HSS and associated standards provides information to protect Arcadis employees, subcontractors, and other affected personnel from exposures to silica-containing dust while conducting work on Arcadis projects.

The following personal exposure limits are established for silica-containing dust by inhalation:

- OSHA ACTION LEVEL
    - Time Weighted Average (TWA) – 25 micrograms per cubic meter of air ($\mu g/m^3$) silica in air averaged over an 8-hour period
- OSHA PERMISSIBLE EXPOSURE LEVELS (PELs)
    - TWA – 50 $\mu g/m^3$ silica in air averaged over an 8-hour period.
- ACGIH THRESHOLD LIMIT VALUES (TLVs)
    - TWA – 0.025 mg/m^3 silica-in-air averaged over an 8-hour period for the respirable crystalline silica fraction which are those particles that enter deep into the lung where gas exchange takes place.

The Action Level, PEL, and TLV apply to three forms of silica-containing dust: Quartz, Cristobalite, and Trydimite. Quartz is by far the most common form of silica-containing dust found at construction workplaces.

2.2 Scope

This HSS and the associated standards apply to all projects where silica-containing dust is generated in a manner in which Arcadis employees, subcontractors and other affected personnel are or could be exposed to silica-containing dust above the Action Level.

3. DEFINITIONS

Definitions related to this HSS can be found in Exhibit 1.

4. RESPONSIBILITIES

4.1 Project Manager, Associate Project Manager and Task Manager

Project Managers, Associate Project Managers and Task Managers (Project Team) are responsible, as part of the project hazard assessment, for determining if silica-containing dust may be generated at the project site. In addition, Project Teams are responsible for determining client requirements with respect to the control of silica-containing dust hazards. Project Teams will assign a Competent Person to oversee all activities that are likely to generate silica-containing dust. Project Teams are also responsible for ensuring that project staff have the appropriate and applicable training for silica-containing dust prior beginning work.

Project Teams are responsible for maintaining exposure monitoring records, if required, for a minimum of 30 years and submitting copies to Corporate Health and Safety, as required by the Industrial Hygiene H&S Standard (ARC HSIH009).

4.2 Project Personnel

Project personnel are responsible for reading and following all hazard control processes, as required by the project Health & Safety Plan (HASP). If unforeseen activities are required that may generate silica-containing dust, Project Personnel are expected to stop work and notify the Site Safety Officer and the Project Manager immediately, and not proceed with the associated task until authorized.

4.3 Competent Person

The Competent Person is an individual who is capable of identifying existing and foreseeable silica-containing dust hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge and ability necessary to fulfill the responsibilities set forth in the Exposure Control Plan. The Competent Person is expected to make frequent and regular inspections of job sites, materials, and equipment to implement the written exposure control plan.

4.4 Corporate Health & Safety

Corporate Health and Safety is responsible for keeping this HSS up-to-date with current regulatory requirements and best practices. In addition, Corporate Health and Safety oversees the medical surveillance program for silica-containing dust, as applicable and provides a silica training program for presentation to appropriate staff.

5. PROCEDURE

5.1 Respirable Crystalline Silica

Exposure to silica-containing dust occurs when the following tools are used on concrete, brick, block, stone, mortar, and other materials that contain silica:

- Stationary masonry saws;
- Handheld power saws;
- Walk-behind saws;
- Drivable saws;
- Rig-mounted core saws or drills;
- Handheld and stand-mounted drills (including impact and rotary hammer drills);
- Dowel drilling rigs;
- Vehicle-mounted drilling rigs;
- Jackhammers and handheld powered chipping tools;
- Handheld grinders;
- Walk-behind milling machines and floor grinders;
- Drivable milling machines;
- Crushing machines; and
- Heavy equipment and utility vehicles when used to abrade or fracture silica-containing materials (such as hoe-ramming or rock ripping) or during demolition activities, and for tasks such as grading and excavating.

Exposures to silica-containing dust also occurs during tunneling operations and during abrasive blasting when sand or other blasting agents containing silica are used, or when abrasive blasting is performed on substrates that contain silica, such as concrete.

The health effects of silica-containing dust are based on the type of exposure encountered. Silicosis is a progressive lung disease resulting from prolonged and repeated exposure to silica-containing dusts. When inhaled, silica-containing dust passes into the lungs, and scavenger cells such as macrophages engulf it. Enzymes released by the scavenger cells cause the lung tissue to scar. The onset and degree of scarring is often dependent upon the duration and frequency of exposure.

- Chronic silicosis usually occurs after 10 or more years of exposure to silica-containing dust at relatively low concentrations, and is often first realized due to breathing difficulty during exercise. Sometimes the breathing difficulty progresses to shortness of breath even during rest. Some people have a cough that may produce

sputum. Breathing may worsen for years after the person stops working with silica-containing dust. The lung damage can lead to lower levels of oxygen in the blood and can also strain the right side of the heart. This strain can lead to a type of heart failure called cor pulmonale (also known as Pulmonary Hypertension), which can be fatal.

- Accelerated silicosis results from exposure to high concentrations of silica-containing dust and develops 5 to 10 years after the initial exposure.

- Acute silicosis occurs where exposure concentrations are the highest and can cause symptoms to develop within a few weeks to 4 or 5 years after the initial exposure.

5.2 Standard Applicability

This HSS applies to all occupational exposures to silica-containing dust, except where employee exposure will remain below 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions.

Some tasks, identified by OSHA, can reasonably be anticipated to remain below 25 µg/m^3 as an 8-hour TWA that involved only minimal exposure to silica-containing dust. Such tasks include:

- Mixing concrete for post holes;

- Pouring concrete footers, slab foundation, and foundation walls; and

- Removing concrete formwork.

When tasks are performed in which exposure is anticipated to remain under 25 µg/m^3 as an 8-hour TWA, and isolated from tasks that generate significant exposures to silica-containing dust, this HSS does not apply. Some employees may perform construction-related tasks involving occasional, brief exposures (below 25 µg/m^3 as an 8-hour TWA) to silica-containing dust that are incidental to their primary work.

> **Example:** For employees using a hand-held drill to install a singular sub slab vapor point, if the duration of exposure is 15 minutes or less, the 8-hour TWA exposure can reasonably be anticipated to remain under the 25 µg/m^3 threshold (assuming no exposure for the remainder of the shift), and this HSS would not apply. If the duration of the exposure is greater than 15 minutes, active real-time air monitoring equipment must be utilized to determine applicability of this HSS.

5.3 Exposure Controls

Project Teams have two options to comply with this HSS when employee exposure is anticipated to be at or above 25 µg/m^3 as an 8-hour TWA under any foreseeable conditions:

1. Specified exposure control methods; or

2. Alternative exposure control methods.

5.3.1 Specified Exposure Control Methods

The specified exposure control option requires full compliance with OSHA's Table 1-Specified Exposure Control Method When Working With Materials Containing Crystalline Silica (Exhibit 2). When controls in Exhibit 2 are fully and properly implemented, Project Teams are not required to assess employees' exposure levels or keep employee exposure at or below the PELs.

When implementing the control measures specified in Exhibit 2, Project Teams shall ensure the following:

- For tasks performed indoors or in enclosed areas, provide a means of exhaust, as needed, to minimize the accumulation of visible airborne dust;
- For tasks performed using wet methods, apply water at flow rates sufficient to minimize release of visible dust;
- For measures implemented that include an enclosed cab or booth, ensure that the enclosed cab or booth:
    - Is maintained as free as practicable from settled dust;
    - Has door seals and closing mechanisms that work properly;
    - Has gaskets and seals that are in good condition and working properly;
    - Is under positive pressure maintained through continuous delivery of fresh air;
    - Has intake air that is filtered through a filter that is 95% efficient in the 0.3-10.0 µm range (e.g., MERV 16 or HEPA [MERV 17-20]); and
    - Has heating and cooling capabilities.
- Where an employee performs more than one task in Exhibit 2 during the course of a shift, and the total duration of all tasks combined is more than four hours, the required respiratory protection for each task is the respiratory protection specified for more than four hours per shift. If the total duration of all tasks in Exhibit 2 combined is less than four hours, the required respiratory protection for each task is the respiratory protection specified for less than four hours per shift.

5.3.2 Alternative Exposure Control Methods

For tasks not listed in Exhibit 2, or where engineering controls, administrative controls, and respiratory protection described in Exhibit 2 are not fully and properly implemented, alternative exposure control methods shall be implemented.

No employee will be exposed to an airborne concentration of silica-containing dust in excess of 50 µg/m^3, calculated as an 8-hour TWA. This is determined by assessing the exposure of each employee who is or may reasonably be expected to be exposed to silica-containing dust at or above the Action Level (25 µg/m^3 as an 8-hour TWA) in

accordance with either the performance option or the scheduled monitoring option (Section 5.4).

Project Teams who follow alternative exposure control methods must:

1. Determine the levels of silica-containing dust that employees are exposed to over an 8hr TWA in accordance with Section 5.4;

2. Limit employee exposures to a PEL of 50 µg/m^3 as an 8-hour TWA;

3. Use engineering and administrative controls, to the extent feasible, to limit employee exposures to the PEL, and supplement the controls with respiratory protection when necessary. If exposure controls are not sufficient in reducing worker exposure to at or below the PEL, the controls must still be implemented and supplemented with respiratory protection (Approved Protection Factor [APF] of 10 or greater).

4. Keep records of employee exposure to silica-containing dust in accordance with the Arcadis Industrial Hygiene HSS (ARC HSIH009).

5.4 Exposure Assessment

Project Teams following alternative exposure control methods must assess the 8-hour TWA exposure for each employee who is or may reasonably be expected to be exposed to silica-containing dust at or above the Action Level.

Personal exposure monitoring shall utilize standard industrial hygiene sampling techniques and recordkeeping as required in Arcadis Industrial Hygiene HSS (ARC HSIH009). Exposure assessments will be completed either using:

- Performance Option; or
- Scheduled Monitoring Option

5.4.1 Performance Option

The Project Team shall assess the 8-hour TWA exposure for each employee on the basis of any combination of air monitoring data or objective data sufficient to accurately characterize employee exposures to silica-containing dust.

Example: Objective data includes:

- Air monitoring data from industry-wide surveys, which includes well-documented procedures for measuring exposures and methods for controlling dust, could be used by Project Team to characterize employee exposures where employees perform tasks consistent with those described in the survey;

- Calculations based on the composition of a substance; area sampling results and exposure mapping profile approaches. Project Teams can use direct-reading instruments to measure real-time levels of respirable dust in the air. Only if Arcadis has information on the percentage of silica-containing dust in that respirable dust (for example, from the analysis of a bulk sample or

information from a safety data sheet), Project Teams can then calculate the level of silica-containing dust in air; and

- Historic air monitoring data collected by Arcadis. Historic air monitoring data collected by the Arcadis could be used to assess employee exposures if the Project Team can show that the data was collected during work operations and conditions that are consistent with the processes, types of material, control methods, work practices, and environmental conditions in the Project Team's current operations.

Project teams choosing the performance options must:

- Conduct the exposure assessments before work begins;
- Reassess exposures, whenever a change in production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or higher exposures at or above the Action Level, or when the Project Team has any reason to believe that new or additional exposures at or above the Action Level have occurred;
- Be able to demonstrate that employee exposures have been accurately characterized; and
- Make sure that the exposure assessment reflects the exposures of employees on each shift, for each job classification, in each work area.

The Performance Option may be especially useful when measuring employee exposures is challenging, such as when tasks are conducted for short durations of time or performed under different weather conditions. Under the Performance Option, Project Teams can characterize employee exposure within a range to account for exposure variability. Project Teams can also use that this option to show that exposures exceed the PEL by a certain level, such as less than 10 times the PEL, after using all feasible controls. Project Teams would then provide respiratory protection (APF of 10 or greater) and medical surveillance for employees required to wear a respirator under this HSS for 30 or more days per year.

5.4.2 Scheduled Monitoring Option

The Project Team shall perform initial personal exposure monitoring with laboratory analysis to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the exposures of employees on each shift, for each job classification, in each work area. Where several employees perform the same tasks on the same shift and in the same work area, the employer may sample a representative fraction of these employees in order to meet this requirement. In representative sampling, the employer shall sample the employee(s) who are expected to have the highest exposure to silica-containing dust.

If initial monitoring indicates that employee exposures are below the Action Level, the Project Team may discontinue monitoring for those employees whose exposures are represented by such monitoring.

When the most recent exposure monitoring indicates that employee exposures are at or above the Action Level but at or below the PEL, the project team shall repeat such monitoring within six months of the most recent monitoring.

Where the most recent exposure monitoring indicates that employee exposures are above the PEL, the Project Team shall repeat such monitoring within three months of the most recent monitoring.

Where the most recent (non-initial) exposure monitoring indicates that employee exposures are below the Action Level, the Project Team shall repeat such monitoring within 6 months of the most recent monitoring until two consecutive measurements, taken seven or more days apart, are below the Action Level, at which time the project team may discontinue monitoring for those employees whose exposures are represented by such monitoring.

The Project Team shall reassess exposures whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional exposures at or above the Action Level, or when the Project Team has any reason to believe that new or additional exposures at or above the Action Level have occurred.

Personal exposure monitoring data will be collected using the Scheduled Monitoring Sampling Form for Silica (Exhibit 3). Completed Scheduled Monitoring Sampling Forms for Silica should be submitted along with a copy of the sample chain of custody (COC), photos and analytical data to 4-Sight-Support@arcadis-us.com. Additional information on Scheduled Monitoring sampling protocol can be found in Exhibit 4.

5.4.3 Exposure Air Monitoring Notification

Project Teams must notify each affected employee of the results of the exposure assessment within 5 working days of completing it, in accordance with the Arcadis Industrial Hygiene HSS (ARC HSIH009). The 5-day period for notification starts when:

- The Project Team following the Performance Option finishes the exposure assessment; or
- The Project Team following the Scheduled Monitoring Approach receives the laboratory results.

Exposures can be characterized and reported as a range (for example, between the Action Level and the PEL), but must reflect exposures that would occur if the employee were not using a respirator.

When an exposure assessment reveals exposure above the PEL, the written notification must also describe the corrective action the Project Team is taking to reduce employee exposures to or below the PEL. Corrective actions must include engineering controls. However, if engineering controls are not feasible or the project team needs more than 5 days to identify the right engineering controls, respiratory protection is the corrective action that would be described in the written notification.

5.5 Respiratory Protection

Project Teams will provide employees with appropriate respirators where required by this HSS. Respirators will be used in accordance with the Arcadis Respiratory Protection HSS (ARC HSGE017). Project Teams who follow the specified exposure control methods listed in Exhibit 2 must provide respiratory protection where required. Project Teams who follow alternative exposure control methods must provide respiratory protection:

- Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;
- Where exposures exceed the PEL during tasks, such as some maintenance and repair tasks, for which engineering and work practice controls are not feasible;
- During tasks in which the employer has implemented all feasible engineering and work practice controls but exposures remain above the PEL.

5.6 Abrasive Blasting

Provision 29 CFR 1910.94(a)(5)(ii)(b) of the General Industry Ventilation Standard requires that "abrasive-blasting respirators" shall be worn by all abrasive-blasting operators when using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure.

The ventilation standard for Construction, 29 CFR 1926.57, also contains requirements for ventilation and PPE, including respirators when using silica-based abrasive blasting media.

5.7 Housekeeping

Cleaning methods such as dry sweeping, dry brushing, and use of compressed air can cause silica-containing dust to get into the air and be inhaled by employees. Therefore, the use of these cleaning methods is prohibited to prevent unnecessary exposures to employees. Other cleaning methods such as wet sweeping and HEPA filtered vacuums shall be used because such methods reduce employee exposures by preventing silica-containing dust from getting into the air. Compressed air maybe used as a cleaning method, if used in conjunction with a ventilation system that effectively captures the silica-containing dust created by compressed air.

Project Teams are not required to follow these housekeeping requirements when cleaning ordinary soil, large debris, and non-silica-containing materials, such as sawdust.

5.8 Written Exposure Control Plan

A written Exposure Control Plan (written plan), Exhibit 5 is required when exposure to silica-containing dust is or can reasonably be expected to exceed 25 µg/m^3 of silica-containing dust in air averaged over an 8-hour period. The written plan will be included in the site-specific HASP, which will be reviewed at least annually to evaluate the effectiveness of the written plan in accordance with the Arcadis Health and Safety Plan HSS (ARC HSFS010). The written plan shall be made readily available to each employee covered by this HSS.

The written exposure plan must include:

- A description of the tasks in the workplace that involve exposure to silica-containing dust;
- A description of the engineering controls, administrative controls, and respiratory protection used to limit employee exposure to silica-containing dust for each task;
- A description of the housekeeping measures used to limit employee exposure to silica-containing dust;
- A description of the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed to silica-containing dust and their level of exposure, including exposures generated by other employers or sole proprietors;
- Designation of the Competent Person who is responsible for implementing the written plan and making frequent and regular inspection of job sites, material, and equipment; and
- A copy of or location of the safety data sheet (SDS) for crystalline silica products in accordance with the Arcadis Hazard Communication HSS (ARC HSGE007).

5.9 Medical Surveillance Program

Arcadis employees will complete an initial (baseline) medical examination for silica within 30 days after initial assignment (the day the employee starts working in a job/task in which he or she will be required by this HSS to wear a respirator for 30 or more days per year). Respirator use with past employers does not count toward the 30-day threshold. Periodic exams will be completed every three years from the employee's last examination or more frequently as determined by the Arcadis a third-party administrator (TPA) for the Arcadis medical surveillance program (currently WorkCare (1-800-455-6155)) occupational health physician.

Refer to the Arcadis Medical Surveillance Program HSS (ARC HSGE010) for additional information on the administration of the Medical Surveillance Program and instructions on requesting an exam.

The medical surveillance program for silica is intended to:

- Identify respirable crystalline silica-related diseases so that employees with those diseases can take actions to protect their health;
- Determine if an employee has any condition, such as a lung disease, that might make him or her more sensitive to silica exposure; and
- Determine the employee's fitness to use respirators.

6. TRAINING

Silica awareness training is required for all employees who must comply with this HSS and/or are assigned to a work area suspected or known to contain silica-containing dust. Awareness training is available in the Arcadis Learning Center and will consist of:

- Operations that involve silica-containing dust exposure;
- Methods/observations that can be used to detect the presence or release of silica-containing dust;
- Physical and health hazards of silica-containing dust;
- Methods used to protect against the hazards of silica-containing dust including PPE and respiratory protection;
- A review of the applicable standard and where copies can be found; and
- An explanation of the medical surveillance program and an employee's right to access medical and exposure records.

6.1 Competent Person Training

The Silica Competent Person training covers all points described previously with the addition of a competency exam following the successful completion of the training. Retraining may be required as determined by Arcadis policy or management or by client or state-specific requirements.

7. REFERENCES

OSHA Silica Page

Arcadis Medical Surveillance H&S Standard – ARC HSGE010

Arcadis Respiratory Protection H&S Standard – ARC HSGE017

Arcadis Industrial Hygiene H&S Standard – ARC HSIH009

Arcadis Health and Safety Plan H&S Standard - ARC HSFS010

8. RECORDS - DATA RECORDING AND MANAGEMENT

Medical records will be maintained by Arcadis' medical surveillance TPA (WorkCare). Employees may obtain a copy of their complete medical record by contacting the medical surveillance TPA directly and a copy will be provided at no cost to the employee.

All records regarding occupational exposure measurements will be provided to employees by the project manager, Site H&S Officer or the Competent Person responsible for administering the exposure monitoring program, maintained in the applicable project team file and copies of such exposure monitoring records provided to both Corporate H&S (4-sight-support@arcadis-us.com) and Human Resources (HRSolutionsCenter.ANA@arcadis.com) for file retention. See the Arcadis Industrial Hygiene HSS (ARC HSIH009) for additional information.

9. APPROVALS AND HISTORY OF CHANGE

Julie Santaniello, CSP - Corporate H&S, Manager of Technical Programs



History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
22 September 2017	01	Greg Mason / Andrew McDonald/ Julie Santaniello	Original document
13 November 2017	02	Greg Mason / Andrew McDonald/ Julie Santaniello	Clarified when Engineering and Administrative controls are to be used in Section 1. Updated example in Section 5.2. Clarified using compressed air during housekeeping in Section 5.7.

Exhibit 1 – Definitions

Action Level is the airborne concentration established by OSHA that triggers certain regulatory requirements (25 µg/m3 silica in air 8-hour time weighted average).

Affected Employee means all employees whose exposures were assessed, including employees whose exposures were represented by other employees' exposure measurements, and those whose exposure assessments were based on objective data.

Air Monitoring Data are any results of air monitoring (analyzed according to the procedures and requirements in 29 CFR 1926.1153 Appendix A methods of sample analysis) that the employer has done to meet the requirements of this HSS.

Crystalline Silica is a common mineral found in many naturally occurring and man-made materials used at construction sites. Materials like sand, concrete, brick, block, stone and mortar contain crystalline silica. Amorphous silica, such as silica gel, is not crystalline silica.

Competent person is an individual who is capable of identifying existing and foreseeable respirable crystalline silica hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them.

Fully and properly implemented means that controls are in place, are properly operated and maintained, and employees understand how to use them. Several factors required for full and proper implementation of controls are listed in the discussion for each Exhibit 2 entry. The presence of large amounts of visible dust generally indicates that controls are not fully and properly implemented. A small amount of dust can be expected from equipment that is operating as intended by the manufacturer; however, a noticeable increase in dust generation during the task is a sign that the dust controls are not operating correctly. The difference between the small amounts of dust generated when control measures are working properly and the large amount of dust generated during tasks when control measures are not used or not operated effectively is easily observed. When this happens, prompt corrective actions are required.

High-Efficiency Particulate Air (HEPA) filter means a filter capable of trapping and retaining at least 99.97 percent of mono-dispersed particles of 0.3 micrometers in diameter.

Objective Data is information demonstrating that a particular product or material containing silica or a specific process, operation, or activity involving silica cannot release dust or fumes in concentrations at or above the Action Level even under the worst-case release conditions. Objective data can be obtained from an industry-wide study or from laboratory product test results from manufacturers of silica-containing products or materials. The data the used from an industry-wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices and environmental conditions in the employer's current operations.

Permissible Exposure Limit (PEL) is an average airborne concentration regulatory limit established by OSHA above which requires control to protect people from adverse health effects (50 µg/m3 silica in air averaged over an 8-hour period).

Respirable Crystalline Silica means quartz, cristobalite, and/or tridymite contained in airborne particles that are determined to be respirable by a sampling device designed to meet the characteristics for respirable-particle-size-selective samplers specified in the International Organization for Standardization (ISO) 7708:1995: Air Quality – Particle Size Fraction Definitions for Health-Related Sampling https://www.iso.org/standard/14534.html.

Threshold Limit Value is a recommended average airborne concentration limit established by ACGIH. The TLVs are reviewed and updated as appropriate annually.

Time Weighted Average (TWA) is the average exposure to a contaminant or condition (such as silica) to which workers may be exposed without adverse effect over a period of 8 hours a day or a 40-hour work week.

Exhibit 2 - OSHA's Table 1- Specified Exposure Control Method When Working With Materials Containing Crystalline Silica

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
1	Stationary masonry saws	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
2a	Handheld power saws (any blade diameter) when used outdoors	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
2b	Handheld power saws (any blade diameter) when used indoors or in an enclosed area	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
3	Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less) for tasks performed outdoors only	• Use saw equipped with commercially available dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.	None	None
4a	Walk-behind saws when used outdoors	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
4b	Walk-behind saws when used indoors or in an enclosed area	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
5	Drivable saws for tasks performed outdoors only	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
6	Rig-mounted core saws or drills	• Use tool equipped with integrated water delivery system that supplies water to cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
7	Handheld and stand-mounted drills (including impact and rotary hammer drills)	• Use drill equipped with commercially available shroud or cowling with dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	None	None
8	Dowel drilling rigs for concrete for tasks performed outdoors only	• Use shroud around drill bit with a dust collection system. • Dust collector must have a filter with 99% or greater efficiency and a filter cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
9a	Vehicle-mounted drilling rigs for rock and concrete	• Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector.	None	None
9b	Vehicle-mounted drilling rigs for rock and concrete	• Operate from within an enclosed cab and use water for dust suppression on drill bit.	None	None
10a	Jackhammers and handheld powered chipping tools when used outdoors	• Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
10b	Jackhammers and handheld powered chipping tools when used indoors or in an enclosed area	• Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
10c	Jackhammers and handheld powered chipping tools when used outdoors	• Use tool equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
10d	Jackhammers and handheld powered chipping tools when used indoors or in an enclosed area	• Use tool equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
11	Handheld grinders for mortar removal (i.e., tuckpointing)	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust	N95 (or Greater Efficiency) Filtering Facepiece or	Powered Air-Purifying Respirator (PAPR) with

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
11 **cont.**	Handheld grinders for mortar removal (i.e., tuckpointing)	emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	Half Mask	P100 Filters
12a	Handheld grinders for uses other than mortar removal for tasks performed outdoors only	• Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
12b	Handheld grinders for uses other than mortar removal when used outdoors	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	None
12c	Handheld grinders for uses other than mortar removal when used indoors or in an enclosed area	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	N95 (or Greater Efficiency) Filtering Facepiece or Half Mask
13a	Walk-behind milling machines and floor grinders	• Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
13b	Walk-behind milling machines and floor grinders	• Use machine equipped with dust collection system recommended by the manufacturer. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None
14	Small drivable milling machines (less than half-lane)	• Use a machine equipped with supplemental water sprays designed to suppress dust. • Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	None	None

Construction Task or Equipment Operation		Engineering and Work Practice Control Methods	Required Respiratory Protection	
			≤ 4 hours/shift	>4 hours/shift
15a	Large drivable milling machines (half-lane and larger) for cuts of any depth on asphalt only	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions.	None	None
15b	Large drivable milling machines (half-lane and larger) for cuts of four inches in depth or less on any substrate	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions.	None	None
15c	Large drivable milling machines (half-lane and larger) for cuts of four inches in depth or less on any substrate	• Use a machine equipped with supplemental water spray designed to suppress dust. • Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	None	None
16	Crushing machines	• Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points). • Operate and maintain machine in accordance with manufacturer's instructions to minimize dust emissions. • Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote-control station.	None	None
17a	Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	• Operate equipment from within an enclosed cab.	None	None
17b	Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	• When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
18a	Heavy equipment and utility vehicles for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials	• Apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
18b	Heavy equipment and utility vehicles for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials	• When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None	None

Exhibit 3 - Scheduled Monitoring Sampling Form for Silica

ARCADIS Design & Consultancy for natural and built assets

Scheduled Monitoring Sampling Form for Silica

Filter/Cassette #_____

Page 1 of 2

Project Number	Date	Project Name

Employee Name	Employee Number

Employee Business Line

Job Description

Type of Work Being Performed

Task	% Time Performing	Task	% Time Performing
☐ Abrasive Blasting	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Mixing Concrete	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ Cutting	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Mixing Mortar	☐ <25% ☐ 25-50% ☐ 50-75% ☐ >75%
☐ Chipping	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Patching	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ Drilling	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Polishing	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ Excavating	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Scabbing/ Scappling	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ Formwork Cleaning	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Sc...g	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ Grading	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Scra...g	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ Grindin...	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ Terra... Wor...	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ ...and Sweeping	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%	☐ ... Wo...	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%
☐ ...	☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%		
☐ Ot...:			☐ <25% ☐ 25-50% ☐ 50-75%, ☐ >75%

Base Material Spec.		Silica Contained in Base Material
☐ Asphalt ☐ Block ☐ Brick ☐ Concrete ☐ Cement ☐ Grout	☐ Gunite ☐ Mortar ☐ Soil ☐ Terrazo ☐ Tile ☐ Other Material: _____	☐ From bulk sample _____ ☐ From estimate (SDS or list) _____

Tool Being Used Attach Photo	PPE Utilized
Make:_____ Model: _____	☐ Dust Mask (DM) ☐ Half Face (HF) ☐ Full Face (FF) ☐ Protective Clothing (PC) ☐ Gloves (G)

Control Methods

☐ None (N)
☐ Dry (D)
☐ Natural Ventilation (NV)
  ☐Employee Downwind
  ☐Employee Upwind
  ☐Employee Crosswind
☐ General Mechanical (GM)
☐ Local Exhaust Ventilation - with HEPA vacuum (LE-HEPA)
☐ Local Exhaust Ventilation - with shop vac or other vacuum (LE-OTHER)
☐ Wet Method - Continuous Drip (WM-CD)
☐ Wet Method - Continuous Spray (WM-CS)
☐ Wet Method - Non-continuous Drip (WM-NCD) Frequency: _____
☐ Wet Method - Non-continuous Spray (WM-NCS) Frequency: _____

EXAMPLE

ARCADIS Design & Consultancy for natural and built assets

Scheduled Monitoring Sampling Form for Silica

Filter/Cassette #_____

Project Numberr	Date	Project Name

Silica controls maintenance plan in effect? ☐ Yes ☐ No
Controls checked during sampling period? ☐ Yes ☐ No
Employee trained and familiar with operation of controls? ☐ Yes ☐ No

Weather Conditions

☐ Sunny ☐ Overcast ☐ Rain ☐ Snow

Environment	Air/Wind Currents	Temperature
☐ Outdoors ☐ Open Sided(Free Flow) ☐ Enclosed 1Side (Limited Flow) ☐ Enclosed All Sides (No Flow)	☐ None ☐ < 5mph ☐ 5-10 mph ☐ > 10 mph	☐ < 40°F (<40) ☐ 40°F < x < 90°F (40-90) ☐ > 90° F (>90)

Nearby Visible Dust Sources	midi
☐ None ☐ Other workers doing same task ☐ Partial from Other tasks and sources ☐ Continuous from Other tasks and source	☐ < 20% (<20 20% < x < % 0-40) % < x < % 0-60) 60 < x < % 80) < 80 <8

Sampling Equipment	
	☐ Respirable Silica (RS)
Sampling Type	
☐ Personal (P) ☐ Area (A - Distance to Activity) ☐ Bulk (B)	

Pump Identification	Analytical Method
Make/Model	NIOSH 7500; OSHA ID-142

Filter	Pre-Calibration Date	Post- Calibration Date	Flow Rates Pre Rate
Cyclone Type			
	Sampling Times		Post Rate
Agent	Start / Stop	Time	
Respirable Silica			
	Start / Stop	Time	Average Flow rate

Average Flow Rate X	Total Sampling Time	Total Volume

Laboratory Results (ug/m3)

Quartz	Cristobalite	Trydymite	RCS

Notations

Samplers Name (Print)

Samplers Signature

EXAMPLE

Exhibit 4 - Scheduled Monitoring Sampling Guidelines

Project Teams using the Scheduled Monitoring Option should collect and analyze samples using the procedures specified in one of the following analytical methods: OSHA ID-142 and/or NIOSH 7500. It is recommended that Project Teams use SKC PPI samplers in place of cyclone samplers. When collecting samples Project Teams should collect 1 field blank per 20 samples. For personal exposure monitoring sampling, devices should be placed in the breathing zone of the employee, often on the employee's lapel. Area samples should also be collected to help determine required exclusion zones, distance from the silica-containing dust source should be recorded on the Scheduled Monitoring Data Sampling Form for Silica (Exhibit 3).

Silica sampling kits can be rented from SGS Galson, which includes all the required equipment to complete the sampling:

- Gil-Air Pump with Charger
- Tubing and Clip
- Media for sample collection
    - Field blank – One field blank per 20 samples will be collected the Field blank will be carried to the sampling site, exposed to the sampling conditions during pump calibration, returned to the laboratory, treated as a sample, and carried through all steps of the analysis to evaluate possible effects attributable to shipping and field handling procedures.
- Instructions
- Calibrator (Rotameter)
- Packing Materials
- Test Report – Silica-containing dust (quartz, cristobalite & tridymite) with respirable dust

Personal exposure monitoring data will be collected using the Scheduled Monitoring Data Sampling Form for Silica (Exhibit 3). Completed Scheduled Monitoring Data Sampling Forms for Silica should be submitted along with a copy of the sample chain of custody (COC), photos and analytical data to 4-Sight-Support@arcadis-us.com.

Exhibit 5 – Silica Exposure Control Plan

ARCADIS Design & Consultancy for natural and built assets

Silica Exposure Control Plan

Project Name: _____
Project Number: _____
Date: _____

Task Description:

1) *Arcadis Silica Competent Person:* _____
The above individual will ensure requirements stipulated in this plan are implemented and has the authority to take corrective measures and/or revise this plan to ensure employee, contractor and/or public exposure to silica dust remains below the respirable inhalation time weighted average action level of 25 µg/m3 over an 8-hour period.

2) *What material will the team be working with on this project?*
Select

3) *The following work activity will be performed on this project which have a potential for silica dust exposure:*
Select

The following controls will be utilized to mitigate exposure to silica dust hazards:
Based on the activities entered above, the following OSHA/Arcadis activity category is:
0

4) *The controls to be utilized include:*
#N/A

4a) *Respiratory Protection:*

	≤4 HRS	>4HRS		≤4 HRS	>4HRS
Indoors or Enclosed Area:	#N/A	#N/A	Outdoors:	#N/A	#N/A

#N/A
#N/A

EXAMPLE

Rev 2_13 November 2017

Additional Housekeeping Requirements:
Arcadis prohibits dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure are not feasible.

Arcadis prohibits use of compressed air to clean clothing or surfaces where such activity could contribute to employee exposure to respirable crystalline silica unless:
The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air. No alternative method allowed.

5) Air Monitoring Requirements for Activities with an Assigned Respirator APF Listed in Section 4a.

- ☐ Real-time air monitoring for silica is not required for this project
- ☐ Real-time air monitoring will be conducted during work activities where employees contractors are exposed to or have the reasonable probability to be exposed to silica dust hazards. Silica air monitoring will include use of an aerosol monitor equipped with a Dorr-Oliver cyclone kit for respirable dust evaluation. Real-time air monitoring for silica will be performed in the employee breathing zone (personal monitoring) and also performed at the perimeter of the work area (exclusion zone boundary). Air samples for laboratory analysis will also be required unless exempt from collection by a CI

Aerosol monitor selected for use on this project: _____
Frequency of air sample collection for laboratory analysis: _____
Air samples will be submitted to the following laboratory: _____

6) Medical Surveillance

Employees performing work activities where exposure to silica dust is known to be or has a reasonable probability to be above the OSHA 8 Hr. TWA action level of 25 µg/m3 will participate in silica medical surveillance in conjunction with their annual HAZWOPER physical. New entrants into the silica medical surveillance program at times when the HAZWOPER physical is not due will coordinate the required surveillance with WorkCare and then maintain the surveillance with their HAZWOPER physical going forward.

7) Additional Instructions

Signatures:

_____ _____
Preparer Name Printed Date

_____
Preparer Signature

_____ _____
Competent Person Name Printed Date

_____
Competent Person Signature

Rev 2_13 November 2017

EXAMPLE

Arcadis of New York, Inc.
One Lincoln Center, 110 West Fayette Street, Suite 300
Syracuse, NY 13202
United States
Phone: 315 446 9120
Fax: 315 449 0017
www.arcadis.com