



Environment

Submitted to:
PPG Industries
Allison Park, Pennsylvania

Submitted by:
AECOM
Piscataway, New Jersey
60149955.4013A
June 2010

Field Sampling Plan / Quality Assurance Project Plan

PPG Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

1 of 2
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Field Sampling Plan / Quality Assurance Project Plan

PPG Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

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FIELD SAMPLING PLAN / QUALITY ASSURANCE PROJECT PLAN Non-Residential and Residential Chromium Sites Hudson County, New Jersey



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FIELD SAMPLING PLAN / QUALITY ASSURANCE PROJECT PLAN Non-Residential and Residential Chromium Sites Hudson County, New Jersey

Prepared By:

Mary O'Connell Kozik

Date: _____

Reviewed By:

Scott H. Mikaelian

Date: _____

Approved By:

QA Reviewer

Kathy Whooley

Date: _____

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1.0 Introduction

1.1 Purpose

The Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP) for operations at the PPG Industries, Inc. (PPG) residential and non-residential chromium sites, including associated perimeter air monitoring, in Hudson County, New Jersey, was developed by AECOM Environment (AECOM) to comply with the New Jersey Department of Environmental Protection (NJDEP) quality assurance (QA) requirements for remedial investigations (RI). The purpose of the FSP/QAPP is to assure reliable monitoring data by serving as the instrument of control for field and analytical activities associated with the project. Stated or referenced within the FSP/QAPP are the analytical methods, sampling procedures, Quality Assurance policies, Quality Control (QC) criteria, and reporting requirements that must be followed by all prime and subcontractor personnel when carrying out their assigned responsibilities on the project.

This document is intended to be an organic document that is updated as required and will be modified as necessary during the performance of activities. This FSP/QAPP was prepared in accordance with the July 19, 1990 Administrative Consent Order (ACO) between the State of New Jersey and PPG Industries, Inc., and the NJDEP Technical Requirements for Site Remediation (New Jersey Administrative Code [N.J.A.C.] 7:26E-2.2 *et. seq.*). This FSP/QAPP will also be utilized during execution of the remedial activities related to the Judicial Consent Order (JCO) as filed on June 26, 2009.

The FSP/QAPP was prepared in accordance with the requirements and methods described in the NJDEP Technical Requirements for Site Remediation (N.J.A.C. 7:26E *et. seq.*, November 4, 2009, date last amended April 19, 2010), Field Sampling Procedures Manual (August, 2005, last updated April 30, 2009), Alternative Ground Water Sampling Techniques (July 1994), Field Analysis Manual (July 1994) and N.J.A.C. Chapter 9D Well Construction, Maintenance, and Sealing of Abandoned Wells Drilling Regulations and Requirements (April 2, 2007), as guidance. Remedial investigation results will be compared to New Jersey's Remediation Standards (N.J.A.C. 7:26D *et. seq.*, November 2009) for soil delineation purposes for non-chromium compounds. The most stringent (non-residential) chromium soil cleanup criteria (CrSCC) of 20 mg/kg for hexavalent chromium, and the most stringent (residential) soil cleanup criteria of 120,000 mg/kg for trivalent chromium, will be utilized for soil delineation purposes pursuant to the Chromium Soil Cleanup Criteria (NJDEP, September 2008). Groundwater results will be compared to the Ground Water Quality Standards (N.J.A.C. 7:9C), last amended November 4, 2009.

The FSP/QAPP is the standard by which field and laboratory procedures must be performed and the standard against which activities will be audited. In the event that the FSP/QAPP must be changed to include a new procedure or modify an existing procedure, the procedure discussed in **Section 3.0** of the FSP/QAPP will be used to document the change.

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1.2 Project Background

PPG Industries, Inc., owned and operated a chromate chemical production facility encompassing approximately 16.6 acres located on Garfield Avenue in the City of Jersey City, County of Hudson, New Jersey.

On or about September 1, 1963, PPG ceased operations at the chromate chemical production facility. These operations had resulted in the generation of chromate ore processing residue (COPR) that was distributed by third parties as fill material for use in certain construction and development projects in Hudson County, New Jersey.

The chromate ore processing residue was used for the backfilling of demolition sites, preparation for building foundations, construction of tank berms, roadway construction, the filling of wetlands and other construction and development-related purposes.

The JCO requires the investigation and if necessary, the remediation of chromate chemical production waste (CCPW) at residential properties within the vicinity of the PPG sites. Perimeter air monitoring will be conducted during various ground intrusive remedial phases at the Garfield Avenue site (PPG Site 114) for protection of residents and the community. The remaining PPG residential and non-residential chromium sites are designated by the ACO. This FSP/QAPP will augment the individual work plans and report submittals developed for on and off-site work.

1.3 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data needed to accomplish the project objectives. The design for each sampling program will be based on USEPA's DQO guidance (USEPA, 2000), a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in decision-making is appropriate for its intended application. This process is summarized below:

- State the problem;
- Identify the decision;
- Identify inputs to the decision;
- Define the study boundaries;
- Develop a decision rule;
- Specify decision error limits; and
- Optimize the study design.

The field collection efforts at the non-residential sites will generate data to be used for a variety of purposes, including but not limited to site characterization, evaluation of alternatives, engineering design, risk assessment, and potential responsible party (PRP) determination. Therefore, the sampling and analysis programs incorporate the following QA elements:

- A sampling program designed to obtain sufficient data to determine levels of constituents in media of interest;

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- The use of sample collection and handling procedures that will ensure the representativeness and integrity of the samples;
- An analytical program designed to generate definitive data of sufficient quality and sensitivity to meet the project objectives; and
- Data deliverables that will allow verification and validation of the data and reproducibility of the reported results.

1.4 Project Schedule

Project schedules for each site are site-specific and will be presented in the site-specific work plans or other individual report submittals for each site.

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2.0 Project Organization

A Project Management Team has been established that consists of three primary classifications: the Principal-in-Charge, Project Managers, and the Field Operations Leader. Responsibilities of the management team, and supporting staff, are described in **Section 2.1**.

2.1 Management Responsibilities

The roles and responsibilities each for program position that will participate in projects associated with this FSP/QAPP are summarized below. Personnel assigned to these positions are provided in **Table 2-1**.

AECOM:

Principal-In-Charge (PIC): The Principal-in-Charge (PIC) works closely with PPG Industries, Inc. and is responsible for managing contractual agreements between AECOM and PPG. The PIC will also have the responsibility for reviewing major deliverables to ensure compliance with the FSP/QAPP requirements.

Project Managers: Project Managers (PMs) will be designated on a site-by-site basis and will be responsible for daily coordination of the project, management of the project team, and the overall success of the project. The Project Manager will review reports and all correspondence prior to submission, and will act as overall technical coordinator. The Project Manager will maintain budget and schedule; track invoices, purchase orders, subcontracts; and set project goals and objectives according to proposal and client-authorized changes as they arise.

Field Operations Leader: The Field Operations Leader (FOL) is directly responsible for sampling quality control. It is the FOL's responsibility to mobilize the proper equipment, ensure that sampling procedures are implemented properly, that field control samples are collected as required, maintain chain of custody, and complete the required documentation. The FOL has full authority over logistical aspects of sampling in the field and the authority to implement minor changes to sampling plans to accommodate field conditions.

Site Supervisor: The site supervisor has the overall responsibility and authority to direct work operations at the job site according to the work plans. The Site Supervisor may also serve as a Task Leader or other role.

Task Leader: Task Leaders have the responsibility for supervising subcontractors, and for overseeing the collection of soil and groundwater sampled. A geologist or hydrogeologist will be the Task Leader for drilling and well construction operations, and has the responsibility for supervising the drilling subcontractor during the collection of soil samples and grab-groundwater samples, and installation of monitoring wells, and for classifying soil samples in the field. The Task Leader will ensure that field engineering and geological data is in accordance with currently accepted

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professional standards and that wells are installed in accordance with the FSP/QAPP, work plans and other report submittals.

The Task Leader will have the direct responsibility to ensure that soil and groundwater sampling activities are performed in accordance with the FSP/QAPP, work plans and other report submittals. The task leader reports directly to and is supervised by the FOL. The task leader will communicate with the FOL and report any conditions that may require changes in field activities or procedures.

The Task Leader or another AECOM representative may be designated by the Site Safety Officer (SSO) to perform as the SSO's field representative, and will report directly to the SSO to ensure that procedures outlined in the Health and Safety Plan (HASP) are followed.

Sampling and Health and Safety Technicians: Sampling Technicians are responsible for implementing sampling procedures as described in the FSP/QAPP, work plans and other report submittals. Sampling Technicians do not have the authority to change the sampling plan. Sampling Technicians may also serve as Health and Safety (H&S) Technician, and will report directly to the SSO's representative to ensure that the proper H&S precautions are taken. There will be an H&S Technician on-site for all activities. The H&S technicians' responsibilities are further outlined in the site-specific HASP and work plans.

Regional Safety, Health & Environment Manager (RSHEM): The AECOM RSHEM is the individual responsible for the preparation, interpretation and modification of the Health and Safety Plans (HASPs) as needed and will serve as the primary Health and Safety resource for the program.

Database Manager: The Database Manager will be responsible for the development and management of the groundwater, soil, and geologic databases. Additional support by trained administrative staff will be available as needed.

GIS Manager: The GIS Manager will be responsible for maintaining the geographic information systems for the program, and directing the production of GIS drawings and data presentation.

Data Validation Manager: The Data Validation Manager will act as the data review supervisor.

Project Quality Assurance Officer (QAO): The QAO will be responsible for maintaining compliance with AECOM's internal and project specific standards and practices for Quality Assurance. The project QAO will maintain and implement the FSP/QAPP.

Engineering Manager: The Engineering Manager will manage and delegate tasks related to evaluation of remedial options and implementation of remedial actions.

On-Site Health & Safety Coordinators: Each of the Task Leaders identified in **Table 2-1** will be in charge of coordinating health and safety issues on site and maintaining health and safety documentation for the duration of time each is on-site. They will apprise the Field Operations Leader of matters regarding health and safety. However, decisions pertaining to health and safety will be the responsibility of the RSHEM, with input from the Site Safety Officer, Site Supervisor and Task Leaders, as appropriate. These personnel will be responsible for coordinating field staff, maintaining budget and schedule, as well as the development of detailed internal work plans and schedules. Each

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will be in charge of coordinating health and safety issues on-site and maintaining health and safety documentation during their time on-site.

PPG Industries, Inc.:

Director, Environmental Affairs: The PPG Director, Environmental Affairs is responsible for overall contract execution and PPG program management.

Project Manager, Environmental Remediation: The PPG Project Managers are responsible for monitoring field activities, assisting in contract execution, management of individual site projects, and coordinating with various contractors on technical work execution.

NJDEP:

Manager, Site Remediation: The primary NJDEP representative is responsible for review and approval of submittals. JCO Team:

JCO Site Administrator: The Site Administrator is appointed by the Courts under the terms of the JCO and is responsible for establishing the Master Schedule, coordination of JCO activities, holding meetings with stakeholders, and hiring experts and consultants to assist him in JCO oversight, financial management of the JCO Fund, and other related tasks as dictated by the JCO.

JCO Site Administrator Project Manager: The Site Administrator Project Manager is responsible to assist the Site Administrator in his duties.

Technical Consultant: The Technical Consultant is hired by the Site Administrator under the terms of the JCO and provides technical support to the Site Administrator and NJDEP, and other tasks as dictated by the JCO.

Table 2-1 Program Personnel

Title, Affiliation, Name	Address	Phone	Email
Principal-In-Charge (AECOM)			
Robert Falotico	2 Technology Park Drive, Westford, MA 01886	(978) 589-3183	Robert.Falotico@aecom.com
Program Manager (AECOM)			
Scott Mikaelian	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3624	Scott.Mikaelian@aecom.com
Project Managers (AECOM)			
Richard Feinberg	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3610	Richard.Feinberg@aecom.com

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Title, Affiliation, Name	Address	Phone	Email
Alfred LoPilato (non-Garfield Avenue sites)	Rusten Corporate Park, 100 Red Schoolhouse Rd, Suite B-1 Chestnut Ridge, NY 10977	(845) 425-4980	Alfred.LoPilato@aecom.com
Robert Cataldo (Garfield Avenue Group)	2 Technology Park Drive Westford, MA	(978) 589-3141	Robert.Cataldo@aecom.com
Leo Gendron (Air Monitoring)	2 Technology Park Drive Westford, MA 01886	(978) 589-3146	Leo.Gendron@aecom.com
William Spronz	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3917	Bill.Spronz@aecom.com
Hue Quan	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3631	Hue.Quan@aecom.com
Richard Simun	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3636	Richard.Simun@aecom.com
Field Operations Leader (AECOM)			
Richard Feinberg	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3610	Richard.Feinberg@aecom.com
Richard Simun (Alternate)	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3636	Richard.Simun@aecom.com
Task Leaders and Health and Safety Technicians (AECOM)			
Christine Basinski	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3603	Christine.Basiniski@aecom.com
Megan Merdinger	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3622	Megan.Merdinger@aecom.com
Julia Shackford	Rusten Corporate Park, 100 Red Schoolhouse Rd, Suite B-1 Chestnut Ridge, NY 10977	(845) 425-4980	Julia.Shackford@aecom.com
Steven Wright	Rusten Corporate Park, 100 Red Schoolhouse Rd, Suite B-1 Chestnut Ridge, NY 10977	(978) 852-7620	Stephen.E.Wright@aecom.com

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Title, Affiliation, Name	Address	Phone	Email
Eric Acs (Site Supervisor)	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3901	Eric.Acs@aecom.com
Mark Hayden (Alternate Site Supervisor)	2 Technology Park Drive Westford, MA 01886	(978) 589-3447	Mark.Hayden@aecom.com
Anne Salazar	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3635	Anne.Salazar@aecom.com
Jeff Holzer	30 Knightsbridge Avenue, Suite 520 Piscataway, NJ 08854	(732) 564-3616	Jeffrey.Holzer@aecom.com
Regional Health, Safety and Environment Manager (AECOM)			
Phillip Platcow	66 Long Wharf Westford, MA 02110	617-899-5403	Phillip.Platcow@aecom.com
District Health, Safety and Environment Manager (AECOM)			
Mike Grasso	1001 West Seneca St. Ithaca, NY 14850	607-277-5716	Michael.Grasso@aecom.com
Air Database Manager (AECOM)			
Melissa Wellman	2 Technology Park Drive Westford, MA 01886	(978) 589-3386	Melissa.Wellman@aecom.com
Overall Database Manager (AECOM)			
James Herberich	2 Technology Park Drive, Westford, MA 01886	(978) 589-3193	Jim.Herberich@aecom.com
GIS Manager (AECOM)			
Erik Anderson	2 Technology Park Drive, Westford, MA 01886	(978) 589-3710	Erik.Anderson@aecom.com
Data Validation Manager (AECOM)			
Lisa Krowitz	2 Technology Park Drive, Westford, MA 01886	(978) 589-3343	Lisa.Krowitz@aecom.com
Quality Assurance Officers (AECOM)			
Mary Kozik (Analytical Procedures)	2 Technology Park Drive, Westford, MA 01886	(978) 589-3338	Mary.OConnellKozik@aecom.com

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Title, Affiliation, Name	Address	Phone	Email
Kathy Whooley (Field Procedures)	30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	(732) 564-3644	Kathy.Whooley@aecom.com
Engineering Manager (AECOM)			
Craig MacPhee	2 Technology Park Drive, Westford, MA 01886	(978) 589-3064	Craig.MacPhee@aecom.com
Director, Environmental Affairs (PPG)			
Mark Terril	4325 Rosanna Drive Allison Park, PA 15101	(412) 492-5466	terril@ppg.com
Project Manager, Environmental Remediation (PPG)			
Brian G. McGuire	4325 Rosanna Drive, Allison Park, PA, 15101	(412) 492-5512	bmcguire@ppg.com
Dave Claassen	4325 Rosanna Drive, Allison Park, PA, 15101	(412) 492-5629	dclaassen@ppg.com
JCO Site Administrator			
Michael McCabe	4 Normandy Drive Chadds Ford, PA 19317	(610) 388-9625	jcsiteadministrator@earthlink.net
Project Manager for JCO Site Administrator			
Brian McPeak	208 Winding Way South Little Silver, NJ 07739	(732) 216-6364	bmcpeak@planningprogress.com
Manager, Site Remediation (NJDEP)			
Thomas Cozzi	401 E State St. 5th floor Trenton, NJ 08625	(609) 984-2905	tom.cozzi@dep.state.nj.us
Technical Consultant (Weston Solutions)			
Prabal Amin	205 Campus Drive Edison, NJ 08837	(732) 417-5857	prabal.amin@westonsolutions.com

2.2 Laboratory

The analytical laboratory contractors supporting the standard analytical work for the non-residential and residential chromium site remedial activities are Accutest Laboratories, Inc. (Accutest), and Test America (formerly Severn Trent Laboratories, Inc. (STL)). The geotechnical laboratory supporting the geotechnical analyses will be GeoTesting Express, Inc. Analysis of hexavalent chromium on air filters will be performed by Galson Laboratories. Analyses of air filters for particulates (PM₁₀) will be performed by the AECOM laboratory in Harvard, MA. Measurements for Dissolved Oxygen, pH,

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temperature, turbidity, specific conductance, and oxidation/reduction potential (ORP) in the field will be performed by AECOM personnel.

All laboratories utilized for this program will be NJDEP-certified laboratories and hold current certifications for parameters of interest listed in **Appendix D** (where appropriate). **Table 2-2** provides contact and certification information for the participating laboratories.

Table 2-2 Laboratory Information

Laboratory	Laboratory Contact	NJDEP Certification No.	Analytical Role
Accutest Laboratories Fresh Ponds Corporate Village, Building B 2235 Route 130 Dayton, NJ 08810	Matt Cordova, Director of Client Services Phone: 732.329.0200 e-mail: matt@accutest.com	12129	Laboratory support for chemical analysis of soil and water samples
AECOM 30 Knightsbridge Road, Suite 520 Piscataway, NJ 08854	Erin Murphy Phone: 732.564.3628 e-mail: erin.murphy@aecom.com	12995	Field measurements of dissolved oxygen, pH, temperature, turbidity, ORP, and specific conductance.
AECOM 325 Ayer Road Harvard, MA 01451	Henry Chow Phone: 978.772.3345 e-mail: henry.chow@aecom.com	MA010	Field GC measurements Particulates
Galson Laboratories 6601 Kirkville Road East Syracuse, NY 13057	Ed Stuber, CIH Phone: 315.432.5227 e-mail: estuber@galsonlabs.com	NY024	Hexavalent Chromium in air
GeoTesting Express Inc. 1145 Massachusetts Ave. Boxborough, MA 01719	Mark Dobday 978-635-0012 Tel 978-844-2074 Cell e-mail: mdobday@geotesting.com	Not Applicable	Laboratory support for geotechnical analysis of solid samples
TestAmerica 777 New Durham Road Edison, NJ 08817	Thomas Tanico Customer Service Manager Phone: 732.549.3900 e-mail: Thomas.Tanico@testamericainc.com	12028	Laboratory support for chemical analysis of soil and water samples

2.3 Field Responsibilities

Task Leaders for continuing investigation and remedial activities, will be responsible for locating sample points (e.g., wells), ensuring adequate sample containers are available for sampling personnel, making sure that the required samples are collected and proper sampling techniques are used, ensuring that the appropriate documentation is completed, and the samples are properly preserved, packaged, and shipped to the appropriate laboratories. Task Leaders will receive copies of field notes and documentation from Field Team members and will review these notes. Deficiencies

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in the field notes will be reported by the Task Leaders to the project QAO and Field Team authors. Field notebook authors will revise the field notes as appropriate. Task Leaders and on-site representatives will also be responsible for subcontractor management while AECOM subcontractor personnel are onsite and ensuring that tailgate health and safety briefings are conducted for compliance with the HASP.

The Field Team members' responsibilities will include collecting field samples, collecting personnel and perimeter air monitoring samples, conducting field measurements, and documentation of all activities pursuant to this FSP/QAPP, work plans, AECOM Standard Operating Procedures (SOPs), and applicable NJDEP regulation and guidance. Field Team members will submit a copy of field documentation to the appropriate Task Leader, and will revise notes as necessary based on the Task Leader's quality assurance review.

2.3.1 Personnel Training

AECOM and subcontractor personnel working on this program will be properly trained and qualified individuals. Prior to the commencement of work on the site, personnel will be given instructions specific to this project, covering the following areas:

- Organization and lines of communication and authority;
- Overview of the field investigation activities;
- QA/QC considerations;
- Documentation requirements;
- Decontamination requirements; and
- Health and safety considerations.

Training of field personnel will be provided by the AECOM Project Manager, AECOM Task Leaders, Project QAO, and/or any other qualified designee. Federal regulations found in Title 49 of the Code of Federal Regulations (49 CFR) Part 172.702 require that each employer whose employees work with hazardous materials (as defined in sections 49 CFR 171 and 172) must train each of its hazmat employees. "Hazmat employees" include those who prepare the packages for shipping, prepare, sign or review the paperwork, load trucks, drive the vehicles or unload or receive the hazardous materials.

A hazmat employee who performs any of these functions may not perform the function unless he or she has been trained in the requirements of hazardous materials (generally: identification, classification, labeling, marking, placarding, packaging, etc.) that apply to that function. It is the duty of each hazmat employer to comply with the applicable requirements of this subchapter and to ensure that each hazmat employee has received the appropriate training. AECOM employee(s) will have the New Jersey Department of Transportation (NJDOT) Hazardous Materials Transportation Certification pursuant to 49 CFR 172.704. Only personnel knowledgeable and trained in the shipment of hazardous or dangerous goods will be responsible for the shipment of hazardous materials.

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3.0 Changes to Project Plans

The following procedure provides a means for controlling and documenting changes to the approved FSP/QAPP or site-specific work plans and changes during field activities or related to changes in accepted methods. The objective of the process is to maintain the level of QA/QC provided in the original review and approval process.

3.1 Changes or Additions

If non time-critical changes to a FSP/QAPP or site-specific work plan are required, the requesting party will initiate a request for change by editing the existing procedure and indicating the proposed changes by underlining the altered portions of the FSP/QAPP, work plans or other report submittals. The revision will be submitted with a cover letter (which includes the timeline for implementation of the change) to PPG and subsequently NJDEP for review, comment, and/or approval. Changes or additions required by NJDEP will be addressed by PPG based on written comments by NJDEP. Upon acceptance or approval of the revision by PPG and NJDEP, the change will be added to the appropriate section of the project planning document. Depending upon the complexity and extent of modifications, changes may be incorporated by marking the revised pages of the document with the word "revised" with the revision number and date placed in the lower right-hand corner. Extensive changes which result in resubmission of the entire document will be noted as a revision number for the document.

If time critical changes which could impact the overall project schedule (Master Schedule) are identified, AECOM will implement a procedure for rapid notification of key parties (AECOM Project Manager and Principal-In-Charge, NJDEP's Technical Consultant [Weston] and PPG via direct contact (phone or electronic mail). This will be followed by written documentation of the issue identified, proposed solution, and proposed schedule revisions to the Site Administrator. Following agreement on actions and approval of changes, the existing FSP/QAPP or work plan will be modified as needed. Revised pages or, if necessary, a complete, revised version of these documents will be prepared and distributed to all parties who received the original documents. Any schedule changes or revisions would also be documented in the Progress Report in accordance with 74.e and 74.f. of the ACO.

3.2 Changes or Additions to Laboratory Services

In the event that an additional laboratory subcontractor is required to handle the project load or there is a need to add additional analyses to the SOPs for the laboratory, a request will be made in writing to the other party. The letter will document the reason for the change, indicate any new analytical procedures to be used, present all pertinent laboratory SOPs, present the laboratory organization along with resumes and include a schedule for implementation as applicable. The requesting party will forward the letter to the other party for review, comment, and/or approval. Upon approval by both parties, the change or addition will be implemented. Appropriate correspondence documenting the acceptance of the change or addition of the analysis, along with supporting documentation, will be added as an appendix to the FSP/QAPP.

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Requests for revisions or additions will be transmitted through the NJDEP Case Manager (if originating from NJDEP) or Mr. Brian McGuire or Mr. Mark Terril. (if originating from PPG) to the AECOM PIC, Mr. Robert Falotico or AECOM Program Manager, Scott Mikaelian

3.3 Field Changes or Additions

Because time critical changes or additions to the FSP/QAPP or site-specific work plan may be needed in order to accommodate field conditions or respond to findings obtained in the field, a mechanism to accommodate such changes has been established. These changes or additions may be initiated by either NJDEP or AECOM and PPG through the use of the following procedure:

1. Notification: The requesting party makes contact with the other party to request and discuss the change and a schedule for implementation. Persons to be contacted in addressing field changes are the AECOM PM and PIC, Technical Consultant (Weston), and PPG representative(s).
2. Field Sign-off: Following internal discussion, if both parties orally agree to the change or addition, it will be implemented according to the agreed upon schedule. Oral requests for field changes and agreement on field changes will be documented in the site log book and will require sign-off by both parties in the field log prior to implementation.
3. Project Manager Sign-off: The requesting party must complete a field change request form (**Appendix A**) and submit it to the other party within 72 hours to document written approval of the change.
4. Revision to the FSP/QAPP: All approved field changes will be followed up by formal written changes to the FSP/QAPP, unless the changes are site-specific. Site-specific changes will be documented in the appropriate site-specific report.

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4.0 Quality Assurance Objectives

The overall QA objective is to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and reporting that will provide results that are legally defensible in a court of law. Specific procedures for sampling, chain of custody, instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field equipment, and corrective action are described in other sections of this FSP/QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability. These terms are described below.

4.1 Precision

4.1.1 Definition

Precision is a measure of the degree to which two or more measurements are in agreement.

4.1.2 Field Precision Objectives

Field precision is assessed through the collection and measurement of field duplicates at a rate of one duplicate per twenty field samples. Precision will be measured through the calculation of relative percent difference (RPD). The equation for this calculation is presented in **Section 5.2.1** of this FSP/QAPP. The objectives for field precision RPDs are 30% RPD for aqueous samples and $\leq 50\%$ RPD for soil, chip, masonry, and air particulate samples. Co-located samples will be collected to assess the precision of air particulate measurements. Field duplicates will not be collected for wipe samples or hexavalent chromium in air.

4.1.3 Laboratory Precision Objectives

Precision in the laboratory is assessed by calculating the RPD for duplicates. The equation for this calculation is presented in **Section 5.2.1** of this FSP/QAPP. Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be used to evaluate the precision of organic analyses. Laboratory duplicates as well as MS and/or MSD samples will be used for inorganic analyses; blank spike and/or blank spike duplicate samples will be used to assess laboratory precision for the determination of hexavalent chromium collected on air filters. Precision objectives will be the statistical control limits, or those specified in the method, whichever are more stringent.

4.2 Accuracy

4.2.1 Definition

Accuracy is the degree of agreement between the observed value and an accepted reference value.

4.2.2 Field Accuracy Objectives

The achievement of accurate data in the field will be addressed through the use of sampling procedures that minimize bias, the calibration of field instruments, and adherence to sample holding

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times and preservation requirements. Accuracy in the field will be evaluated through the use of trip blanks and/or field blanks. These blanks should contain no target analytes above the reporting limit.

4.2.3 Laboratory Accuracy Objectives

Laboratory accuracy will be expressed as percent recovery and will be determined through the analysis of matrix spikes, surrogates, and laboratory control samples. The equation that will be used to calculate percent recovery is included in **Section 5.2.2** of this FSP/QAPP. Laboratory accuracy objectives limits will be the statistical control limits, or those specified in the method, whichever are more stringent.

4.3 Completeness

4.3.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan were implemented as planned.

4.3.2 Field Completeness Objective

Field completeness will be measured on the basis of (1) the number of valid field measurements and (2) the number of valid samples collected. The equation for completeness is presented in **Section 5.2.3** of this FSP/QAPP. The objective for field completeness for this project is greater than 90%.

4.3.3 Laboratory Completeness Objectives

Laboratory completeness will be measured by the number of valid measurements obtained compared to the number of valid samples submitted. The equation for calculating completeness is presented in **Section 5.2.3** of this FSP/QAPP. The completeness objective for the laboratory is greater than 90%.

4.4 Representativeness

4.4.1 Definition

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

4.4.2 Measures to Ensure Representativeness of Field and Laboratory Data

Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The rationale of the sampling program is discussed in the site-specific work plan. Representativeness will be satisfied by ensuring that the work plan is followed, proper sampling techniques are used, samples are appropriately preserved, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will be included as a QA measure during the yearly Project QA audits.

Sampling protocols (discussed in **Section 6**) have been developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and

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shipping) have also been designed to protect the representativeness of the collected samples. Proper field documentation will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

4.5 Comparability

4.5.1 Definition

Comparability expresses the confidence with which one data set can be compared to another.

4.5.2 Measures to Ensure Comparability of Field and Laboratory Data

The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in this FSP/QAPP, are expected to provide comparable data. Any changes in procedure or QA objectives, however, may affect data comparability.

When comparing data, it is important to compare data collected under the same set of conditions. Seasonal trends, depth of sample collection, analytical protocol, stream flow during sample collection, and any other sampling/analytical variables must be taken into account when comparing data sets.

Comparability will be maximized by: (1) the use of Project Operating Procedures (POPs) and SOPs throughout the project; (2) the recording of data in a standardized format; (3) the use of standard methods; (4) conducting confirmatory sampling and analysis when using alternative sampling and analysis methodologies; and (5) reporting of data in appropriate, consistent units.

4.6 Level of Quality Control Effort

4.6.1 Field Measurement

The field measurement equipment will be calibrated required under the methodologies specified in **Section 11** of this FSP/QAPP and the individual work plan(s). SOPs and POPs for the use of field instrumentation also contain detailed calibration requirements.

4.6.2 Laboratory Analysis

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort required under the methodologies specified in **Section 12** of this FSP/QAPP. Each sample set processed as a batch by the laboratory will include a method blank, a measure of analytical accuracy such as a blank spike or matrix spike, and a measure of analytical precision such as a laboratory or matrix spike duplicate. Laboratories will adhere to all quality control procedures required in the analytical SOPs specified in **Appendix D**.

In accordance with the quality assurance requirements of the recently amended N.J.A.C. 7:26E-2.1(a)7, "The person responsible for conducting the remediation shall ensure that hexavalent chromium analysis of aqueous and nonaqueous samples is conducted as follows: i. Measure the pH and Eh of each sample, not just the quality control sample, with the pH and Eh data included and plotted in the full data deliverables using the graph in USEPA SW-846 Method 3060A incorporated herein by reference, as amended and supplemented; and ii. Use a site sample for the quality control

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analyses so the reduction/oxidation effects of the site matrix can be properly evaluated using USEPA SW-846 Method 3060A.” The NJDEP certified laboratories that will perform the hexavalent chromium analysis are aware of these requirements. These requirements will also be included in the technical terms and conditions which are part of the laboratory purchase order in order to ensure compliance.

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5.0 Data Assessment Procedures

5.1 Field Measurements

Field data will be reviewed by the AECOM Field Operations Leader and Task Leader for compliance with the Work plan, FSP/QAPP, and SOPs/POPs as applicable. Precision, accuracy, and completeness will be evaluated based on the methods and equations described in **Sections 4.1, 4.2, and 4.3**.

5.2 Laboratory Data

Laboratory analytical results will be assessed for compliance with precision, accuracy, completeness, and sensitivity requirements as described in the following sections.

5.2.1 Precision

AECOM will review the nonconformance summaries reported by the laboratories, which include RPD measurements outside laboratory QC limits by analyte group.

AECOM expects that the precision of laboratory analysis will be assessed by comparing the analytical results between MS/MSD samples for organic analysis, and laboratory duplicate analyses and MS/MSD samples for inorganic analysis. The RPD will be calculated for each pair of duplicate analysis using the following equation:

$$\% \text{ RPD} = \frac{(S - D)}{(S + D)} \times 100$$

where S = original sample data
D = duplicate sample data

5.2.2 Accuracy

AECOM will review the nonconformance summaries reported by the laboratories which include monitoring of recovery measurements based on laboratory QC limits by analyte group. The accuracy of laboratory results will be assessed for compliance with the criteria established in **Section 4.2** of this FSP/QAPP using the analytical results of method blanks, trip blanks, field blanks, and MS/MSD samples. The percent recovery (%R) of matrix spike samples will be calculated using the following equation:

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$$\% R = \frac{(A - B)}{C} \times 100$$

where A = the analyte concentration determined experimentally from the spiked sample,
B = the background level determined by a separate analysis of the unspiked sample, and
C = the amount of the spike added.

5.2.3 Completeness

The completeness of laboratory analytical results will be assessed by the laboratory for the amount of data required in **Section 4.3** of this FSP/QAPP. The completeness will be calculated using the following equation.

$$Completeness = \frac{ValidDataObtained}{TotalPlannedData} \times 100$$

5.2.4 Sensitivity

The laboratory will monitor the data quality through constant instrument performance and that instrument sensitivity will be monitored through the use of method blanks, calibration check samples, etc., in accordance with the methods listed in **Appendix D** of this FSP/QAPP. Method detection limits will be calculated according to 40 CFR Part 136 Appendix B.

As required in the Technical Requirements for Site Remediation at N.J.A.C. 7:26E-2.1(a)8, samples that will be used for determining compliance will be analyzed using a method with adequate sensitivity to accurately measure to the applicable remedial standard. Detection limits will be at or below applicable Remediation Standards (N.J.A.C 7:26D), last revised November 4, 2009, or Soil Cleanup Criteria, last revised May 12, 1999 (for trivalent and hexavalent chromium), Table 1 from the NJDEP guidance document Development of Site-Specific Impact to Ground Water Soil Remediation Standards using the Soil-Water Partition Equation, December 2008 (revised), and the Ground Water Quality Standards (N.J.A.C. 7:9C Appendix Table 1) adopted by reference as Ground Water Remediation Standards. **Tables 5-1 and 5-2** provide a comparison of the laboratory reporting limits with the applicable NJDEP practical quantitation levels (PQL) and remediation standards for the soil and aqueous analytes of interest. The detection limits and action limits for the air monitoring program will be specified in the specific air monitoring work plan.

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6.0 Field Operations

The standard sampling procedures to be used for the PPG residential and non-residential chromium sites, and perimeter air monitoring are described in this section. All sample collection and field screening will be conducted in accordance with the current versions of the NJDEP Field Sampling Procedures Manual (August 2005), the NJDEP Technical Requirements for Site Remediation (November 2009), applicable AECOM SOPs/POPs, and accepted practices. SOPs and POPs for all significant field activities are presented in **Appendix B**. All samples will be handled in a manner consistent with the sample container, preservation, and holding time requirements specific to the analytical and data quality requirements of the investigation.

All samples collected during the field investigation will be analyzed by NJDEP-certified laboratories. The laboratories will adhere to the United States Environmental Protection Agency (USEPA) protocols for sample preparation and analysis dictated by the requested analytical method.

Full laboratory data deliverables, as detailed in Appendix A of the NJDEP Technical Requirements for Site Remediation (November 2009) will be submitted for all hexavalent chromium and hexavalent chromium associated analytical data (pH, Eh, sulfides, etc.). The full laboratory data deliverables will consist of the following:

- three electronic copies of the laboratory data package on CD in Adobe portable document format (pdf),
- one paper copy of the laboratory data package,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*,
- and one electronic copy of the analytical data in the EQUIS four-file format, as modified by AECOM.

Reduced laboratory data deliverables, as detailed in Appendix A of the NJDEP Technical Requirements for Site Remediation (November 2009), will be submitted for all other analytical data (ex. metals, volatile organic compounds [VOCs], etc...). The reduced laboratory data deliverables will consist of the following:

- one electronic copy of the full, validatable laboratory data package on CD in Adobe pdf will be submitted,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*, and
- one electronic copy of the analytical data in the EQUIS four-file format, as modified by AECOM.

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Details are provided in this section for both field measurement activities and sample acquisition. Details are also provided for:

- Equipment cleaning and decontamination;
- Drilling and monitoring well installation;
- Sample storage and handling; and
- Documentation.

In addition to the requirements described in the above protocols, the following general requirements apply to all sampling activities:

- Whenever possible, samples will be collected in order of least to most contaminated, so that risks of systematic contamination are minimized.

Samples designated for laboratory analysis will be collected from the liner and placed in appropriate laboratory pre-cleaned containers (after homogenization, if appropriate). Per Section 6.9.2, Means of Sample Collection, of the NJDEP Field Sampling Procedures Manual (August 2005) the order in which analytical samples should be collected is as follows:

1. VOC (prior to soil sample homogenization);
2. Total organic halogens (TOX)
3. Total organic carbon (TOC)
4. Semivolatile organic compounds (SVOCs)
5. Extractable petroleum hydrocarbons (EPH)
6. Polychlorinated biphenyls (PCBs)
7. Total metals
8. Dissolved metals (groundwater only)
9. Phenols
10. Cyanide
11. Chloride
12. Preserved inorganics
13. Non-preserved inorganics

When several wells with known or suspected contamination will be sampled, the least contaminated well should be sampled first, and the wells then sampled in order of increasing contamination.

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- Additional sample locations will be co-located when necessary to obtain additional sample volume for the required analyses from each depth interval or sample location. The samples will be thoroughly homogenized prior to filling the sample bottles, except for samples collected for volatile organics analysis.
- Wherever possible, sampling equipment will arrive at the Site pre-cleaned and will be dedicated to one sample location on-site. Where not practical, field decontamination will be conducted in accordance with **Section 9**.
- Water and soil samples requiring chemical preservation will be placed in pre-preserved containers supplied by the laboratory.
- Sample containers and blank water will be obtained from the analytical laboratories which will provide properly cleaned and preserved (where required) sample containers. The vendor-prepared bottles will be prepared according to USEPA protocol as described in Specification and Guidance for Contaminant-Free Sample Containers, EPA 540/R-93/051. The laboratories will also prepare analyte-free blank water to be used for field blanks. Care will be taken to ensure that blanks are prepared using only water supplied by the laboratory that will perform the analysis. In general, a single laboratory will be responsible for the analysis of samples collected at a single location. For air samples, a blank filter will be submitted with field samples; the filter will be from the same manufacturing lot as that used for sample collection.
- Field changes to site-specific work plan(s), either by AECOM field personnel or NJDEP field personnel, are permissible only when made in strict accordance with field change policies described in **Section 3**.
- Outer gloves will be changed between sampling locations.
- Air monitoring will be conducted in accordance with the HASP. Field instruments for air monitoring will include a photoionization detector (PID), hydrogen sulfide (H₂S) portable, hand-held analyzer, and an aerosol/dust monitor.

6.1 Soil and Building Materials Investigation

Drilling and soil sample collection will be supervised by the Task Leader who will be an AECOM geologist/hydrogeologist. Drilling, sample collection, well construction and well/boring abandonment will be conducted in accordance with N.J.A.C 7.9D. A driller licensed by the State of New Jersey will be in charge of all drilling operations. Drillers shall be required to comply with OSHA 1910.120. Drilling and soil sampling procedures in the applicable POP(s) are attached in **Appendix B (POP Nos. PPG 005 and PPG 006)**.

Soil samples will be screened for VOC in the field shortly after collection using an instrument equipped with a PID. The equipment will be issued through a formal equipment tracking system and operated by trained personnel in accordance with manufacturers' recommendations. All field measurement equipment will be maintained to ensure that measurements obtained are accurate and defensible.

All samples will be placed in pre-cleaned containers for transport to the laboratory. Soil samples for VOC will be transferred directly from the sample collection tool to containers prepared by the laboratory in accordance with the NJDEP *Field Sampling Procedures Manual* (August 2005) (refer to

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applicable POP(s) in **Appendix B (POP No. PPG 005)**. VOC sample collection utilizing EnCore® or similar sampling devices will reduce the potential for VOC loss during sample collection and will result in lower reporting limits comparable to the impact to groundwater soil remediation standard. VOC samples will be collected using an EnCore® or similar sampling device and promptly shipped to the laboratory to permit freezing or analysis within 48 hours of collection.

Soil samples for all other parameters will be homogenized prior to placing in the containers. Homogenization will be performed in a stainless-steel bowl per the applicable POP(s) in **Appendix B (POP No. PPG 005)**. Building materials samples will be placed in containers without homogenization. Prior to homogenization, soils will be field screened with a PID using the applicable POP(s) in **Appendix B (POP Nos. PPG 004 and PPG 005)**.

In accordance with N.J.A.C. 7:26E-3.6(a)4, all soil samples to be analyzed for volatile organics shall be collected as follows:

i. A bulk sampling device that will collect an intact core (for example, splitspoon) shall be used to minimize contaminant loss during sampling; and

ii. Each core shall be screened with a properly calibrated direct reading instrument equipped with a photoionization detector (PID), flame ionization detector (FID), or other suitable instrument capable of detecting the contaminants pursuant to N.J.A.C. 7:26E-2.1(b) to select samples of volatile organics analysis using the following criteria:

(1) If field measurement readings are detected above background:

(A) The coring shall be extended until either background readings are achieved, groundwater is encountered, or bedrock is encountered; and

(B) An undisturbed sample from the six-inch interval registering the highest field measurement reading shall be collected, at a minimum, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4; or

(2) If all intervals register the same field measurement reading or all field measurement readings do not exceed backgrounds:

(A) The coring shall be extended to groundwater, bedrock, or 10 feet, whichever is encountered first; and

(B) One undisturbed sample at a minimum, from the six-inch interval at the bottom of the soil boring shall be collected, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4; and

iii. Contaminants that cannot be detected with field-screening instruments shall be sampled in accordance with the requirements at N.J.A.C. 7:26E-3.4(a).

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6.1.1 Utility Protection

Prior to conducting any intrusive operations, existing drawings and other available documentation will be reviewed to evaluate whether potential conflicts with underground utilities exist. New Jersey One Call will be notified by the drilling contractor at least three and not more than ten business days prior to the start of drilling in each off-site area.

If any doubt exists regarding the potential presence of subsurface utilities, a professional utility locating service will be retained to conduct surveys to clear proposed drilling locations. A variety of techniques are available to locate utilities, including ground penetrating radar, electromagnetic conductivity, radio frequency, audio frequency, and passive electric. The efficacy of each technique is dependent on the material used to construct the utility, type of utility, number and type of nearby utilities, and many other factors. As such, it is common practice to use more than one utility locating technique. The requirements for utility location and appropriate techniques will be determined once available information is gathered and evaluated.

Soil boring, sampling, and monitoring well locations will be adjusted to avoid underground and overhead utilities. As an added precaution, vacuum boring to a depth of four feet or to the expected invert depth of the deepest utility at any given soil boring or well location may be conducted. However, if vacuum boring is required at certain locations, collection of shallow soil samples for laboratory analysis in the vacuumed zone will still be undertaken from the sidewall area of the vacuumed zone to ensure that shallow surface soil samples will be collected at all proposed off-site investigation locations.

6.1.2 Direct-Push Drilling and Soil Sampling

Direct-push methods (Geoprobe[®] and similar systems) of soil sampling utilize a hydraulically-powered percussion drilling machine to drive hollow soil samplers into the subsurface to obtain soil samples. The equipment and hydraulics used in the drilling machine are generally mounted on a vehicle to provide both mobility around the jobsite and a stable drilling platform. A POP for direct-push drilling is included in **Appendix B (POP No. PPG 005)**.

Geoprobe[®] sampling systems typically utilize the Macro-Core sampler, which is a 45-inch long, 1.5-inch diameter hollow steel sampling barrel, lined with a disposable factory-clean acetate liner. It is the Macro-Core which is driven into the ground for collection of soil samples. This method works best in stable subsurface environments where borehole collapse is not a significant issue.

Where borehole instability is anticipated (e.g., "running sands"), sampling can also be conducted using a dual tube sampling system. This system is similar to the Macro-Core except that the liner (in this case PVC) is withdrawn but the steel outer casing remains in place until the last sample is collected and the borehole grouted to prevent borehole collapse.

Once a sample is collected, the liner is cut with a knife by the driller (per the project HASP). Following liner cutting, the soil sample will be field screened with a calibrated PID, if required. Sample recovery will be determined by the geologist/hydrogeologist using a folding rule or tape measure. Any portion of the split-spoon contents which are not considered part of the true sample (heaved soils, borehole scrapings, etc.) will not be included in the measurement.

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Due to anticipated variations in sample recovery, thickness of various strata identified in the recovered sample, and the number of analyses proposed, sample collection precedence as described below will be used to collect soil samples. Samples will be collected using this precedence until no additional material is available for the sampling interval. If additional sample volume is needed to complete the analyte suite required, sample volume will be collected from the six-inch interval directly above or below the target interval, whichever is most similar in terms of geology and field observations.

Samples designated for laboratory analysis will be collected from the liner and placed in appropriate laboratory pre-cleaned containers (after homogenization, if appropriate). Sample order precedence is discussed above in **Section 6.0**. Sample handling is discussed in **Section 10.0**.

6.1.3 Split-Spoon Sampling

Soil samples obtained during hollow-stem auger or mud-rotary drilling will be collected using a split-spoon sampler (refer to POP No. PPG 005 in **Appendix B**). Split-spoon sampling devices are constructed of steel and are most commonly available in lengths of 18 and 24 inches and inside diameters of 1.5 to 3 inches. Typically, the 1.5-inch diameter sampler is used; however, larger diameter samplers may be used if large volumes of soil are required for analytical testing.

The split-spoon consists of a tubular body with two halves that split apart lengthwise, a drive head on the upper end with a ball-check valve for venting, and a hardened steel cutting shoe at the bottom. The soil sample enters the split-spoon through the cutting shoe as the device is driven into the ground. A replaceable plastic or metal basket is often inserted into the shoe to assist with retaining samples. Once the sampler is retrieved, the drive head and cutting shoes are removed and the split-spoon halves are then separated, revealing the sample.

The drilling subcontractor will lower the split-spoon into the borehole. The sampler is generally driven into the ground using a 140-pound hammer with a vertical free drop of 30 inches, although a down-hole hammer or hydraulic drivers may be utilized as an alternative.

The number of blows required for every 6 inches of penetration will be recorded on the boring. Blow count information is used as an indicator of soil density for stratigraphic logging purposes. Once the split-spoon has been driven to its fullest extent, or to refusal, it will be removed from the borehole. Refusal is defined as 50 blows for six inches or less of penetration.

The split-spoon will be immediately opened upon removal from the casing/auger/borehole. The open sampler shall then be field screened with a calibrated PID, if required. Sample recovery will be determined by the geologist/hydrogeologist using a folding rule or tape measure. Any portion of the split-spoon contents which are not considered part of the true sample (heaved soils, borehole scrapings, etc.) will not be included in the measurement.

Samples designated for laboratory analysis will be collected from the liner and placed in appropriate laboratory pre-cleaned containers (after homogenization, if appropriate). Sample order precedence is discussed in **Section 6.0**. Sample handling is discussed in **Section 10.0**.

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6.1.4 Soil Sampling Beneath Residential Slabs

During completion of field activities, it may become necessary to collect soil samples from beneath concrete slabs in residential buildings. Soil sampling beneath residential slabs will be conducted following the applicable POP(s) in **Appendix B** (POP No. PPG 005). Prior to collection of the samples, utility protection measures consistent with **Section 6.1.1** will be implemented to ensure the concrete at the proposed sampling location is free of utilities. After the sampling location has been cleared for utilities, the drilling contractor will utilize a concrete core drill to create an opening in the slab of sufficient size to allow for collection of the soil samples. Upon completion of sampling activities, the drilling contractor will repair the opening with concrete.

6.1.5 Air Sampling

The AIRMETRICS MiniVol™ portable air sampler will be used for the integrated sampling of airborne particulates (PM₁₀) and hexavalent chromium on 47 mm filters. Two separate MiniVol™ samplers will be used; for the collection of PM₁₀ the sampler will be configured to draw air at 5 liters/minute through a 10 micron particle size separator (impactor) then through a 47 mm pre-weighed filter. A similar configuration will be used for the collection of hexavalent chromium with the exception that no particle size impactor is required and the flow rate will be set at 3.5 liters/minute. Filters for PM₁₀ and hexavalent chromium will be recovered and shipped under chain-of-custody to off-site laboratories for analysis.

Additional on-site air measurements will include the use of a direct reading real-time MIE DataRAM Analyzer or TSI DustTrak Aerosol Monitor or equivalent for the determination of PM₁₀ which will be used as a surrogate for continuous monitoring of hexavalent chromium, metals, and polyaromatic hydrocarbons (PAHs). Total VOC (TVOC) concentrations associated with ground intrusive activities will be monitored through the use of RAE portable PID. If an elevated TVOC level is detected at one of the fixed air monitoring sites, a gas chromatograph fitted with an automatic injection feature will monitor for benzene, toluene, ethylbenzene and xylenes (BTEX). As needed, handheld measurements for hydrogen sulfide will be made using the Arizona Instrument Jerome Model 631X Hydrogen Sulfide portable analyzer or equivalent.

Specific procedures for these field instruments are contained in SOP Nos. PPG-017 and PPG 020 in Appendix B.

6.1.6 Feasibility Study

Material which is tentatively identified as Green-Gray Mud or Chromite Ore Processing Residue (COPR) but cannot be confirmed to be one of these materials through other techniques such as visual, magnetic or similar tests will be subjected to hydrochloric acid testing using the procedure described in POP PPG 015. Green-Gray Mud is expected to contain percent levels of calcium; COPR may contain significant levels of calcium as well. The field test described in POP PPG 015 will involve dropwise addition of 1:1 Hydrochloric Acid to a sample of the suspected material, if calcium or other carbonate salts/minerals are present foaming or effervescence should occur. However, as noted in the POP, this test is not specific to calcium and should be used in conjunction with other observations to assist in the identification of materials containing Green/Gray Mud and COPR.

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In order to document that representative samples are obtained for testing of proposed remediation procedures, samples taken from a predetermined grid will be field screened for grain size using a series of sieves. In addition, soil color and the presence/absence of COPR nodules or paste-like material will be documented; photographs will be used as appropriate to further document the nature of the sample. POP PPG 016 describes the specific procedures which will be used to document the condition of field samples collected for assessment of remediation options.

6.2 Quality Control Samples

QC samples collected during field activities will consist of trip blanks, field blanks, field duplicates, matrix spike, and matrix spike duplicate samples. The procedures for collection of specific sample matrices are discussed in the applicable POPs in **Appendix B** (POP Nos. PPG 005, PPG 008, PPG 010, PPG 011, PPG 012, PPG 013, PPG 018, and PPG019) and below. A description of the QC samples is provided below:

- **Field Blanks:** Field blanks are analyzed to check for procedural contamination at the site that may cause sample contamination. Field blanks will be prepared by routing analyte free deionized/distilled water (provided by each laboratory performing the sample analysis) through sampling equipment after equipment decontamination and before field sample collection. The blank water quality supplied by each laboratory will meet the requirements stated in Section 2.5.4 of the NJDEP *Field Sampling Procedures Manual* (August 2005). The appropriate laboratory water will be used to collect the field blanks depending on the analysis and the laboratory performing the analysis. Thus, field blanks associated with analyses to be performed by a designated laboratory will only be collected using the deionized/distilled water supplied by the designated laboratory. In addition, if specific water is provided by the laboratory for a specific analysis then only that water will be used to collect the associated field blank.

Field blanks will be preserved in the same manner as samples (**Appendix C**). For air and wipe sampling, field blanks will be collected using filters and wipes from same lot number as those used for sampling. For this FSP/QAPP, field blanks will be collected at the frequency specified in Table 6-1 and analyzed for all applicable target parameters as specified in **Table 6-1**.

For the non-aqueous matrix, for sampling events lasting more than one day, field blanks associated should be performed at a rate of 10% of the total number of samples collected throughout the event for all parameters sampled that day. If collection of 10% of total number of samples will result in the collection of more than 1 Field Blank per day, this is not necessary per the NJDEP FSPM (2005).

For the aqueous matrix, field blanks must be performed at a rate of one per day for all parameters sampled that day.

- **Trip Blanks:** Trip blanks are used to assess the potential for contamination of samples due to VOC contaminant migration during sample shipment and storage. Each laboratory performing volatile organic analysis will prepare trip blanks by filling sets of 40-milliliter (ml) vials with analyte free deionized water, sealing the vials with septum-lined caps (allowing no headspace or entrapped air bubbles). The vials will then be kept with the sample cooler

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from the time the sampling kit leaves the laboratory until it is returned from the field. The blank water quality supplied by each laboratory will meet the requirements stated in Section 2.5.4 of the NJDEP *Field Sampling Procedures Manual* (August 2005). The trip blanks prepared by a designated laboratory will only accompany samples being delivered to that designated laboratory. In general, a single laboratory will be responsible for all analyses associated with a specific location. According to the *NJDEP Field Sampling Procedures Manual* (August 2005), trip blanks are not required for the non-aqueous matrix. Trip blanks will be required at a frequency of one set per cooler in which aqueous VOC samples are shipped (**Table 6-1**). Trip blanks will be analyzed for VOC only.

- **Field Duplicates:** Field duplicates are analyzed to check for sampling and analytical reproducibility. Duplicate samples will be collected by alternately filling sample bottles from the source being sampled. Field duplicates will not be collected for wipe samples. Co-located samplers will be used for the collection of field duplicates for the PM₁₀ analysis. Field duplicates for air, soil, aqueous, chip, and masonry samples will be collected at the frequencies specified in **Table 6-1**.
- **Matrix Spike Samples:** Matrix spikes provide information about the effect of the sample matrix on the preparation and measurement methodology. Matrix spikes for organic and inorganic analyses are performed in duplicate and (referred to as MS/MSD samples). MS/MSD samples will be prepared by the laboratory according to their SOPs, as applicable to the method. A matrix spike/laboratory duplicate analysis may be substituted for an MS/MSD for inorganic parameters (if allowed by the method) at the same frequency as the MS/MSD. MS/MSDs will not be collected for wipe and air samples; blank spikes and blank spike duplicates will be used for these analyses. MS/MSD soil, aqueous, chip, and masonry samples will be collected at the frequencies specified in **Table 6-1**.

6.3 Borehole Abandonment

Unless a well is to be installed, boreholes will be abandoned by grouting in accordance with N.J.A.C. 7.9D.

6.4 Location Measurements

The locations of all new borings and other sample collection points will be measured using standard surveying techniques or using GPS. The locations and elevations of all new monitoring wells will be measured by a New Jersey State licensed surveyor in accordance with NJDEP requirements. Latitude and Longitude will be measured to the nearest 1/10 of second (NAD 83) and to the New Jersey State Plane Coordinates (NAD 83) to the nearest 1 foot. A permanent reference mark will be made on the top of the riser (cap off), and the elevation (NAVD 88) will be surveyed to the nearest 1/10 foot. Surveyors shall be required to comply with OSHA 1910.120. All surveying and reporting of location information will be in compliance with the requirements of N.J.A.C. 7:26E-3.13(c)3v.

TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY

Matrix ¹	Analyses ¹	Quality Assurance Samples	Sampling Frequency	Criteria
AIR	Chromium (Total and Hexavalent)	Field Blank	1/day from same lot number as sample filters	<MDL ⁸
	Particulates (PM ₁₀)	Field (Blind) Duplicate (co-located)	1/20 samples (5% of total) or minimum of 1/week	RPD < 50%
WIPES	Chromium ⁴ (Total and Hexavalent)	Field Blank	1/day from same lot number as the sample wipes	<RL ²
SOIL, CHIP, CONCRETE, SWEEP, MASONRY (including TCLP and/or SPLP, as applicable)	TCL VOCs	Field Blank	Either 1/day or 10% of the total number of samples collected, but not more than 1/day	< RL ²
	TCL SVOCs			
	TCL PCBs	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 50%
	TAL Metals			
	Hexavalent Chromium ⁴	MS/MSD	1/20 samples (5% of total)	See method ³
	EPH			
	Phenols	Field Blank	Either 1/day or 10% of the total number of samples collected, but not more than 1/day	< RL ²
	Cyanide			
	Wet Chemistry ⁵	Field Blank	Either 1/day or 10% of the total number of samples collected, but not more than 1/day	< RL ²
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 50%
	Geotechnical ⁶	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 50%
	Waste Characteristics ⁷			

TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY (continued)

Matrix ¹	Analyses ¹	Quality Assurance Samples	Sampling Frequency	Criteria
AQUEOUS	TCL VOCs	Trip Blank	1/cooler	< RL ²
		Field Blank	1/day	< RL ²
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
		MS/MSD	1/20 samples (5% of total)	See method ³
	TCL SVOCs TCL PCBs TAL Metals Hexavalent Chromium ⁴ EPH Phenols Cyanide	Field Blank	1/day	< RL ²
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
		MS/MSD	1/20 samples (5% of total)	See method ³
		Field Blank	1/day	< RL ²
	Wet Chemistry ⁵	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
	Waste Characteristics ⁷	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%

Notes:

- ¹ - These are proposed matrices and analytes, refer to the RIWP for the specific matrices and analytes.
- ² - Refer to Tables 5-1 and 5-2 for the analyte specific RL.
- ³ - Refer to the specific analytical methods for the MS/MSD QC Criteria.
- ⁴ - Hexavalent chromium analysis includes Eh and pH analysis on every sample.
- ⁵ - Wet Chemistry analyses may include BOD, CEC, COD, TDS, TSS, TOC, TOX, Alkalinity, Chloride, Ferrous iron, Nitrate, Nitrite, Phosphate, and Sulfide.
- ⁶ - Geotechnical analyses may include moisture content, permeability, specific gravity, grain size, bulk density, Atterberg limits, and unconfined compressive strength.
- ⁷ - Waste Characteristic analyses may include ignitability, reactivity, moisture content, and corrosivity.
- ⁸ - Refer to the specific air monitoring work plan.

Acronyms:

EPH	Extractable Petroleum Hydrocarbons	TAL	Target Analyte List
MDL	Method Detection Limit	TCL	Target Compound List
PCB	Polychlorinated Biphenyl	TDS	Total Dissolved Solids
PM ₁₀	Particulates	TOC	Total Organic Carbon
RL	Reporting Limit	TOX	Total Organic Halides
RPD	Relative Percent Difference	TSS	Total Suspended Solids
SOP	Standard Operating Procedure	VOC	Volatile Organic Compound
SVOC	Semivolatile Organic Compound		

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7.0 Groundwater Investigation

Soil boring investigation methodologies are described previously in **Section 6.0**. The following section details the well construction, development, and groundwater sampling methodologies.

7.1 Well Construction

Wells will be constructed by the drilling contractor at the direction of the Site geologist/hydrogeologist. Wells will be constructed in accordance with N.J.A.C. 7.9D typically using two-inch (nominal) Schedule-40 PVC riser and screen. Wells installed below the meadow mat (or equivalent elevation, where there is no meadow mat) will be double cased using a six-inch (minimum) nominal diameter steel pipe as the outer casing. The outer diameter of the borehole will be a minimum of four inches larger than the well riser or outer casing. Double cased (or telescoping) wells will be advanced into the meadow mat (intermediate wells) or deeper confining layer (deep wells). The outer casing will be installed into the confining or semi-confining geological unit and grouted in place. Drilling to the target depth will proceed following a minimum period of 24 hours so that the grout has had sufficient time to set.

In boreholes where a shallow water-bearing zone is encountered above a deeper water bearing zone, casing will be installed to prevent downward migration between the water-bearing zones in accordance with N.J.A.C. 7.9D. The casing will be installed into the confining or semi-confining unit; or where absent to a sufficient depth to prevent migration between the water-bearing zones. The annular space between the casing and borehole, as well as the annular space between water-bearing zones, will be grouted. The grout will be allowed to set for a minimum of 24 hours prior to further advancement of the borehole. In accordance with the NJDEP *Field Sampling Procedure Manual* (August 2005), installation of well couplets (e.g., shallow and deep) and well triplets (e.g., shallow, intermediate and deep) will be installed in separate boreholes since grout is less likely to invade well intakes (screens) if the wells are installed in separate boreholes. Care will be taken to assure that any confining unit between aquifer zones is not breached without providing adequate protection of underlying/overlying aquifers.

Well screens will be machine-slotted (0.010- to 0.020-inch slots), and will be of a length suitable for the particular use. Sand pack will be installed to an approximate height of two feet or greater above the top of the screen. An approximate one-foot thick bentonite seal will then be placed above the sand pack and the remainder of the well annulus will be grouted with a Portland cement and bentonite mixture. Specific well construction procedures are presented in POP PPG 006 in **Appendix B**.

7.2 Well Development

Not sooner than 24 hours after completion, all wells will be developed to remove fines and minimize the effects of drilling on the water quality. Pumping will be the preferred method for developing the monitoring wells. When recharge is adequate, the monitoring well will be surged (by surge block or by raising and lowering the pump along the screened interval) and pumped using one of the following: a

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submersible pump or a surface centrifugal pump. Bailing may be used to surge the well and remove sediment if recharge is inadequate to use a submersible pump to develop the monitoring well.

Well development water will be contained in 55-gallon drums or tanks for waste classification and disposal. The determination of groundwater disposal for off-site wells will be made on a case-by-case basis by the Site hydrogeologist, with PPG approval. Well development procedures are presented in POP PPG 007 in **Appendix B**.

7.3 Groundwater Sampling Procedures and Equipment

To ensure that each groundwater sample collected is representative of the conditions at that location, and that the sample is neither altered nor contaminated by the sampling and handling procedures, AECOM will conduct all sampling as per the NJDEP *Field Sampling Procedure Manual* (August 2005), and applicable AECOM SOPs and POPs. All groundwater samples will be handled in a manner consistent with the sample container, preservation, and holding time requirements specific to the analysis requirements of this investigation (refer to Appendix C of the *Field Sampling Procedures Manual*, August 2005). Groundwater sampling procedures are presented in POP PPG 008 in **Appendix B**.

Field instruments that will be utilized in the groundwater remedial investigation will include water level indicators (Solinst® or equivalent), oil/water interface probes, water quality meters (Horiba U-22 or equivalent), and/or PIDs (as required). All field measurement equipment will be maintained to ensure that measurements obtained are accurate and defensible. The equipment will be issued through a formal equipment tracking system and operated by trained personnel in accordance with manufacturers' recommendations.

7.3.1 Groundwater Sampling Program

All groundwater samples will be collected in accordance with the NJDEP *Low Flow Purging and Sampling Guidance* (December 2003). Prior to initiating the groundwater sampling program, synoptic groundwater elevation measurements will be collected. A PID and/or a gas monitor (if required by the HASP) will be used to screen the well headspace immediately after the cap is removed. Then, from the survey mark at the top of the well casing, the depth to water and the total depth of the well will be measured using an appropriate water level gauging meter.

Permanent monitoring wells installed with a screened interval of 10 feet will be sampled at two locations within the well. The locations will be at five-foot intervals within the screen, in accordance with the NJDEP *Low Flow Purging and Sampling Guidance* (December 2003). Groundwater sampling logs will be completed in the field as per New Jersey Technical Requirements and will include measurements of field parameters (i.e., temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential). Groundwater quality parameters will be measured and recorded at timed intervals prior to and during purging to evaluate the stabilization of water quality parameters prior to sampling as directed in applicable guidance documents.

7.3.1.1 Low-Flow Purging and Sampling

Low-flow purging and sampling will be accomplished using a peristaltic pump (submersible or bladder pumps will be utilized for samples for VOC analysis) as described in POP PPG 008 in **Appendix B**.

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Groundwater will then be purged from the well at rates between 0.1 liters per minutes (L/min) and 0.5 L/min) through dedicated polyethylene tubing (Teflon[®] or Teflon[®]-lined tubing will be utilized for samples for VOC analysis) attached to a flow-through cell and in-line water quality meter.

Water quality indicator parameters (WQIPs) will be collected once water fills the in-line cell at a minimum of 5-minute intervals. Water quality parameters will be monitored for stabilization. Stabilization will be defined when three consecutive water quality readings are within:

Field Measurement	Stabilization Requirement
Temperature	±3%
pH	±0.1 Standard Units
Specific Conductivity	±3%
Turbidity	±1 Nephelometric Turbidity Units (NTU)*
Dissolved Oxygen (DO)	±10%
Oxidation-Reduction Potential (ORP)/Eh	±10 mV
* Turbidity readings must stabilize to ± 10% for turbidity (if greater than 1 NTU). Because metals are a primary concern at this site and metals analyses are strongly influenced by the presence of suspended solids in the sample, special attention will be paid to turbidity measurements. Typically, turbidity stabilization needs to occur first. The target value shall be < 10 NTUs. After turbidity stabilization is attained the remainder of parameters will be evaluated for stabilization. After four hours of purging, samples will be collected regardless of whether WQIPs have stabilized.	

Water levels will also be monitored during purging and the purge rate will be adjusted (where possible) to minimize drawdown (not greater than 0.3 feet). Upon stabilization of water quality parameters, the water line will be severed prior to the in-line water quality meter and samples will be collected directly from the pump/tubing. AECOM is certified (NJ Lab Certification # 12995) to collect Dissolved Oxygen, pH and temperature measurements in the field. AECOM's Lab Certification for field measurement of conductivity, turbidity and ORP is pending upon NDJEP approval of certification. Laboratory-supplied sample bottleware will be filled directly from the tube starting with VOC vials. The order of sample collection will be:

1. VOC
2. TOX
3. TOC
4. SVOC
5. EPH

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6. PCBs
7. Total Metals
8. Dissolved Metals (groundwater only)
9. Phenols
10. Cyanide
11. Chloride
12. Preserved inorganics
13. Non-preserved inorganics

Non-VOC samples may not be collected before VOC samples. When several wells will be sampled of known or suspected contamination, the least contaminated well should be sampled first, and the wells then sampled in order of increasing contaminant concentration for that parameter, as long as VOCs are collected prior to non-VOC parameters.

7.4 Hydraulic Conductivity Testing

In-situ permeability (rising and falling head or “slug”) tests will be conducted in selected wells to estimate in-situ lateral variability thereof. Permeability data will be used to estimate the average linear velocity of the groundwater, and to evaluate whether separate flow regimes may exist as a result of lithologic differences.

Time-drawdown data will be collected by instantaneously displacing a volume of water and recording the change in water level as the well recovers. Water will be displaced using a solid slug. Slug size will be selected to displace enough water to ensure a valid test. Where the static water level is found above the screened interval, a falling-head test and a rising-head test will be performed. Where the static water level is in the screen, two rising head tests will be performed, as displacement of water into the unsaturated screened zone introduces error into testing results. Water levels will be recorded automatically with pressure transducers and an electronic data logger. The time-drawdown data will be analyzed in the office utilizing the appropriate analytical method. Duplicate test results will be compared to determine the precision of the method and then, if appropriate, averaged to give a more accurate value. Field procedures for performing slug tests are presented in POP PPG 009 in **Appendix B**.

7.5 Quality Control Samples

QC samples collected during field activities will consist of trip blanks, field blanks, field duplicates, and/or MS/MSDs (described in **Section 6.2**) as appropriate to the matrix and analytical method. The procedures for collection of these samples are discussed in **Section 6.0**. Frequencies of collection for QC samples are specified in **Table 6-1**.

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8.0 Building Component Sampling

Building component sampling provides information on monitoring surficial contamination and is intended for non-volatile species. Four types of sampling methods for collecting building components are presented as follows:

1. **Chip Sampling:** Applicable for obtaining samples of porous material (e.g., concrete and brick) on flat surfaces (e.g., floors). The procedure is presented in POP PPG 010 in **Appendix B**.
2. **Wipe Sampling:** Applicable mostly for collecting samples from the surface of non-porous materials (e.g., painted walls, glass, or metal). The procedure is presented in POP PPG 011 in **Appendix B**.
3. **Concrete Core Sampling:** Applicable for collecting samples of concrete floor slabs and foundations. The procedure is presented in POP PPG 012 in **Appendix B**.
4. **Scrape/Sweep:** Applicable for collecting scrape and sweep samples from all types of surfaces. The procedure is presented in POP PPG 013 in **Appendix B**.

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9.0 Decontamination and Waste Management Procedures

All equipment, vehicles, and personal protective equipment (PPE) potentially exposed to hazardous materials will be decontaminated prior to removal from the Site.

Equipment in contact with samples will be decontaminated prior to use to ensure sample integrity. Wherever possible, pre-cleaned, disposable or dedicated equipment will be utilized. All other sampling equipment used in the field investigations will be cleaned before and after sample collection using a three-part decontamination procedure. Cleaning of equipment is performed to prevent cross-contamination between samples and to maintain a clean working environment for all personnel. Detailed decontamination procedures are presented in POP PPG 014 in **Appendix B**.

Although it is preferred that all non-aqueous field sampling equipment is either laboratory cleaned, wrapped, and dedicated, it may be necessary to decontaminate in the field using more than one method. Decontamination of equipment in the field that is not dedicated or disposable will be conducted in general accordance with POP PPG 014 found in **Appendix B** of this FSP/QAPP. The following modifications to the decontamination POP PPG 014 in **Appendix B** will be made:

Eight-Step Decontamination Process:

A solvent rinse and acid rinse steps of the full 8-step decontamination process will not be performed during field decontamination. Under typical field conditions, the 3-step decontamination process consisting of a laboratory grade glassware detergent (i.e., Alconox®) and tap water scrub to remove visible contamination followed by a generous tap water rinse and a final rinse using distilled and deionized (ASTM Type II) water. If visual contamination persists, or gross contamination is suspected, additional decontamination procedures will be required (steps 4 through 8 below dependent upon the analysis required).

The field sampling equipment cleaning and decontamination procedures are as follows:

1. Laboratory grade glassware detergent plus tap water wash to remove all visible particulate matter and residual oils and grease;
2. Generous tap water rinse;
3. Distilled and deionized (ASTM Type II) water rinse;
4. 10% nitric acid rinse (trace metal or higher grade HNO₃ diluted with distilled and deionized (ASTM Type II) H₂O)*
5. Distilled and deionized (ASTM Type II) water rinse*
6. Acetone (pesticide grade) rinse**
7. Total air dry or pure nitrogen blow out**

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8. Distilled and deionized (ASTM Type II) water rinse**

*Only if sample is to be analyzed for metals.

**Only if sample is to be analyzed for organics.

All sampling equipment decontaminated via this procedure must be wrapped and/or sealed during storage and prior to use. If visual contamination persists, or gross contamination is suspected, additional decontamination procedures will be required.

In the field, decontamination should be carried out over a container and the residual liquid material must be properly disposed. Decontamination wastes must be disposed in accordance with current NJDEP policy (see Chapter 2 of the *Field Sampling Procedure Manual* (August 2005), Section 2.4.5.7, *Disposal of Development, Purge, Pump Test and Decontamination Water*). Where possible, only dedicated and disposable materials will be used for sample collection to minimize the need for on-site full decontamination.

Decontamination of drilling equipment will be performed by the drilling subcontractor. AECOM will provide the drilling subcontractors with a copy of all the applicable POP(s). Subcontractors will be overseen to ensure that decontamination is completed in accordance with POP PPG 014 and NJDEP *Field Sampling Procedures Manual* (August 2005).

9.1 Management of Waste Liquids

Waste liquids are managed directly by PPG in accordance with the Resource Conservation and Recovery Act (RCRA), Department of Transportation (DOT) requirements, NJDEP requirements for the disposal of installation, development, purge, pumping test and decontamination waters (Section 2.4.5.7 of the *Field Sampling Procedures Manual* (August 2005)) and all applicable laws and regulations. All purge water and waste decontamination fluids will be containerized. Waste liquids are periodically (less than 90 days after generation) transported off-site for proper management as a hazardous waste.

Waste liquids generated at off-site parcels will be placed in 55-gallon drums. The 55-gallon drums will either be transported to the Site 114 Drum Storage Area by the drilling contractor utilizing a rack truck, or will be secured at the off-site parcel for subsequent disposal.

9.2 Management of Drill Cuttings

Drill cuttings and other hazardous solids are managed directly by PPG in accordance with RCRA and DOT requirements, NJDEP requirements for the disposal of drill cuttings (Section 2.4.5.6 of the *Field Sampling Procedures Manual* (August 2005)) and all applicable laws and regulations. All drill cuttings will be containerized in DOT-approved 55-gallon drums and transported on a daily basis (minimum) to the on-site drum storage area. Drummed waste is periodically (less than 90 days after generation) transported off-site for proper management as a hazardous waste. Drill cuttings generated at off-site parcels will be placed in 55-gallon drums. The 55-gallon drums will either be transported to the Site 114 Drum Storage Area by the drilling contractor utilizing a rack truck, or will be secured at the off-site parcel for subsequent disposal.

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10.0 Documentation and Chain-of-Custody

Documentation of custody is one of several factors that are necessary to document the proper handling of samples. A sample is considered to be in a person's custody if:

- It is in the actual possession of an authorized person;
- It is in the view of an authorized person, after being in his/her actual possession;
- It was in the actual physical possession of an authorized person and then was locked up to prevent tampering; or
- It is in a designated and identified secure area.

10.1 Field Custody Procedures

10.1.1 Field Procedures

The field sampling personnel along with the Task Leader will be personally responsible for the care and custody of the samples until they are transferred or dispatched properly.

All sample containers will be labeled with a unique sample identifier that will consist of an alphanumeric sequence. Any other pertinent information regarding sample identification will be recorded in the field logbooks and/or on sample log sheets. Soil samples will be identified by the boring number followed by the depth of the sample below ground surface. Groundwater samples will be identified by the well number.

Labels will be completed prior to or during the sampling event for each sample. Labels will be completed with the site name, sample ID, sample collection date and time, analysis requested, and preservative (if any) and will be initialed by the sample collector. Labels will be water resistant, and will be completed using waterproof ink.

All relevant information will be transferred to a laboratory-supplied chain of custody (COC) form and signed by the individual responsible for the sampling.

Copies of the COC and field documentation will be supplied to the FOL or his/her designee on the same day as the sampling event. The FOL will review field activities to determine whether proper custody procedures were followed during the fieldwork and will decide if additional samples are required. The FOL will notify the project QAO of any deficiencies encountered during the review of documentation and will provide a copy of the reviewed/corrected COC to the Database Manager.

10.1.2 Field Notebook/Documentation

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

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Field notebooks will be bound, numbered, field survey books or notebooks. Field notebooks will be maintained by the Task Manager until they are archived. Each notebook will contain the notebook number, project identification, "return to" information, and project start and end dates. Entries into the notebook will include the Project name and number, date, start-time, weather, summary and purpose of planned field activities, and the names of all sampling team members present. The names of visitors to the Site (including subcontractors), the times and dates of their arrival and departure, and the purpose of their visit will also be recorded in the field notebook.

Content of the field notebook will include, but not be limited to, measurements made and samples collected, descriptions of sampling locations, sample collection times and depths, calibration information for field equipment, etc. Information recorded in the field notebook may be transferred to AECOM standard logs used to record and present field data. These logs may include:

- Geologic/Soil boring logs;
- Well construction logs;
- Well development logs;
- Groundwater purge and sample logs;
- Water level and product thickness records;
- COC forms; and
- Environmental sample logs.

Logs will include entries in every blank, with appropriate use of the abbreviations NA (not applicable) and NR (not recorded). All "NR" entries should be accompanied by an explanation. All entries will be recorded in waterproof ink or marker, and signed and dated by the person making the entry. No erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, the correct entry recorded, and the change initialed and dated by the person making the correction.

Special visual observations and detection of odors shall be indicated in the field book. However, careful attention shall be given when attributing the source or substance of the observations.

A photographic log will also be maintained (when applicable) by AECOM field personnel. Field documentation of each photograph will be recorded in the field notebook and will contain a description of the object and field of view being photographed, type and lens size (if applicable) of camera, direction faced, frame number, time and date the photograph was taken, identity of photographer, and indication of scale or scale reference. The reference number assigned to the photograph and described in the log will be written on the back of the photograph and/or the file name of the electronic version will be saved with the reference number. Copies of the photographic logs will be filed in a central location in the AECOM Piscataway, New Jersey office. Detailed field documentation procedures for the Recording of Field Data are presented in POP PPG 001 in **Appendix B**.

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10.1.3 Transfer of Custody and Shipment Procedures

Samples will be packaged and shipped according to POPs PPG 002 and PPG 003 in Appendix B. Samples will be accompanied by a properly completed COC form. At the time the sample possession is transferred, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler, to another person, to a mobile laboratory, to the permanent laboratory, or to/from secure storage locations.

Minimum information recorded on the COC record in addition to the signatures and dates of all custodians will include the following information in the appropriate spaces on the COCs:

Name (for Reporting):	Designated AECOM Project Manager
Company:	AECOM
Address:	(INSERT Task Manager address)
City, State, Zip Code:	(INSERT Task Manager address)
Phone:	(INSERT Task Manager phone)
Fax:	(INSERT Task Manager fax)
Email:	njlabdata@aecom.com
Name (for Invoicing):	Erin Farrell
Company:	AECOM
Address:	30 Knightsbridge Road, Suite 520
City, State, Zip Code:	Piscataway, NJ 08854
Phone:	(732) 564-3609
Fax:	(732) 369-0122
Email:	Erin.Farrell@aecom.com
Samplers Name:	This person must be the same person that relinquishes initial custody.
Sample Delivery Group (SDG) No.	The SDG Number will be recorded when assigned by the laboratory. The PPG Site Number will be included in the Sample ID.
Purchase Order (PO) Number:	AECOM's PO number (provided to the sampler by the Task Manager)
AECOM Project Number	INSERT Task Specific Project Number (Mandatory Information to be Required on all COCs)
Site/Project Identification:	PPG Site Number
Case Type:	NJ –Administrative Consent Order

Any special instructions are to be filled in on every page of the COCs and page numbers must be written at the top right corner of the COC.

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Aqueous and non-aqueous (soil, chip, wipe, sweep, waste, core) samples will be packed in coolers and transported, as needed, from the field to the laboratory by courier, laboratory representative, or AECOM personnel. For air samples, sample cassette /plastic mailer assemblies should be placed in a clean Ziploc[®] bag and the bag should be packed with small bubble wrap snugly in a clean shipping container or cooler to prevent movement of the samples during shipment. To preserve the samples during transit, blue ice packs will be placed inside the shipping cooler as standard practice. Refer to POP PPG 019. Samples are generally shipped daily to arrive at the laboratory within 24 hours of collection. Sample containers will be placed in a cooler packed with an absorbent material such as vermiculite and packed with ice to maintain a temperature of 4°C.

All sample containers will be labeled as described above. All sample documentation will then be affixed to the underside of each transport container lid. If samples are shipped to the laboratory via overnight air transportation (e.g., Federal Express) or by commercial courier, the COC record identifying the contents will be enclosed in each sample cooler and the cooler will be taped closed with fiberglass tape covering the custody seals. If a laboratory courier is used, the courier will sign the COC before departing the site. The transport container lid will then be closed and affixed with a custody seal. The coolers will be locked or secured with strapping or packing tape and sealed with custody seals. The preferred procedure is to attach a custody seal to the front right and back left of the cooler. The back copy of the COC will be detached and kept as part of the field records. The original record and remaining copies will accompany the coolers.

Regulations for packaging, marking/labeling, and shipping hazardous materials and wastes are issued by the USDOT. Air carriers which transport hazardous materials, such as Federal Express, may also require compliance with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations. The IATA protocol details the procedures for the shipment and transportation of hazardous materials by a common air carrier. It is important to note that following all current IATA regulations will ensure compliance with USDOT protocol.

10.2 Laboratory Custody Procedures

The laboratory will be responsible for receiving the samples and logging them in. On arrival at the laboratory, all samples will be inspected thoroughly to confirm that the integrity of the samples and containers has not been compromised. The cooler custody seals will be inspected to verify that they are still intact and were properly signed and dated by the field sampling team. The individual sample containers will be inspected to verify that each has a sample label. The condition of the samples may be noted on the COC form under "Remarks".

The sample containers will be checked against the accompanying chain-of-custody to verify that the cooler contents are identical to the samples described on the COC documents. If discrepancies exist, they will be reported to the designated Project Manager by the Laboratory's Project Manager. The problem will be resolved, in writing (e.g., email, fax, memo, etc.), before the samples are logged in.

After it has been determined that the samples are in satisfactory condition and the documents are in order, each sample will be assigned a unique laboratory identification number. A sample log-in sheet will be initiated and will serve as documentation as to the condition of the samples upon receipt and cross-referenced between field identification numbers and assigned laboratory numbers.

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After the samples have been entered into the laboratory tracking system, copies of the log-in forms and chain-of-custody records will be sent to the Project Manager, who will verify that the specified samples and parameters correspond to the samples and parameters identified in the FSP/QAPP. The samples will be placed in a secured storage area, under the conditions called for by the analytical method, until taken for analysis. Samples removed from the secure area for preparation or analysis will be tracked using internal custody forms.

Typically, samples will not be delivered on Saturday or Sunday. If Saturday delivery is required, the laboratory will be notified in advance.

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11.0 Calibration Procedures

This section describes procedures for maintaining the accuracy of all the instruments that are used for conducting field tests and laboratory analyses. These instruments will be calibrated at the frequencies recommended by the manufacturer and the information will be recorded in the appropriate field book.

11.1 Field Instrument Calibration

Instruments used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Field instruments will be issued through a formal tracking system and operated by trained personnel, in accordance with the appropriate POPs or manufacturer's specifications. Each instrument used in the field will be examined daily by the AECOM FOL or his designee to verify that it is operating properly.

Field instruments will include a PID; hydrogen sulfide portable, hand-held monitor; air monitoring units containing continuous gas chromatographs (GC) fitted with a PID; the MiniVol™ portable (tactical) air sampler; water level meter; multi-parameter water quality meter; turbidity meter; and an aerosol/dust monitor. Calibration procedures will be performed according to the applicable SOP(s) and/or POP(s) in **Appendix B** work plans, and/or applicable manufacturer's instructions. In general, each instrument will be calibrated daily before its initial use. The calibration will be checked periodically according to the manufacturer's recommendations and/or the requirements in the applicable SOP(s), POP(s) and work plans. Calibration and calibration check results will be recorded in calibration log forms or in the field logbook. Preventative maintenance will be performed by the equipment rental agency supplying the instruments.

Calibration procedures will be documented in the field records. Documentation will include the date and time of calibration, the identity of the person performing the calibration, the reference standard used, the readings taken, and any corrective action. This information will be incorporated into the appropriate reports to be submitted to NJDEP for review. In addition to the manufacturer's recommended calibration procedures and frequencies, the contractor's preventive maintenance and internal calibration schedule will be provided and kept at the site for review by the NJDEP auditor. Field instruments will be calibration checked at a minimum of twice daily, before and after use. A calibration curve will be run every six (6) to eight (8) weeks. Documentation will also include the calibration curve, as well as a log of field calibration dates and standards.

11.1.1 Laboratory Instrument Calibration

Calibration is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet the detection limits established for the method (refer to the applicable SOPs in **Appendix D**). These methodologies include specific instrument calibration procedures and frequencies that will be followed by the laboratory. If an instrument has not been properly calibrated and the quality of the data has been adversely affected, the corrective actions outlined in the methodologies will be implemented.

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The laboratory maintains documentation for each instrument which includes the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions, and the samples associated with these calibrations.

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12.0 Laboratory Operations

12.1 Analytical Procedures

The analytical methods shown in **Appendix D, Laboratory SOP Lists**, will be used for all site specific analyses, such as, hexavalent chromium and total chromium. Additional analyses may be required including those for volatile and semi-volatile organics, PCBs, and additional metals. The site-specific work plans for each site will provide a specific list of analytes. SW-846 Methods are used for determination of volatile and semivolatile organics, metals, and hexavalent chromium; these methods are consistent with the regulatory requirements of this program but permit flexibility to maximize data usability with regard to sample preparation and clean up, and analytical sensitivity. Contract Laboratory Program (CLP)-type quality control requirements will, however, be implemented for all analyses as noted in **Section 12.3** of this document.

The laboratories identified in **Section 2.2** will be responsible for conducting all chemical analyses specified in **Appendix D**. Sample handling protocols, analytical procedures, and reporting procedures employed by the laboratories are described in the laboratory SOPs (**Appendix D**) and in the Quality Assurance Plan for each laboratory (which can be provided upon request).

12.2 Bottle Preparation

The laboratories will provide properly prepared containers for sampling in a convenient insulated shipping container/cooler. COC seals and forms are provided to ensure complete documentation during sample transport, sampling and analysis. The laboratories provide both chemical preservatives and ice packs in the coolers to ensure that proper preservation techniques are performed and preservation requirements are met. The laboratories provide new, properly cleaned sample containers in the cooler for sample collection. The laboratories do not prepare solvent rinsed sample containers. Solvent rinsed bottles are purchased as projects necessitate. The vendor-prepared bottles are prepared by USEPA protocol. The bottle and preservation requirements for the non-residential sites are summarized in **Appendix C**.

Bottle preparation procedures are described in Specifications and Guidance for Contaminant-Free Sample Containers, EPA-540/R-93/051. The selected laboratories provide containers from suppliers who meet or exceed the requirements outlined in this document; each lot of bottles is delivered with documentation certifying that the containers meet USEPA specifications. The laboratory sample management staff documents the receipt of each bottle shipment upon delivery. The bottle size, vendor lot number, date received, date submitted for quality control checking and date approved for use are recorded in a Bottle Receipt Logbook. The lot certificate of analysis supplied by the bottle manufacturer is archived by the laboratory Quality Assurance Manager; this information is available on request.

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12.3 Quality Control

Each laboratory has a QC program in place to ensure the reliability and validity of the analysis performed at the laboratories. All analytical procedures are documented in writing as SOPs and each SOP includes a QC section which addresses the minimum QC requirements for the procedure to meet CLP requirements. The internal QC checks differ slightly for each individual procedure but the following general QC requirements are incorporated as appropriate to the analytical procedure:

- Method blanks;
- Reagent/preparation blanks (inorganic parameters);
- Instrument blanks;
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates
- Laboratory control sample (LCS);
- Post-digestion spike
- Internal standard areas;
- Mass tuning;
- Inductively Coupled Plasma (ICP) serial dilutions; and
- ICP interference check samples.

12.4 Data Reduction and Reporting

Data reduction, QC review, and reporting will be the responsibility of the analytical laboratory and is discussed in this section. Data assessment, including a formal data validation procedure, will be conducted by AECOM. AECOM will also conduct data reduction to facilitate the use of raw data in site evaluations. This process is discussed in the next section.

12.4.1 Data Reduction

Data reduction includes all automated and manual processes for reducing or organizing raw data generated by the laboratory. For all published and referenced methods, the laboratories adhere strictly to the requirements of the method for calculation of results. Further details are supplied in the laboratories' Standard Operating Procedures.

12.4.2 Data QC Review

Prior to being released as final, laboratory data will proceed through a tiered review process. Data verification starts with the analyst who performs a review of the data to ensure the work was done correctly the first time. Following the completion of the initial verification by the analyst performing the data reduction, a systematic check of the data will be performed by an experienced peer or supervisor. This check will be performed to ensure that initial review has been completed correctly and thoroughly. A third-level review will be performed by the Laboratory Project Manager before

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results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed.

12.4.3 Data Reporting

The full analytical, quality control, and deliverables requirements (3 electronic copies, and one paper copy for chromium results; full data packages for all analytes) will be provided with the final Remedial Investigation Report, including New Jersey Electronic Data Deliverable (EDD), to be submitted to NJDEP. At a minimum, the data included in the laboratory report will meet the requirements of the Reduced Laboratory Data Deliverables for non-USEPA CLP Methods. A fully validatable CLP-type data package containing all raw data will be requested for those data sets being subjected to full data validation.

Full laboratory data deliverables, as detailed in Appendix A of the NJDEP *Technical Requirements for Site Remediation* (November 2009) will be submitted for all hexavalent chromium and hexavalent chromium associated (pH, Eh, sulfides, etc.) analyses. The full laboratory data deliverables will consist of the following:

- three electronic copies of the laboratory data package on CD in Adobe portable document format (pdf),
- one paper copy of the laboratory data package,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*,
- and one electronic copy of the analytical data in the EQuIS four-file format, as modified by AECOM.

Reduced laboratory data deliverables, as detailed in Appendix A of the NJDEP *Technical Requirements for Site Remediation* (November 2009), will be submitted for all other analytical data (ex, metals, VOCs, etc.). The reduced laboratory data deliverables will consist of the following:

- one electronic copy of the laboratory data package on CD in Adobe pdf will be submitted,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*,
- and one electronic copy of the analytical data in the EQuIS four-file format, as modified by AECOM.

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13.0 Data Validation

Each data package will undergo a formal review procedure. The validation will be performed by the AECOM data validation staff under direction of the AECOM Data Validation Manager.

13.1 Data Validation

Validation of the laboratory deliverables will be performed by AECOM. One hundred percent of the analytical data will be reviewed, either as full or limited validation or for completeness. The percentage of the data for each level of validation will be identified in the site-specific work plan for each program.

For full validation, the data will be reviewed for the following, where applicable to the method:

- Completeness of deliverable;
- Technical holding times and sample preservation;
- Laboratory and field blank contamination;
- Surrogate spike recoveries,
- Field and laboratory duplicates;
- MS/MSD recoveries and RPDs;
- Post-digestion spike recoveries;
- LCS recoveries;
- Initial and continuing calibrations;
- Instrument tuning,
- Internal standard performance,
- ICP serial dilution results;
- ICP interference check sample results; and
- Calculation and transcription verifications (i.e., verifying summary data against raw data).

Limited validation will be based on information presented on summary forms and will include the following:

- Completeness of deliverable;
- Technical holding times and sample preservation;
- Laboratory and field blank contamination;
- Surrogate spike recoveries,

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- Field and laboratory duplicates;
- MS/MSD recoveries and RPDs; and
- LCS recoveries.

The discovery of significant anomalies or discrepancies during validation using the summary forms may result in an in-depth review of the raw data and the incorporation of additional review elements into the validation of all data.

AECOM will perform validation of soil and aqueous samples according to the following validation protocols:

- Target Compound List (TCL) Organics, USEPA Region 2 Data Validation Guidance, which will be modified as required to reflect the actual laboratory SOPs used for this program.):
 - *Validating Volatile Organic Compounds by SW-846 Method 8260B, SOP-HW-24, Rev.2, October 2006;*
 - *Validating Semivolatile Organic Compounds by SW-846, Method 8270; SOP HW-22, Rev 3, October 2006*
- Target Analyte List (TAL) Inorganics, NJDEP Office of Data Quality Data Validation (DV) SOP:
 - SOP 5.A.16 , Rev. 1, *Quality Assurance Data Validation of Analytical Deliverables for Inorganics (based on USEPA SW-846 methods); May 2002.*
- Hexavalent Chromium, NJDEP Office of Data Quality DV SOPs:
 - SOP 5.A.9, Rev.1, *Standard Operating Procedure for the Completion of the Hexavalent Chromium Data Validation Report Forms and the Preparation of the Final Data Validation, October 2001.*
 - SOP 5.A.10, Rev.3, *Standard Operating Procedure for Analytical Data Validation of Hexavalent Chromium, September 2009.*

Data for PM₁₀ and hexavalent chromium in air will be reviewed for adherence to the respective SOP, and the laboratory precision and accuracy control limits contained in the method.

Once the validation for a data package is completed, a validation report will be prepared. This report will summarize the samples reviewed, elements reviewed, any nonconformances with the established criteria, and validation actions (including application of data qualifiers). Data qualifiers will be consistent with the NJDEP SOPs. Data validation results will be presented in accordance with the NJDEP "hit list" format using the template provided in **Appendix E**. A copy of each validation report as well as the analytical data package will be forwarded to the NJDEP for review with each report submittal.

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13.2 Data Assessment

Following data validation, the AECOM project technical staff will assess the data for usability. Data assessment activities will examine site-specific factors which interfere with chemical analyses or utility of the results. Some of the factors which will be assessed include:

- Adverse matrix effects on the analytical recoveries.
- Nature and cause of extraneous contamination not attributable to laboratory contamination.
- Reproducibility of results for site-specific media in relation to stated precision goals.
- Adequacy of the data base in terms of numbers of samples, critical data points, and representativeness for meeting stated objectives.

Validated data and related assessments will be reported in appropriate charts and tables in the RI report.

13.3 Data Reliability

The overall reliability of the data will be assessed primarily using the results of the data validation process and will include a discussion of the effect of any nonconformances with regard to holding times, sample preservation, blank contamination, instrument calibration, and QC analyses. The usability of hexavalent chromium data will be evaluated based on the pre-digestion and post-digestion spike recoveries and the parameters indicative of oxidizing/reducing conditions.

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14.0 Performance and System Audits

A system audit is defined as a qualitative evaluation of the components of a measurement system to determine their proper selection and use. A performance audit is a quantitative evaluation of the measurement system that requires testing of the system with samples of known composition or behavior to evaluate precision and accuracy.

14.1 Field Procedures

14.1.1 Field Performance Audits

It will be the responsibility of the AECOM FOL to continually monitor the performance of the field team, including subcontractors, for conformance to the site-specific work plan(s) and the FSP/QAPP. Any problems or deficiencies will be communicated to the Project Manager and project QAO. A record of any problems encountered, and their resolution, will be maintained in the field notebook.

Field performance will also be evaluated based on the analytical results of the field blanks and field duplicates. Field blanks assess the effectiveness of measures taken in the field to minimize cross contamination. The results of field duplicates reflect the ability of the field team to collect representative sample portions of each matrix type.

14.1.2 Field System Audits

Internal audits of field activities will be conducted periodically by the project QAO (or designate) during the field sampling program. Follow-up audits will be conducted if significant problems are encountered.

The audits will cover the execution of sample identification, sample control, COC procedures, field sampling and documentation, agreement with QA/QC objectives, FSP/QAPP and site-specific work plan(s). The audits will involve a review of field logbooks and standard forms, COC records, and instrument calibration records. The project QAO will review field performance with the FOL.

During the field performance audit, the auditor will maintain a record of the audit with written field notes. Preliminary results of the audit will be reviewed with the FOL. Corrective action for deficiencies that adversely affect the quality of the data will be implemented immediately.

Upon completion of the audit, the project QAO will develop an audit report in the form of a memorandum that summarizes the audit findings and identifies those areas still requiring corrective measures. This report will be submitted in memorandum form to the AECOM Project Manager, Task Manager, FOL, to NJDEP as well as to the project file. The resolution of final action as described in **Section 17.0** of the FSP/QAPP will be subsequently implemented.

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14.2 Laboratory Audits

AECOM has contracted NJDEP-certified laboratories to perform all laboratory analysis of soil and groundwater sampling performed by AECOM.

14.2.1 Laboratory Performance Audits

Continuous performance auditing is accomplished through the regular use of LCS, matrix spike samples, duplicate samples, QC samples, proficiency testing, and through continuing calibration verification samples. Federal and State agencies may administer the proficiency testing.

14.2.2 Laboratory System Audits

The laboratory will conduct regular audits of facilities, processes, and procedures according to written protocols established by the laboratory QA Program. These audits will be conducted by the laboratory's QA Officer and the results documented in the laboratory analytical reports.

Laboratory audits are conducted periodically by AECOM or another qualified party as part of their analytical subcontractor monitoring program. The laboratory audit includes a review of the following areas:

- QA organization and procedures;
- Personnel training and qualifications;
- Sample log-in procedures;
- Sample storage facilities;
- Analyst technique;
- Adherence to laboratory SOPs;
- Compliance with QA/QC objectives;
- Instrument calibration and maintenance;
- Facility security;
- Bottleware preparation;
- Waste management;
- Data archival;
- Data recording, reduction, review, and reporting; and
- Cleanliness and housekeeping.

Preliminary results of the systems audit are discussed with laboratory personnel in an on-site debriefing. A written report that summarizes audit findings and recommends corrective actions is prepared and submitted to the laboratory for response, to the AECOM Project Manager and will be submitted to NJDEP as well. The results of the audit, including resolution of any deficiencies, are included in the QA reports to management as described in **Section 17**.

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15.0 Preventative Maintenance

15.1 Field Instruments

Field instruments will be rented through an equipment rental company. Preventive maintenance for all field instruments is conducted according to applicable manufacturer's instructions by the rental company. A representative log for maintenance or calibration of field instruments is included with the rental unit. Instrument instruction manuals will be maintained with the rental unit.

AECOM field personnel will be responsible for ensuring that the instruments are properly functioning. At a minimum, this will entail checking the instrument prior to shipment to the field and performing daily operational checks and calibration as described in **Section 11**. Routine maintenance and trouble-shooting procedures will be performed as described in the manufacturer's instructions. All calibration and maintenance procedures will be documented in field records. Spare parts will be readily available on site or from the vendor. Preventive maintenance for all field instruments will be conducted according to applicable manufacturer's instructions, NJDEP guidance, and rental company SOPs.

Instrument instruction manuals will be available on site. Critical spare parts such as lamps, probes, and battery chargers will be kept on site to minimize downtime.

15.2 Laboratory Instruments

The laboratories will conduct preventative maintenance routinely on each analytical instrument and analytical instruments will be maintained and serviced in accordance with the manufacturer's specifications, laboratory SOPs, and analytical methods.

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16.0 Corrective Action

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-limit QC performance that can affect data quality. Corrective action can occur during data compilation, data import, data validation, and data assessment. Any nonconformance with the established QC procedures in the FSP/QAPP will be identified and corrected in accordance with the FSP/QAPP. Corrective actions proposed and implemented in response to potential data quality issues will be documented in the QA sections of project deliverables. The following procedures should be followed when problems are identified and corrective actions are taken:

The person who identifies the problem is responsible for notifying the AECOM Project Manager, relevant Task Manager, and project QAO.

- Corrective action should only be implemented after approval by the AECOM Project Manager, or his designee (generally the FOL).
- If immediate corrective action is required, approvals may be secured by telephone from the AECOM Project Manager.
- All corrective actions should be documented in writing.

Corrective actions are defined as those measures taken to rectify a laboratory or field measurement system that exceeds its control limits. These actions may be initiated by any person performing work in support of investigation or remediation activity. The need for corrective action may be identified by system or performance audits or by standard QC checks. The essential steps in the corrective action process are:

- Identifying and defining the problem;
- Assigning responsibility for investigating the problem;
- Investigating and determining the cause of the problem;
- Determining a corrective action to eliminate the problem;
- Assigning and accepting responsibility for implementing the corrective action;
- Implementing the corrective action and evaluating its effectiveness; and
- Verifying that the corrective action has eliminated the problem.

16.1 Sample Collection/Field Measurements

Corrective action in the field can be needed when:

- The sample network is changed (i.e., more or fewer samples, sampling locations other than those specified in the site-specific work plan(s) and/or FSP/QAPP, etc.);

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- Sampling procedures and/or field analytical procedures require modification because of unexpected conditions; or
- The integrity of field measurements or samples is in question.

The field team members will be responsible for identifying any suspected technical or QA deficiencies and reporting them to the AECOM FOL. The AECOM FOL will be responsible for assessing the suspected deficiency, for determining the impact on the quality of the data (in consultation with the project QAO, Task Manager, and Project Manager), developing the appropriate corrective action, and ensuring it is implemented. If the corrective action augments the original scope of the sampling plan (i.e., increases the numbers or types of samples/analyses) and uses existing and approved procedures in this FSP/QAPP, approval by the AECOM FOL and AECOM Project Manager will be sufficient. If the corrective action results in a reduced scope of the work, significant alterations in sample location, major modifications to analytical methods, or causes the project data quality objectives not to be achieved, it will be necessary for all levels of project management to concur with the proposed action.

If problems with field measurements occur, corrective action may include:

- Repeating the measurement to check the error;
- Checking for all proper adjustments for ambient conditions such as temperature;
- Checking the batteries;
- Recalibrating equipment;
- Checking the calibration;
- Replacing the instrument or piece of equipment; or
- Stopping work.

If, during his/her review of sampling operations, the AECOM FOL determines that the integrity or quality of the sample(s) has been adversely affected, the following corrective measures may be implemented:

- Reviewing sampling and/or COC procedures and modifying as necessary;
- Replacing or repairing sampling equipment;
- Collecting replacement sample(s); or
- Stopping work.

Deficiencies may also be noted during internal field audits. The project QAO will identify the deficiencies and recommend the appropriate corrective action to the AECOM Project Manager. Upon approval by the AECOM Project Manager, the AECOM FOL, Task Manager, and field team members will be responsible for implementing the corrective action. If the use of unapproved methods, or the improper use of approved methods, is adversely affecting the data, corrective action may be implemented immediately.

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Corrective actions will be documented in the field records. Documentation will include:

- A description of the circumstance that initiated the corrective action;
- The action taken in response;
- The final resolution; and
- Any necessary approvals.

Corrective action resulting from internal field audits will be documented in the QA reports to management per **Section 17**. No staff member will initiate corrective action without prior communication of findings through the proper channels.

16.2 Laboratory Analyses

Laboratory personnel will be alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- Blanks contain target analytes above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the QA department during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received.

Corrective action procedures may be handled at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors, check the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. Corrective action will be in accordance with method protocol (when applicable). If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor, manager and/or QA department for further investigation. If the nonconformance causes the project objectives not be achieved, the AECOM Project QAO will be notified, who in turn will communicate the issue to the AECOM Project Manager and Task Manager.

Corrective actions will be performed prior to the release of data from the laboratory. The corrective action will be documented in both the laboratory's corrective action files, and in the narrative data report generated by the laboratory.

16.3 Data Validation/Data Assessment

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include re-sampling by the field team or re-injection and reanalysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team, whether the data to be collected are necessary to meet the required QA objectives, and physical limitations on the ability to recollect or reanalyze the sample.

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The need for corrective action may be identified by the data validator or by a member of the project team assessing the data. The person responsible for identifying the corrective action situation will notify the AECOM Project Manager, who will be responsible for approving implementation of the corrective action. All corrective actions of this type will be documented by the project QAO in the QA reports (**Section 17**).

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17.0 Quality Assurance Reports

As part of the requirements of each member of the project team, notification will be submitted to the project QAO to ensure that any problems identified during the sampling and analysis programs are investigated and the proper corrective measures taken in response. The FOL and Task Managers will assist the project QAO in preparing the QA reports. These reports will be prepared on an as-needed basis and will include:

- Summary of the status of field activities, including compiled field data sets and the results of field audits;
- Periodic assessment of measurement data accuracy, precision, and completeness;
- Data validation results;
- Summary of the status of laboratory activities, including timely submittal of analytical results, and compilation of QC data; and
- Any other QA issues relevant to the project, including corrective action situations, resolutions of previously stated problems, summaries of training programs, results of any performance evaluation audits, and any minor changes to this FSP/QAPP.

These QA reports will be prepared in writing by the project QAO who will provide compilation report(s), as necessary to the AECOM Principal-in-Charge, Project Manager, and to NJDEP. If serious QA deficiencies are noted, supplemental reports may be submitted.

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18.0 References

New Jersey Administrative Code (N.J.A.C.), 2007. Title 7.

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NJDEP, July, 1994. Alternative Ground Water Sampling Techniques Guide.

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NJDEP, June 1997. Guidance for the Submission and Use of Data In GIS Compatible Formats Pursuant to "Technical Requirements for Site Remediation," last revised January 30, 2009.

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NJDEP, May 2002. SOP 5.A.16 Rev. 1, Quality Assurance Data Validation of Analytical Deliverables for Inorganics (based on USEPA SW-846 methods).

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USEPA Region II, October 2006; *Validating Semivolatile Organic Compounds by SW-846, Method 8270*; SOP HW-22, Rev 3.

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Tables

TABLE 5-1 ANALYTES, ANALYTICAL METHODS, NJDEP SITE REMEDIATION STANDARDS, NJDEP PRACTICAL QUANTITATION LIMITS, AND LABORATORY REPORTING LIMITS FOR SOIL/SOLID SAMPLES

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
TAL Metals									
Aluminum	SW846 6010B	SW846 6010B	7429-90-5	3,900	78,000	NA	20	20	10
Antimony	SW846 6010B	SW846 6010B	7440-36-0	4	31	450	6	2	0.5
Arsenic	SW846 6020	SW846 6010B	7440-38-2	19 ⁹	19*	19*	1	0.04	0.25
Barium	SW846 6010B	SW846 6010B	7440-39-3	1,300	16,000	59,000	20	20	10
Beryllium	SW846 6010B	SW846 6010B	7440-41-7	0.5	16	140	0.5	0.2	0.1
Cadmium	SW846 6010B	SW846 6010B	7440-43-9	1	78	78	0.5	0.5	0.25
Calcium	SW846 6010B	SW846 6010B	8047-59-4	NA	NA	NA	NA	500	250
Chromium - Hexavalent	SW846 3060A/7196A	SW846 7196A	18540-29-9	See note ¹⁷	120	20	2	2	2
Chromium (total)	SW846 6020	SW846 6010B	16065-83-1	See note ¹⁷	120,000	NA	2	1	0.5
Cobalt	SW846 6010B	SW846 6010B	7440-48-4	59	1,600	590	5	5	2.5
Copper	SW846 6010B	SW846 6010B	7440-50-8	7,300	3,100	45,000	3	3	1.25
Iron	SW846 6010B	SW846 6010B	8053-60-9	NA	NA	NA	NA	10	7.5
Lead	SW846 6020	SW846 6010B	7439-92-1	59	400	800	1	0.10	0.25
Magnesium	SW846 6010B	SW846 6010B	7439-95-4	NA	NA	NA	NA	500	250
Manganese	SW846 6010B	SW846 6010B	7439-96-5	42	11,000	5,900	2	2	0.75
Mercury	SW846 7471A	SW846 7471A	7439-97-6	0.1 ¹⁰	23	65	0.1	0.03	0.033
Nickel	SW846 6010B	SW846 6010B	7440-02-0	31	1,600	23,000	4	4	2
Potassium	SW846 6010B	SW846 6010B	7440-09-7	NA	NA	NA	NA	1000	250
Selenium	SW846 6010B	SW846 6010B	7782-49-2	7	390	5,700	4	2	0.5
Silver	SW846 6010B	SW846 6010B	7440-22-4	1 ¹⁰	390	5,700	1	0.5	0.5
Sodium	SW846 6010B	SW846 6010B	7646-69-7	NA	NA	NA	NA	1000	250
Thallium	SW846 6010B	SW846 6010B	7440-28-0	3 ¹⁰	5	79	3	1	0.5
Vanadium	SW846 6010B	SW846 6010B	7440-62-2	NA	NA	NA	NA	5	2.5
Zinc	SW846 6010B	SW846 6010B	7440-66-6	600	23,000	110,000	6	2	1.5

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
TCL VOC									
1,1,1-Trichloroethane	SW846 8260B	SW846 8260B	71-55-6	0.2	290	4,200	0.005	0.005	0.001
1,1,2,2-Tetrachloroethane	SW846 8260B	SW846 8260B	79-34-5	0.005 ¹⁰	1	3	0.005	0.005	0.001
1,1,2-trichloro-1,2,2-trifluoroethane	SW846 8260B	SW846 8260B	76-13-1	NA	NA	NA	NA	0.005	0.001
1,1,2-Trichloroethane	SW846 8260B	SW846 8260B	79-00-5	0.01	2	6	0.005	0.005	0.001
1,1-Dichloroethane	SW846 8260B	SW846 8260B	75-34-3	0.2	8	24	0.005	0.005	0.001
1,1-Dichloroethene	SW846 8260B	SW846 8260B	75-35-4	0.005	11	150	0.005	0.005	0.001
1,2,3-Trichlorobenzene	SW846 8260B	SW846 8260B	87-61-6	NA	NA	NA	NA	0.005	0.001
1,2,4-Trichlorobenzene	SW846 8260B	SW846 8260B	120-82-1	0.4	73	820	0.005	0.005	0.001
1,2-Dibromo-3-chloropropane	SW846 8260B	SW846 8260B	96-12-8	0.005 ¹⁰	0.08	0.2	0.005	0.01 (0.0005) ¹²	0.001
1,2-Dibromoethane	SW846 8260B	SW846 8260B	106-93-4	0.005 ¹⁰	0.008	0.04	0.005	0.001	0.001
1,2-Dichlorobenzene	SW846 8260B	SW846 8260B	95-50-1	11	5,300	59,000	0.005	0.005	0.001
1,2-Dichloroethane	SW846 8260B	SW846 8260B	107-06-2	0.005 ¹⁰	0.9	3	0.005	0.001	0.001
1,2-Dichloropropane	SW846 8260B	SW846 8260B	78-87-5	0.005 ¹⁰	2	5	0.005	0.005	0.001
1,3-Dichlorobenzene	SW846 8260B	SW846 8260B	541-73-1	12	5,300	59,000	0.005	0.005	0.001
1,4-Dichlorobenzene	SW846 8260B	SW846 8260B	106-46-7	1	5	13	0.005	0.005	0.001
1,4-Dioxane	SW846 8260B	SW846 8260B	123-91-1	NA	NA	NA	NA	0.13	0.5
2-Butanone (MEK)	SW846 8260B	SW846 8260B	78-93-3	0.6	3,100	44,000	0.01	0.01	0.01
2-Hexanone	SW846 8260B	SW846 8260B	591-78-6	NA	NA	NA	NA	0.005	0.01
4-Methyl-2-pentanone(MIBK)	SW846 8260B	SW846 8260B	108-10-1	NA	NA	NA	NA	0.005	0.01
Acetone	SW846 8260B	SW846 8260B	67-64-1	12	70,000	NA	0.01	0.01	0.01
Benzene	SW846 8260B	SW846 8260B	71-43-2	0.005 ¹⁰	2	5	0.005	0.001	0.001
Bromochloromethane	SW846 8260B	SW846 8260B	74-97-5	NA	NA	NA	NA	0.005	0.001
Bromodichloromethane	SW846 8260B	SW846 8260B	75-27-4	0.005 ¹⁰	1	3	0.005	0.005	0.001
Bromoform	SW846 8260B	SW846 8260B	75-25-2	0.02	81	280	0.005	0.005	0.001
Bromomethane	SW846 8260B	SW846 8260B	74-83-9	0.03	25	59	0.005	0.005	0.001
Carbon disulfide	SW846 8260B	SW846 8260B	75-15-0	4	7,800	110,000	0.5	0.005	0.001

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
Carbon tetrachloride	SW846 8260B	SW846 8260B	56-23-5	0.005 ¹⁰	0.6	2	0.005	0.005	0.001
Chlorobenzene	SW846 8260B	SW846 8260B	108-90-7	0.4	510	7,400	0.005	0.005	0.001
Chloroethane	SW846 8260B	SW846 8260B	75-00-3	NA	220	1,100	0.005	0.005	0.001
Chloroform	SW846 8260B	SW846 8260B	67-66-3	0.2	0.6	2	0.005	0.005	0.001
Chloromethane	SW846 8260B	SW846 8260B	74-87-3	NA	4	12	0.005	0.005	0.001
cis-1,2-Dichloroethene	SW846 8260B	SW846 8260B	156-59-2	0.2	230	560	0.005	0.005	0.001
cis-1,3-Dichloropropene	SW846 8260B	SW846 8260B	10061-01-5	0.005 ¹⁰	2	7	0.005	0.005	0.001
Cyclohexane	SW846 8260B	SW846 8260B	110-82-7	NA	NA	NA	NA	0.005	0.001
Dibromochloromethane	SW846 8260B	SW846 8260B	124-48-1	0.005 ¹⁰	3	8	0.005	0.005	0.001
Dichlorodifluoromethane	SW846 8260B	SW846 8260B	75-71-8	25	490	230,000	0.005	0.005	0.001
Ethylbenzene	SW846 8260B	SW846 8260B	100-41-4	8	7,800	110,000	0.005	0.001	0.001
Isopropylbenzene	SW846 8260B	SW846 8260B	98-82-8	NA	12NA	NA	NA	0.005	0.001
m,p-Xylene	SW846 8260B	SW846 8260B	108-38-3 & 106-42-3	12	NA	NA	NA	0.002	0.002
Methyl Acetate	SW846 8260B	SW846 8260B	79-20-9	14	78,000	NA	0.005	0.005	0.001
Methyl Tert Butyl Ether	SW846 8260B	SW846 8260B	1634-04-4	0.2	110	320	0.005	0.001	0.001
Methylcyclohexane	SW846 8260B	SW846 8260B	108-87-2	NA	NA	NA	NA	0.005	0.001
Methylene chloride	SW846 8260B	SW846 8260B	75-09-2	0.007	34	97	0.005	0.005	0.001
o-Xylene	SW846 8260B	SW846 8260B	95-47-6	12	NA	NA	NA	0.001	0.001
Styrene	SW846 8260B	SW846 8260B	100-42-5	2	90	260	0.005	0.005	0.001
Tetrachloroethene	SW846 8260B	SW846 8260B	127-18-4	0.005 ¹⁰	2	5	0.005	0.005	0.001
Toluene	SW846 8260B	SW846 8260B	108-88-3	4	6,300	91,000	0.005	0.001	0.001
trans-1,2-Dichloroethene	SW846 8260B	SW846 8260B	156-60-5	0.4	300	720	0.005	0.005	0.001
trans-1,3-Dichloropropene	SW846 8260B	SW846 8260B	10061-02-6	0.005 ¹⁰	NA	NA	NA	0.005	0.001
Trichloroethene	SW846 8260B	SW846 8260B	79-01-6	0.007	7	20	0.005	0.005	0.001
Trichlorofluoromethane	SW846 8260B	SW846 8260B	75-69-4	22	23,000	340,000	0.005	0.005	0.001
Vinyl chloride	SW846 8260B	SW846 8260B	75-01-4	0.005 ¹⁰	0.7	2	0.005	0.005	0.001
Xylene (total)	SW846 8260B	SW846 8260B	1330-20-7	12	12,000	170,000	0.005	0.002	0.003

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
TCL SVOC									
1,1'-Biphenyl	SW846 8270C	SW846 8270C	92-52-4	90	3,100	34,000	0.2	0.067	0.33 ⁸
1,2,4,5-Tetrachlorobenzene	SW846 8270C	Need to subcontract ⁵	95-94-3	NA	NA	NA	NA	0.17	Use Accutest ⁵
2,3,4,6-Tetrachlorophenol	SW846 8270C	Need to subcontract ⁵	58-90-2	NA	NA	NA	NA	0.17	Use Accutest ⁵
2,4,5-Trichlorophenol	SW846 8270C	SW846 8270C	95-95-4	44	6,100	68,000	0.2	0.17	0.33 ⁸
2,4,6-Trichlorophenol	SW846 8270C	SW846 8270C	88-06-2	0.2 ¹⁰	19	74	0.2	0.17	0.33 (0.06) ¹²
2,4-Dichlorophenol	SW846 8270C	SW846 8270C	120-83-2	0.2 ¹⁰	180	2,100	0.2	0.17	0.33 (0.05) ¹²
2,4-Dimethylphenol	SW846 8270C	SW846 8270C	105-67-9	0.7	1,200	14,000	0.2	0.17	0.33 ⁸
2,4-Dinitrophenol	SW846 8270C	SW846 8270C	51-28-5	0.3 ¹⁰	120	1,400	0.3	0.67 (0.04) ¹²	1 (0.07) ¹²
2,4-Dinitrotoluene	SW846 8270C	SW846 8270C	121-14-2	NA	0.7	3	0.2	0.067	0.067
2,6-Dinitrotoluene	SW846 8270C	SW846 8270C	606-20-2	NA	0.7	3	0.2	0.067	0.067
2-Chloronaphthalene	SW846 8270C	SW846 8270C	91-58-7	NA	NA	NA	NA	0.067	0.33
2-Chlorophenol	SW846 8270C	SW846 8270C	95-57-8	0.5	310	2,200	0.2	0.17	0.33 ⁸
2-Methylnaphthalene	SW846 8270C	SW846 8270C	91-57-6	5	230	2400	0.2	0.067	0.33 ⁸
2-Methylphenol	SW846 8270C	SW846 8270C	95-48-7	NA	310	3,400	0.2	0.067	0.33 ⁸
2-Nitroaniline	SW846 8270C	SW846 8270C	88-74-4	NA	39	23,000	0.3	0.17	0.067
2-Nitrophenol	SW846 8270C	SW846 8270C	88-75-5	NA	NA	NA	NA	0.17	0.33
3&4-Methylphenol	SW846 8270C	SW846 8270C	108-39-4 & 106-44-5	NA	31	340	31	0.067	0.33
3,3'-Dichlorobenzidine	SW846 8270C	SW846 8270C	91-94-1	0.2 ¹⁰	1	4	0.2	0.17	0.067
3-Nitroaniline	SW846 8270C	SW846 8270C	99-09-2	NA	NA	NA	NA	0.17	0.067
4,6-Dinitro-o-cresol	SW846 8270C	SW846 8270C	534-52-1	0.3 ¹⁰	6	68	0.3	0.67 (0.04) ¹²	1 (0.16) ¹²
4-Bromophenyl phenyl ether	SW846 8270C	SW846 8270C	101-55-3	NA	NA	NA	NA	0.067	0.33
4-Chloro-3-methyl phenol	SW846 8270C	SW846 8270C	59-50-7	NA	NA	NA	NA	0.17	0.33
4-Chloroaniline	SW846 8270C	SW846 8270C	106-47-8	NA	NA	NA	NA	0.17	0.33
4-Chlorophenyl phenyl ether	SW846 8270C	SW846 8270C	7005-72-3	NA	NA	NA	NA	0.067	0.33
4-Nitroaniline	SW846 8270C	SW846 8270C	100-01-6	NA	NA	NA	NA	0.17	0.067

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
4-Nitrophenol	SW846 8270C	SW846 8270C	100-02-7	NA	NA	NA	NA	0.33	1
Acenaphthene	SW846 8270C	SW846 8270C	83-32-9	74	3,400	37,000	0.2	0.033	0.33 ⁸
Acenaphthylene	SW846 8270C	SW846 8270C	208-96-8	NA	NA	300,000	0.2	0.033	0.33 ⁸
Acetophenone	SW846 8270C	SW846 8270C	98-86-2	2	2	5	0.2	0.17	0.33 ⁸
Anthracene	SW846 8270C	SW846 8270C	120-12-7	1,500	17,000	30,000	0.2	0.033	0.33 ⁸
Atrazine	SW846 8270C	SW846 8270C	1912-24-9	0.2 ¹⁰	210	2,400	0.2	0.17	0.33 (0.06) ¹²
Benzaldehyde	SW846 8270C	SW846 8270C	100-52-7	NA	6100	68,000	0.2	0.17	0.33 ⁸
Benzo(a)anthracene	SW846 8270C	SW846 8270C	56-55-3	0.5	0.6	2	0.2	0.033	0.033
Benzo(a)pyrene	SW846 8270C	SW846 8270C	50-32-8	0.2 ¹⁰	0.2	0.2	0.2	0.033	0.033
Benzo(b)fluoranthene	SW846 8270C	SW846 8270C	205-99-2	2	0.6	2	0.2	0.033	0.033
Benzo(g,h,i)perylene	SW846 8270C	SW846 8270C	191-24-2	NA	380,000	30,000	0.2	0.033	0.33 ⁸
Benzo(k)fluoranthene	SW846 8270C	SW846 8270C	207-08-9	16	6	23	0.2	0.033	0.033
bis(2-Chloroethoxy)methane	SW846 8270C	SW846 8270C	111-91-1	NA	NA	NA	NA	0.067	0.33
bis(2-Chloroethyl)ether	SW846 8270C	SW846 8270C	111-44-4	0.2 ¹⁰	0.4	2	0.2	0.067	0.033
bis(2-Chloroisopropyl)ether	SW846 8270C	SW846 8270C	108-60-1	3	23	67	0.2	0.067	0.33 ⁸
bis(2-Ethylhexyl)phthalate	SW846 8270C	SW846 8270C	117-81-7	790	35	140	0.2	0.067	0.33 ⁸
Butyl benzyl phthalate	SW846 8270C	SW846 8270C	85-68-7	150	1,200	14,000	0.2	0.067	0.33 ⁸
Caprolactam	SW846 8270C	SW846 8270C	105-60-2	8	31,000	340,000	0.2	0.067	0.33 ⁸
Carbazole	SW846 8270C	SW846 8270C	86-74-8	NA	24	96	0.2	0.067	0.33 ⁸
Chrysene	SW846 8270C	SW846 8270C	218-01-9	52	62	230	0.2	0.033	0.33 ⁸
Dibenzo(a,h)anthracene	SW846 8270C	SW846 8270C	53-70-3	0.5	0.2	0.2	0.2	0.033	0.033
Dibenzofuran	SW846 8270C	SW846 8270C	132-64-9	NA	NA	NA	NA	0.067	0.33
Diethyl phthalate	SW846 8270C	SW846 8270C	84-66-2	57	49,000	550,000	0.2	0.067	0.33 ⁸
Dimethyl phthalate	SW846 8270C	SW846 8270C	131-11-3	NA	NA	NA	NA	0.067	0.33
Di-n-butyl phthalate	SW846 8270C	SW846 8270C	84-74-2	620	6,100	68,000	0.2	0.067	0.33 ⁸
Di-n-octyl phthalate	SW846 8270C	SW846 8270C	117-84-0	3300 ¹¹	2,400	27,000	0.2	0.067	0.33 ⁸

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
Fluoranthene	SW846 8270C	SW846 8270C	206-44-0	840	2,300	24,000	0.2	0.033	0.33 ⁸
Fluorene	SW846 8270C	SW846 8270C	86-73-7	110	2,300	24,000	0.2	0.033	0.33 ⁸
Hexachlorobenzene	SW846 8270C	SW846 8270C	118-74-1	0.2 ¹⁰	0.3	1	0.2	0.067	0.033
Hexachlorobutadiene	SW846 8270C	SW846 8270C	87-68-3	0.6	NA	NA	NA	0.033	0.067
Hexachlorocyclopentadiene	SW846 8270C	SW846 8270C	77-47-4	210	45	110	0.2	0.67 ⁸	0.33 ⁸
Hexachloroethane	SW846 8270C	SW846 8270C	67-72-1	0.2 ¹⁰	35	140	0.2	0.17	0.033
Indeno(1,2,3-cd)pyrene	SW846 8270C	SW846 8270C	193-39-5	5	0.6	2	0.2	0.033	0.033
Isophorone	SW846 8270C	SW846 8270C	78-59-1	0.2 ¹⁰	510	2,000	0.2	0.067	0.33 (0.04) ¹²
Naphthalene	SW846 8270C	SW846 8270C	91-20-3	16	6	17	0.2	0.033	0.33 ⁸
Nitrobenzene	SW846 8270C	SW846 8270C	98-95-3	0.2 ¹⁰	31	340	0.2	0.067	0.033
N-Nitroso-di-n-propylamine	SW846 8270C	SW846 8270C	621-64-7	0.2 ¹⁰	0.2	0.3	0.2	0.067	0.033
N-Nitrosodiphenylamine	SW846 8270C	SW846 8270C	86-30-6	0.2	99	390	0.2	0.17	0.33 (0.05) ¹²
Pentachlorophenol	SW846 8270C	SW846 8270C	87-86-5	0.3 ¹⁰	3	10	0.3	0.33 (0.06) ¹²	1 (0.16) ¹²
Phenanthrene	SW846 8270C	SW846 8270C	85-01-8	NA	NA	300,000	0.2	0.033	0.33 ⁸
Phenol	SW846 8270C	SW846 8270C	108-95-2	5	18,000	210,000	0.2	0.067	0.33 ⁸
Pyrene	SW846 8270C	SW846 8270C	129-00-0	550	1,700	18,000	0.2	0.033	0.33 ⁸
TCL PCBs									
Aroclor 1016	SW846 8082	SW846 8082A	12674-11-2	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1221	SW846 8082	SW846 8082A	11104-28-2	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1232	SW846 8082	SW846 8082A	11141-16-5	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1242	SW846 8082	SW846 8082A	53469-21-9	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1248	SW846 8082	SW846 8082A	12672-29-6	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1254	SW846 8082	SW846 8082A	11097-69-1	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1260	SW846 8082	SW846 8082A	11096-82-5	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1262	SW846 8082	SW846 8082A	37324-23-5	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸
Aroclor 1268	SW846 8082	SW846 8082A	11100-14-4	0.2	0.2	1	0.03	0.034 ⁸	0.067 ⁸

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
Miscellaneous									
Cyanide	9012B	SW846 9012A	57-12-5	13	1,600	23,000	3	0.24	0.5
Extractable Petroleum Hydrocarbons (EPH)	NJDEP EPH Ver.1.1 10/09 Rev. 2	See note ⁶	NA	NA	NA	NA	NA	80	Use Accutest ⁶
Phenols	SW846 9065	SW846 9065	64743-03-9	5	NA	NA	NA	2.4	5
Total Organic Carbon (TOC)	EPA Lloyd Kahn	EPA Lloyd Kahn	7440-44-0	NA	NA	NA	NA	1000	100
Total Organic Halides (TOX)	SW846 9020 B	See note ⁵	NA	NA	NA	NA	NA	20	Use Accutest ⁵
Cation Exchange Capacity (CEC)	SW846 9081	See note ⁵	NA	NA	NA	NA	NA	NA	Use Accutest ⁵
pH ⁷	SW846 9045C	SW846 9045C	STL00204	NA	NA	NA	NA	NA	NA
Eh ⁷	ASTM D1498-76M	SM2580	NA	NA	NA	NA	NA	NA	NA
COD ^{3, 15}	HACH 8000M	5220D	STL00070	NA	NA	NA	NA	20 mg/l and 150 mg/l	200
Sulfide ³	EPA 376.1M	SW846 9034	18496-25-8	NA	NA	NA	NA	4	10
Ferrous Iron ^{3, 15}	ASTM D3872	ASTM D3872	NA	NA	NA	NA	NA	2	2
TCLP ⁴	SW846 1311	SW846 1311	NA	See individual limits above	NA	NA	NA	see RLs above	see RLs above
SPLP ⁴	SW846 1312	SW846 1312	NA	See individual limits above	NA	NA	NA	see RLs above	see RLs above
Nitrite ¹⁶	SM19 4500NO2 B Modified	EPA 353.2 modified	NA	NA	NA	NA	NA	0.2	2
Nitrate/Nitrite ¹⁶	EPA 353.2 modified	EPA 353.2 modified	NA	NA	NA	NA	NA	20	2
Alkalinity ¹⁶	EPA 310.1 modified	EPA 310.1 modified	NA	NA	NA	NA	NA	50	20
Phosphate ¹⁶	EPA 365.3 modified	EPA 365.3 modified	NA	NA	NA	NA	NA	2.5	0.6
Ignitability	SW846 1010A	1030	STL00250	NA	NA	NA	NA	NA	NA
Reactivity	SW846 9034, Ch.7	SW846 9034, Ch.7	NA	NA	NA	NA	NA	100	100

Analyte¹	Accutest Method	Test America Method	CAS No.	NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)	NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)	NJDEP Soil PQL (mg/kg)	Accutest RL (mg/kg)	Test America RL (mg/kg)
Corrosivity	SW846 9045C	SW846 9045C	STL00179	NA	NA	NA	NA	NA	NA
Moisture Content	ASTM D1744-92	EPA CLP SOW SOM01.1	NA	NA	NA	NA	NA	NA	NA
Bulk Density	ASTM D2937-94M	See note ⁵	NA	NA	NA	NA	NA	NA	Use Geotesting or Accutest ⁵
Analyte¹	GeoTesting Method								
Compressive Strength	ASTM D1633		NA	NA	NA	NA	NA	NA	
Moisture Content	ASTM D2216		NA	NA	NA	NA	NA	NA	
Strength and stress-strain relationships of cohesive soil	ASTM 2850		NA	NA	NA	NA	NA	NA	
Grain Size Analysis	ASTM D422		NA	NA	NA	NA	NA	NA	
Plasticity of soils	ASTM D 4318		NA	NA	NA	NA	NA	NA	
Strength/stress-strain relationships of saturated cohesive soil	ASTM D4767		NA	NA	NA	NA	NA	NA	
Resistance of Solid Wastes to Freezing and Thawing ¹⁴	ASTM D4842		NA	NA	NA	NA	NA	NA	
Wet/Dry Test of Solid Wastes	ASTM D4843		NA	NA	NA	NA	NA	NA	
Hydraulic Conductivity (Permeability)	ASTM D5084		NA	NA	NA	NA	NA	NA	
Specific Gravity	ASTM D854		NA	NA	NA	NA	NA	NA	

NOTES

CAS No. - Chemical Abstracts System Registration Number

MDL – Method Detection Limit

Mg/kg – milligram per kilogram

NA – Not available for this constituent.

NJDEP – New Jersey Department of Environmental Protection

PQL - Practical Quantitation Level as defined in N.J.A.C. 7:9C-1.4

RL – Reporting Limit

TAL – Target Analyte List

TCL – Target Compound List

¹ – The individual RIWPs will indicate the parameters/analytes that will be analyzed.

² – Or Allergic Contact Dermatitis (ACD) whichever is lower. ACD for hexavalent chromium is a site-specific determination.

³ – This analysis may be required if the MS/MSD does not meet QC requirements for hexavalent chromium analysis. The analysis is used to assist in the evaluation of the tendency of Cr+6 to exist or not exist in the unspiked sample. This analysis is only necessary if the unspiked sample contains detectable Cr 6+. .

⁴ – TCLP and/or SPLP may be needed for waste characterization

⁵ – Test America does not perform this analysis, thus the analysis will be performed by Accutest or GeoTesting Express.

⁶ – Test America is pending approval of their NJDEP EPH method; however, Accutest will be the only laboratory used for this analysis until Test America receives NJDEP certification.

⁷ – Eh and pH are required to be determined under the hexavalent chromium analysis.

⁸ – The laboratory reporting limit(s) (RLs) exceed the NJDEP Soil PQLs; however, since the laboratory RLs are less than both the NJDEP residential direct contact soil remediation standard and NJDEP non-residential direct contact soil remediation standard, these RLs are acceptable for these analytes.

⁹ – Health based criterion defaults to background according to Table 1 in the NJDEP Guidance Document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation*, December 2008.

¹⁰ – Standard set a Practical Quantitation Limit (PQL) according to Table 1 in the NJDEP Guidance Document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation*, December 2008.

¹¹ – Health based criterion defaults to soil saturation limit according to Table 1 in the NJDEP Guidance Document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation*, December 2008.

¹² – The laboratory reporting limit(s) (RLs) exceed one of the NJDEP standards (i.e., Impact to GW, NJDEP Soil PQL, NJDEP residential direct contact soil remediation standard, and/or NJDEP non-residential direct contact soil remediation standard. However, the laboratory MDL in parenthesis is below the NJDEP standards and thus is acceptable. Note, that a laboratory fortified blank (LFB) at a concentration equivalent to the lowest applicable NJDEP standard for those analytes with standards between the RL and MDL will be performed to ensure that the instrument accuracy is acceptable.

¹³ - Standard represents a maximum value

¹⁴ – Method has been removed from ASTM, but will only be used for informational purposes during the Feasibility Pilot Studies.

¹⁵ – These parameters do not have applicable NJ certified methods for soil/solid samples. However, the aqueous methods are NJ certified. These parameters in soil are for informational purposes only to support the hexavalent chromium analysis (SW846 3060/7196) if the MS/MSD fails.

¹⁶ – These parameters do not have applicable NJ certified methods for soil/solid samples. However, the aqueous methods are NJ certified. These parameters in soil are for informational purposes only to support the feasibility pilot studies to monitor the treatment.

¹⁷ – Impact to GW soil remediation standards must be developed on a site-specific basis for chromium. For Class II GW, the GW quality standard is 70 ug/l (measured as total chromium), but assuming it is all in the form of hexavalent chromium. In addition to the cleanup criteria listed above, all remedial actions at sites that have hexavalent chromium must comply with Commissioner Jackson's memorandum dated February 8, 2007. A copy of this memorandum can be found on the Department web site at

<http://www.state.nj.us/dep/dsr/chromium/crmorlift200702.pdf>

TABLE 5-2 – ANALYTES, ANALYTICAL METHODS, NJDEP SPECIFIC GW QUALITY CRITERIA, NJDEP PRACTICAL QUANTITATION LIMITS, AND LABORATORY REPORTING LIMITS FOR AQUEOUS SAMPLES

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
TAL Metals							
Aluminum	SW846 6020B	SW846 6010B	7429-90-5	200	30	100 ⁷	50 ⁷
Antimony	SW846 6020B	SW846 6020	7440-36-0	6	3	4 ⁷	0.25
Arsenic	SW846 6010B	SW846 6020	7440-38-2	0.02	3	3	0.25
Barium	SW846 6010B	SW846 6020	7440-39-3	6000	200	200	200
Beryllium	SW846 6010B	SW846 6020	7440-41-7	1	1	1	0.1
Cadmium	SW846 6020B	SW846 6020	7440-43-9	4	0.5	2 ⁷	0.25
Calcium	SW846 6010B	SW846 6010B	8047-59-4	NA	NA	5000	5000
Chromium - Hexavalent	SW846 3060A/7196A	SW846 3060A/7196A	18540-29-9	70 ³	1	10	10
Chromium (total)	SW846 6020B	SW846 6020	16065-83-1	70 ³	1	1.4 ⁷	5 ⁷
Cobalt	SW846 6010B	SW846 6010B	7440-48-4	NA	NA	50	50
Copper	SW846 6010B	SW846 6020	7440-50-8	1300	4	10 ⁷	0.5
Iron	SW846 6010B	SW846 6020	8053-60-9	300	20	100 ⁷	15
Lead	SW846 6010B	SW846 6010B	7439-92-1	5	5	3	5
Magnesium	SW846 6010B	SW846 6010B	7439-95-4	NA	NA	5000	5000
Manganese	SW846 6020B	SW846 6020B	7439-96-5	50	0.4	2 ⁷	10 ⁷
Mercury	SW846 7470A	SW846 7470A	7439-97-6	2	0.05	0.200 ⁷	0.200 ⁷
Nickel	SW846 6010B	SW846 6020	7440-02-0	100	4	10 ⁷	0.5
Potassium	SW846 6010B	SW846 6010B	7440-09-7	NA	NA	10000	5000
Selenium	SW846 6010B	SW846 6020B	7782-49-2	40	4	10 ⁷	2.5
Silver	SW846 6010B	SW846 6010B	7440-22-4	40	1	10 ⁷	5 ⁷
Sodium	SW846 6020B	SW846 6010B	7646-69-7	50,000	400	500 ⁷	250
Thallium	SW846 6010B	SW846 6020	7440-28-0	0.5	2	2	0.1
Vanadium	SW846 6020B	SW846 6020	7440-62-2	60 ⁴	1	10 ⁷	0.5
Zinc	SW846 6010B	SW846 6020	7440-66-6	2000	10	10 ⁷	2

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
TCL VOC							
1,1,1-Trichloroethane	SW846 8260B	SW846 8260B	71-55-6	NA	1	1	1
1,1,2,2-Tetrachloroethane	SW846 8260B	SW846 8260B	79-34-5	1	1	1	1
1,1,2-trichloro-1,2,2-trifluoroethane	SW846 8260B	SW846 8260B	76-13-1	2000	1	5 ⁷	1
1,1,2-Trichloroethane	SW846 8260B	SW846 8260B	79-00-5	3	2	1	1
1,1-Dichloroethane	SW846 8260B	SW846 8260B	75-34-3	50	1	1	1
1,1-Dichloroethene	SW846 8260B	SW846 8260B	75-35-4	1	1	1	1
1,2,3-Trichlorobenzene	SW846 8260B	SW846 8260B	87-61-6	NA	NA	5	1
1,2,4-Trichlorobenzene	SW846 8260B	SW846 8270C	120-82-1	9	1	5 ⁷	1
1,2-Dibromo-3-chloropropane	SW846 8260B	SW846 8260B	96-12-8	0.02	0.02	0.02	1 ⁹
1,2-Dibromoethane	SW846 8011	SW846 8260B	106-93-4	0.0004	0.03	0.02	1 ⁹
1,2-Dichlorobenzene	SW846 8260B	SW846 8260B	95-50-1	600	5	1	1
1,2-Dichloroethane	SW846 8260B	SW846 8260B	107-06-2	0.3	2	1	1
1,2-Dichloropropane	SW846 8260B	SW846 8260B	78-87-5	0.5	1	1	1
1,3-Dichlorobenzene	SW846 8260B	SW846 8260B	541-73-1	600	5	1	1
1,4-Dichlorobenzene	SW846 8260B	SW846 8260B	106-46-7	75	5	1	1
1,4-Dioxane	SW846 8260B	SW846 8260B	123-91-1	NA	NA	130	1000
2-Butanone (MEK)	SW846 8260B	SW846 8260B	78-93-3	300	2	10 ⁷	10 ⁷
2-Hexanone	SW846 8260B	SW846 8260B	591-78-6	NA	NA	5	10
4-Methyl-2-pentanone(MIBK)	SW846 8260B	SW846 8260B	108-10-1	NA	NA	5	10
Acetone	SW846 8260B	SW846 8260B	67-64-1	6000	10	10	10
Benzene	SW846 8260B	SW846 8260B	71-43-2	0.2	1	1	1
Bromochloromethane	SW846 8260B	SW846 8260B	74-97-5	NA	NA	5	1
Bromodichloromethane	SW846 8260B	SW846 8260B	75-27-4	0.6	1	1	1
Bromoform	SW846 8260B	SW846 8260B	75-25-2	4	0.8	4 ⁷	1 ⁷
Bromomethane	SW846 8260B	SW846 8260B	74-83-9	10	1	2 ⁷	1
Carbon disulfide	SW846 8260B	SW846 8260B	75-15-0	700	1	2 ⁷	1
Carbon tetrachloride	SW846 8260B	SW846 8260B	56-23-5	0.4	1	1	1

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
Chlorobenzene	SW846 8260B	SW846 8260B	108-90-7	50	1	1	1
Chloroethane	SW846 8260B	SW846 8260B	75-00-3	NA	NA	1	1
Chloroform	SW846 8260B	SW846 8260B	67-66-3	70	1	1	1
Chloromethane	SW846 8260B	SW846 8260B	74-87-3	NA	NA	1	1
cis-1,2-Dichloroethene	SW846 8260B	SW846 8260B	156-59-2	70	1	1	1
cis-1,3-Dichloropropene	SW846 8260B	SW846 8260B	10061-01-5	0.4	1	1	1
Cyclohexane	SW846 8260B	SW846 8260B	110-82-7	NA	NA	5	1
Dibromochloromethane	SW846 8260B	SW846 8260B	124-48-1	0.4	1	1	1
Dichlorodifluoromethane	SW846 8260B	SW846 8260B	75-71-8	1000	2	5 ⁷	1
Ethylbenzene	SW846 8260B	SW846 8260B	100-41-4	700	2	1	1
Isopropylbenzene	SW846 8260B	SW846 8260B	98-82-8	700	1	2 ⁷	1
m,p-Xylene	SW846 8260B	SW846 8260B	108-38-3 & 106-42-3	1000 ⁵	2	1	2
Methyl Acetate	SW846 8260B	SW846 8260B	79-20-9	7000	0.5	5 ⁷	2 ⁷
Methyl Tert Butyl Ether	SW846 8260B	SW846 8260B	1634-04-4	70	1	1	1
Methylcyclohexane	SW846 8260B	SW846 8260B	108-87-2	NA	NA	5	1
Methylene chloride	SW846 8260B	SW846 8260B	75-09-2	3	1	2 ⁷	1
o-Xylene ⁵	SW846 8260B	SW846 8260B	95-47-6	1000	2	1	1
Styrene	SW846 8260B	SW846 8260B	100-42-5	100	2	5 ⁷	1
Tetrachloroethene	SW846 8260B	SW846 8260B	127-18-4	0.4	1	1	1
Toluene	SW846 8260B	SW846 8260B	108-88-3	600	1	1	1
trans-1,2-Dichloroethene	SW846 8260B	SW846 8260B	156-60-5	100	1	1	1
trans-1,3-Dichloropropene	SW846 8260B	SW846 8260B	10061-02-6	0.4	1	1	1
Trichloroethene	SW846 8260B	SW846 8260B	79-01-6	1	1	1	1
Trichlorofluoromethane	SW846 8260B	SW846 8260B	75-69-4	2000	1	5 ⁷	1
Vinyl chloride	SW846 8260B	SW846 8260B	75-01-4	0.08	1	1	1
Xylene (total)	SW846 8260B	SW846 8260B	1330-20-7	1000	2	1	3 ⁷

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
TCL SVOC							
1,1'-Biphenyl	SW846 8270C	SW846 8270C	92-52-4	400	10	2	10
1,2,4,5-Tetrachlorobenzene	SW846 8270C	See Note below ⁸	95-94-3	NA	NA	5	Use Accutest ⁸
2,3,4,6-Tetrachlorophenol	SW846 8270C	See Note below ⁸	58-90-2	200	3	5 ⁷	Use Accutest ⁸
2,4,5-Trichlorophenol	SW846 8270C	SW846 8270C	95-95-4	700	10	5	10
2,4,6-Trichlorophenol	SW846 8270C	SW846 8270C	88-06-2	1	20	5	10
2,4-Dichlorophenol	SW846 8270C	SW846 8270C	120-83-2	20	10	5	10
2,4-Dimethylphenol	SW846 8270C	SW846 8270C	105-67-9	100	20	5	10
2,4-Dinitrophenol	SW846 8270C	SW846 8270C	51-28-5	10	40	20	30
2,4-Dinitrotoluene	SW846 8270C	SW846 8270C	121-14-2	NA	NA	2	2
2,6-Dinitrotoluene	SW846 8270C	SW846 8270C	606-20-2	NA	NA	2	2
2-Chloronaphthalene	SW846 8270C	SW846 8270C	91-58-7	600	10	5	10
2-Chlorophenol	SW846 8270C	SW846 8270C	95-57-8	40	20	5	10
2-Methylnaphthalene	SW846 8270C	SW846 8270C	91-57-6	NA	NA	2	10
2-Methylphenol	SW846 8270C	SW846 8270C	95-48-7	NA	NA	2	10
2-Nitroaniline	SW846 8270C	SW846 8270C	88-74-4	NA	NA	5	20
2-Nitrophenol	SW846 8270C	SW846 8270C	88-75-5	NA	NA	5	10
3&4-Methylphenol	SW846 8270C	SW846 8270C	108-39-4 & 106-44-5	NA	NA	2	10
3,3'-Dichlorobenzidine	SW846 8270C	SW846 8270C	91-94-1	0.08	30	5	20
3-Nitroaniline	SW846 8270C	SW846 8270C	99-09-2	NA	NA	5	20
4,6-Dinitro-o-cresol	SW846 8270C	SW846 8270C	534-52-1	NA	NA	20	30
4-Bromophenyl phenyl ether	SW846 8270C	SW846 8270C	101-55-3	NA	NA	2	10
4-Chloro-3-methyl phenol	SW846 8270C	SW846 8270C	59-50-7	NA	NA	5	10
4-Chloroaniline	SW846 8270C	SW846 8270C	106-47-8	30	10	5	10
4-Chlorophenyl phenyl ether	SW846 8270C	SW846 8270C	7005-72-3	NA	NA	2	10
4-Nitroaniline	SW846 8270C	SW846 8270C	100-01-6	NA	NA	5	20
4-Nitrophenol	SW846 8270C	SW846 8270C	100-02-7	NA	NA	10	30

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
Acenaphthene	SW846 8270C	SW846 8270C	83-32-9	NA	NA	0.1	10
Acenaphthylene	SW846 8270C	SW846 8270C	208-96-8	NA	NA	0.1	10
Acetophenone	SW846 8270C	SW846 8270C	98-86-2	700	10	5	10
Anthracene	SW846 8270C	SW846 8270C	120-12-7	2000	10	0.1	10
Atrazine	SW846 8270C	SW846 8270C	1912-24-9	3	0.1	5 ⁹	10 ⁹
Benzaldehyde	SW846 8270C	SW846 8270C	100-52-7	NA	NA	5	10
Benzo(a)anthracene	SW846 8270C SIM	SW846 8270C SIM	56-55-3	0.05	0.1	0.1	0.05
Benzo(a)pyrene	SW846 8270C SIM	SW846 8270C SIM	50-32-8	0.005	0.1	0.1	0.05
Benzo(b)fluoranthene	SW846 8270C SIM	SW846 8270C SIM	205-99-2	0.05	0.2	0.1	0.05
Benzo(g,h,i)perylene	SW846 8270C	SW846 8270C	191-24-2	NA	NA	0.1	10
Benzo(k)fluoranthene	SW846 8270C SIM	SW846 8270C	207-08-9	0.5	0.3	0.1	0.05
bis(2-Chloroethoxy)methane	SW846 8270C	SW846 8270C	111-91-1	NA	NA	2	10
bis(2-Chloroethyl)ether	SW846 8270C	SW846 8270C	111-44-4	0.03	7	2	1
bis(2-Chloroisopropyl)ether	SW846 8270C	SW846 8270C SIM	108-60-1	300	10	2	0.02
bis(2-Ethylhexyl)phthalate	SW846 8270C	SW846 8270C	117-81-7	2	3	2	10 ⁹
Butyl benzyl phthalate	SW846 8270C	SW846 8270C	85-68-7	100	1	2 ⁷	10 ⁷
Caprolactam	SW846 8270C	SW846 8270C	105-60-2	NA	NA	2	10
Carbazole	SW846 8270C	SW846 8270C	86-74-8	NA	NA	2	10
Chrysene	SW846 8270C	SW846 8270C SIM	218-01-9	5	0.2	0.1	0.05
Dibenzo(a,h)anthracene	SW846 8270C	SW846 8270C SIM	53-70-3	0.005	0.3	0.1	0.05
Dibenzofuran	SW846 8270C	SW846 8270C	132-64-9	NA	NA	5	10
Diethyl phthalate	SW846 8270C	SW846 8270C	84-66-2	6000	1	2 ⁷	10 ⁷
Dimethyl phthalate	SW846 8270C	SW846 8270C	131-11-3	NA	NA	2	10
Di-n-butyl phthalate	SW846 8270C	SW846 8270C	84-74-2	700	1	2 ⁷	10 ⁷
Di-n-octyl phthalate	SW846 8270C	SW846 8270C	117-84-0	100	10	2	10
Fluoranthene	SW846 8270C	SW846 8270C	206-44-0	300	10	0.1	10
Fluorene	SW846 8270C	SW846 8270C	86-73-7	300	1	0.1	10 ⁷
Hexachlorobenzene	SW846 8270C SIM	SW846 8270C SIM	118-74-1	0.02	0.02	0.02	0.02

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
Hexachlorobutadiene	SW846 8270C	SW846 8270C	87-68-3	0.4	1	1	1
Hexachlorocyclopentadiene	SW846 8270C	SW846 8270C	77-47-4	40	0.5	20 ⁷	10 ⁷
Hexachloroethane	SW846 8270C	SW846 8270C	67-72-1	2	7	5	1
Indeno(1,2,3-cd)pyrene	SW846 8270C	SW846 8270C SIM	193-39-5	0.05	0.2	0.1	0.05
Isophorone	SW846 8270C	SW846 8270C	78-59-1	40	10	2	10
Naphthalene	SW846 8270C	SW846 8270C	91-20-3	300	2	0.1	10 ⁷
Nitrobenzene	SW846 8270C	SW846 8270C	98-95-3	4	6	2	1
N-Nitroso-di-n-propylamine	SW846 8270C	SW846 8270C	621-64-7	0.005	10	2	1
N-Nitrosodiphenylamine	SW846 8270C	SW846 8270C	86-30-6	7	10	5	10
Pentachlorophenol	SW846 8270C SIM	SW846 8270C SIM	87-86-5	0.3	0.1	0.3 ⁷	0.2 ⁷
Phenanthrene	SW846 8270C	SW846 8270C	85-01-8	NA	NA	0.1	10
Phenol	SW846 8270C	SW846 8270C	108-95-2	2000	10	2	10
Pyrene	SW846 8270C	SW846 8270C	129-00-0	200	0.1	0.1	10 ⁷
TCL PCBs							
Aroclor 1016	SW846 8082	SW846 8082	12674-11-2	0.02	0.5	0.5	0.5
Aroclor 1221	SW846 8082	SW846 8082	11104-28-2	0.02	0.5	0.5	0.5
Aroclor 1232	SW846 8082	SW846 8082	11141-16-5	0.02	0.5	0.5	0.5
Aroclor 1242	SW846 8082	SW846 8082	53469-21-9	0.02	0.5	0.5	0.5
Aroclor 1248	SW846 8082	SW846 8082	12672-29-6	0.02	0.5	0.5	0.5
Aroclor 1254	SW846 8082	SW846 8082	11097-69-1	0.02	0.5	0.5	0.5
Aroclor 1260	SW846 8082	SW846 8082	11096-82-5	0.02	0.5	0.5	0.5
Aroclor 1262	SW846 8082	SW846 8082	37324-23-5	0.02	0.5	0.5	0.5
Aroclor 1268	SW846 8082	SW846 8082	11100-14-4	0.02	0.5	0.5	0.5
Miscellaneous							
Cyanide	SW846 9012B	SW846 9012A	57-12-5	100	6	10 ⁷	10 ⁷
Extractable Petroleum Hydrocarbons (EPH) ⁶	NJ DEP EPH	See Note Below ¹⁰	NA	None Noted	NA	0.8	Use Accutest ¹⁰
Phenols	SW846 9066	SW846 9065	108-95-2	2000	10	200 ⁷	50 ⁷
Cation Exchange Capacity (CEC)	SW846 9081	See Note Below ⁸	NA	NA	NA	NA	Use Accutest ⁸
pH	SW846 9040C	SW846 9045C	NA	NA	NA	NA	NA

Analyte ¹	Accutest Method	Test America Method	CAS No.	NJDEP Specific GW Quality Criteria (µg/L)	NJDEP PQL (µg/L)	Accutest RL (µg/L)	Test America RL (µg/L)
eH	ASTM D1498-76	SM2580	NA	NA	NA	NA	NA
Ferrous Iron ²	SM3500Fe-B	SM 3500Fe-D	15438-31-0	NA	NA	200	100 ¹⁰
Carbon Oxygen Demand (COD) ²	SM5220C	SM 5220D	NA	NA	NA	20,000 or	10000
Biological Oxygen Demand (BOD) ²	SM5210B	SM 5210B	NA	NA	NA	2000	2000
Sulfide ²	SM4500S-F	SM9034	18496-25-8	NA	NA	1000	1000
Total Organic Carbon (TOC)	SM5310 B	SM5310 B	NA	NA	NA	1000	1000
Total Organic Halides (TOX)	SW846 9020B M	See Note Below ⁸	NA	NA	NA	50	Use Accutest ⁸
Ignitability	SW846 1010A	SW846 1020A	NA	NA	NA	NA	NA
Reactivity	SW846 9034	SW846 9034	NA	NA	NA	NA	NA
Corrosivity	SM9040C	SM9045C	NA	NA	NA	NA	NA
Total Suspended Solids (TSS)	SM 2540D	SM 2540D	NA	NA	NA	NA	NA
Total Dissolved Solids (TDS)	SM 2540C	SM 2540C	NA	500,000	10000	10000	10000
Chloride	SM 4500Cl-C	SM 4500Cl-E	NA	250,000	2000	2000	10000 ⁷

Notes:

¹ – The individual RIWPs will indicate the parameters/analytes that will be analyzed.

² - Cr+6 Reanalysis may require these additional parameters if the matrix spike/matrix spike duplicate do not meet QC requirements.

³ - GW criteria is for total chromium

⁴ - GW criteria is for vanadium pentoxide

⁵ - GW criteria is for total xylenes

⁶ - GW criteria is for Oil & Grease & Petroleum Hydrocarbons

⁷ - The laboratory RLs exceed the NJDEP PQLs; however, the laboratory RLs are less than the NJDEP Specific GW Quality Criteria and thus are acceptable.

⁸ – Test America does not perform this analysis, thus the analysis will be performed by Accutest.

Acronyms:

CAS - Chemical Abstracts System Registration Number

NA - not available for this constituent

NJDEP - New Jersey Department of Environmental Protection

PCB - Polychlorinated Biphenyl

PQL - Practical Quantitation Level as defined in N.J.A.C. 7:9C-1.4

RL - Reporting Limit

SVOC- Semivolatile Organic Compound

TAL - Target Analyte List

TCL - Target Compound List

µg/L - microgram per liter

VOC - Volatile Organic Compound

TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY

Matrix ¹	Analyses ¹	Quality Assurance Samples	Sampling Frequency	Criteria
AIR	Chromium (Total and Hexavalent)	Field Blank	1/day from same lot number as sample filters	<MDL ⁸
	Particulates (PM ₁₀)	Field (Blind) Duplicate (co-located)	1/20 samples (5% of total) or minimum of 1/week	RPD < 50%
WIPES	Chromium ⁴ (Total and Hexavalent)	Field Blank	1/day from same lot number as the sample wipes	<RL ²
SOIL, CHIP, CONCRETE, SWEEP, MASONRY (including TCLP and/or SPLP, as applicable)	TCL VOCs	Field Blank	Either 1/day or 10% of the total number of samples collected, but not more than 1/day	< RL ²
	TCL SVOCs			
	TCL PCBs	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 50%
	TAL Metals			
	Hexavalent Chromium ⁴	MS/MSD	1/20 samples (5% of total)	See method ³
	EPH			
	Phenols	Field Blank	Either 1/day or 10% of the total number of samples collected, but not more than 1/day	< RL ²
	Cyanide			
	Wet Chemistry ⁵	Field Blank	Either 1/day or 10% of the total number of samples collected, but not more than 1/day	< RL ²
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 50%
	Geotechnical ⁶	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 50%
	Waste Characteristics ⁷			

TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY (continued)

Matrix ¹	Analyses ¹	Quality Assurance Samples	Sampling Frequency	Criteria
AQUEOUS	TCL VOCs	Trip Blank	1/cooler	< RL ²
		Field Blank	1/day	< RL ²
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
		MS/MSD	1/20 samples (5% of total)	See method ³
	TCL SVOCs TCL PCBs TAL Metals Hexavalent Chromium ⁴ EPH Phenols Cyanide	Field Blank	1/day	< RL ²
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
		MS/MSD	1/20 samples (5% of total)	See method ³
		Field Blank	1/day	< RL ²
	Wet Chemistry ⁵	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
		Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%
	Waste Characteristics ⁷	Field (Blind) Duplicate	1/20 samples (5% of total)	RPD < 30%

Notes:

- ¹ - These are proposed matrices and analytes, refer to the RIWP for the specific matrices and analytes.
- ² - Refer to Tables 5-1 and 5-2 for the analyte specific RL.
- ³ - Refer to the specific analytical methods for the MS/MSD QC Criteria.
- ⁴ - Hexavalent chromium analysis includes Eh and pH analysis on every sample.
- ⁵ - Wet Chemistry analyses may include BOD, CEC, COD, TDS, TSS, TOC, TOX, Alkalinity, Chloride, Ferrous iron, Nitrate, Nitrite, Phosphate, and Sulfide.
- ⁶ - Geotechnical analyses may include moisture content, permeability, specific gravity, grain size, bulk density, Atterberg limits, and unconfined compressive strength.
- ⁷ - Waste Characteristic analyses may include ignitability, reactivity, moisture content, and corrosivity.
- ⁸ - Refer to the specific air monitoring work plan.

Acronyms:

EPH	Extractable Petroleum Hydrocarbons	TAL	Target Analyte List
MDL	Method Detection Limit	TCL	Target Compound List
PCB	Polychlorinated Biphenyl	TDS	Total Dissolved Solids
PM ₁₀	Particulates	TOC	Total Organic Carbon
RL	Reporting Limit	TOX	Total Organic Halides
RPD	Relative Percent Difference	TSS	Total Suspended Solids
SOP	Standard Operating Procedure	VOC	Volatile Organic Compound
SVOC	Semivolatile Organic Compound		

Field Sampling Plan / Quality Assurance Project Plan

Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

Section: Appendix A
Revision: 1
Date: June 2010

Appendix A

Field Change Request Form



FIELD CHANGE REQUEST

PPG INDUSTRIES - NON-RESIDENTIAL SITES

CHANGE NUMBER _____

(To be completed by requesting party)

ACO Site Number:	Site Name:

Requesting Party*:	Signature:	Date:

Change Description:

Reason for Change:

Implementation Schedule:

(To be completed by concurring party)

Project Manager*:	Signature:	Date:

Comments:

Technical Contact Name and Affiliation	Phone Number
Tom Cozzi, NJDEP	(609) 633-1408
Prabal Amin, Technical Consultant (Weston Solutions)	(732) 417-5857
Brian McPeak, JCO Site Administrator Project Manager	(732) 216-6364
Brian McGuire, Project Manager, PPG Industries	(412) 492-5683
W. B. Kennedy, Jr., PPG Industries, Remediation Manager	(330) 753-2783
Bob Falotico, AECOM Principal-in-Charge	(978) 589-3183
Scott Mikaelian, AECOM Program Manager	(732) 564-3624
Rich Feinberg, AECOM Field Operations Leader	(732) 233-4552

Field Sampling Plan / Quality Assurance Project Plan

Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

Section: Appendix B
Revision: 1
Date: June 2010

Appendix B

Field Standard Operating Procedures and Project Operating Procedures

APPENDIX B
AECOM FIELD POPs and SOPs
PPG FSP/QAPP

POP or SOP No.	POP or SOP TITLE	SOURCE	ORIGINAL POP or SOP DATE	REVISION NO.	REVISION DATE
PPG 001	Recording of Field Data	AECOM	June 2010	0	N/A
PPG 002	Chain of Custody Procedures	AECOM	June 2010	0	N/A
PPG 003	Packaging and Shipment of Environmental Samples	AECOM	June 2010	0	N/A
PPG 004	Operation and Calibration of a Photoionization Detector	AECOM	June 2010	0	N/A
PPG 005	Surface and Subsurface Soil Sampling Procedures and Boring Log Template	AECOM	June 2010	0	N/A
PPG 006	Monitoring Well Construction and Installation	AECOM	June 2010	0	N/A
PPG 007	Monitoring Well Development	AECOM	June 2010	0	N/A
PPG 008	Low Flow Groundwater Sampling	AECOM	June 2010	0	N/A
PPG 009	Hydraulic Conductivity Tests	AECOM	June 2010	0	N/A
PPG 010	Chip Sampling	AECOM	June 2010	0	N/A
PPG 011	Wipe Sampling	AECOM	June 2010	0	N/A
PPG 012	Concrete Core Sampling	AECOM	April 2010	0	N/A
PPG 013	Sweep Sampling	AECOM	June 2010	0	N/A
PPG 014	Decontamination of Field Equipment	AECOM	June 2010	0	N/A
PPG 015	Procedures for Acid Testing of Green-Grey Mud and COPR	AECOM	March 2010	0	N/A
PPG 016	Field Screening for Grain Size Procedures	AECOM	June 2010	0	N/A
PPG- 017	Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor	AECOM	June 2010	1	N/A
PPG-018	SOP No. 2000-226 Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS)	AECOM	June 2010	1	N/A
PPG-019	Sample Collection of Airborne Hexavalent Chromium using Airmetrics MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2	AECOM	May 2010	0	N/A
PPG-020	Operation and Calibration of a Hydrogen Sulfide Monitor	AECOM	May 2010	0	N/A
PPG-021	Field and Laboratory Measurement of pH	AECOM	December 2009	2	12/29/2009
PPG-022	Field and Laboratory Measurement of Dissolved Oxygen	AECOM	June 2010	2	12/29/2009
PPG-023	Field and Laboratory Measurement of Temperature	AECOM	December 2009	2	12/29/2009
PPG-024	Calibration and Operation of the Mamotte 2020 Turbidimeter	AECOM	May 2010	DRAFT	5/26/2010
PPG-025	Calibration and Operation of the YSI 6-Series Water Quality Meter for Temperature, pH, Dissolved Oxygen, Conductivity and Oxidation Reduction Potential	AECOM	May 2010	DRAFT	5/26/2010
PPG-026	Operation/Field Calibration of the Baseline BTX Model 1030A GC, SOP No. 2600-150A	AECOM	October 2004	1	10/1/2004
PPG-027	Changing the BTX Span Value(s) for an Air Monitoring System, Procedure No. 2000-119	AECOM	May 2008	0	6/4/2008
PPG-028	Standard Operating Procedure for the Niton XL3t 600 XRF	AECOM	June 2010	0	6/15/2010



Project Operating Procedure

Recording of Field Data

Procedure Number: PPG 001

Revision No.: 0

Revision Date: June 2010

POP Author

QA Reviewer

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Project Operating Procedure

Recording of Field Data

POP No.: PPG 001
Revision: 0
Date: June 2010
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Project Operating Procedure

Recording of Field Data

POP No.: PPG 001
Revision: 0
Date: June 2010
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1.0 Scope and Applicability

1.1 Purpose and Applicability

This Project Operating Procedure (POP) provides instructions for recording data when documenting a sample collection event, field measurements, or a site visit. Field data may be recorded in field logbooks, on standardized forms, as annotated maps, as photo documentation, or electronically. Chain-of-custody records are also considered field data; however, these records are specifically addressed in POP PPG 002 Chain of Custody Procedures and POP PPG 003 Packaging and Shipment of Environmental Samples.

2.0 Health and safety considerations

2.1 Not Applicable

3.0 Interferences

3.1 Not Applicable

4.0 Equipment and materials

The following materials are necessary for this procedure:

- Bound field logbook (preferably waterproof, such as Rite-in-Rain™)
- Standardized field data sheets (refer to individual POPs for test pit logs, boring logs, groundwater sample collection logs, etc.)
- Pen or Sharpie™
- Watch or other time-keeping device

The following materials may also be needed:

- Site maps
- Clipboard
- Three-ring binder or equivalent
- Camera
- Hand-held electronic recording device (e.g., PDA, laptop, or tablet PC)

Project Operating Procedure

Recording of Field Data

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5.0 Procedures

5.1 General

Field activities vary widely and no general rules can specify the exact information that must be recorded for each event. However, the field records must contain sufficient detail so that persons going to the site could reconstruct a particular situation without reliance on the collector's memory.

Field logbooks may be supplemented by standardized forms (e.g., well construction and development, sample collection forms, drum logs). In that case, the logbook provides a chronology of events, summary of personnel on site, and a narration of events not covered by the standardized forms. It is recommended that the details recorded on the standardized forms not be replicated in the logbook due to the potential for transcription errors and inconsistencies. References to standardized forms must be included in the logbook.

Entries will be recorded legibly in permanent ink (a black ballpoint pen is preferable) and will be signed and dated. No erasures or obliterations will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark which is initialed and dated by the sampler, and the correct information added.

Pencils should not be used. If a ballpoint pen cannot be used because of adverse weather conditions (rain or freezing temperatures), a fine-point Sharpie™ is an acceptable substitute. If conditions are such that only pencil can be used, an explanation must be included in the logbook and the affected data should be photocopied, signed as verified copy, and maintained in the project files as documentation that the data has not been changed.

Information to be recorded should address the questions of who, where, what, when, how, and why. A specific list of information that should be recorded is included in Table 1.

Entries will be objective, factual, and free of personal feelings or inappropriate language. Cryptic notes and undefined abbreviations or acronyms should be avoided.

Information will be made in as close to real time as possible. Information recorded significantly after the fact must be dated as such.

5.2 Field Logbooks

Field logbooks will be bound water-proof field survey books or notebooks with consecutively numbered pages.

Logbooks will be assigned to field personnel, and will be identified by a unique document number. The logbook should be kept in the field person's possession or in a secure location during field activities and archived in the project files upon completion of the field program.

Logbooks should be specific to a project. Multiple projects should not be included in one logbook because of document retention and evidentiary reasons.

Project Operating Procedure

Recording of Field Data

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The title page of each logbook will contain the following:

- Person to whom the logbook is assigned, AECOM office location, and phone number,
- The logbook number,
- Project name and number, and
- Start and end dates of work covered by the logbook.

Logbook entries documenting sample collection or field measurements must clearly identify the task being completed (for example, water level measurements, headspace readings). Units must be included for all measurements.

For ease of reference, it is recommended that a new page be started for each sampling day and that the time be recorded in the far left column. Each day's entries will be signed and dated by the person making the entries. A diagonal line across the bottom of the page will indicate the end of an entry.

5.3 Standardized Forms

- At a minimum, each form must include a title identifying the activity being documented and the project identification (name and number).
- Each form must be signed and dated by the person completing the form.
- There should be no blank spaces on the form. Each space must be filled in with the information requested or "NA" (not applicable).
- Forms should not be loose, but should be maintained in an organized manner (e.g., clipboards, binders).

5.4 Maps and Drawings

Maps and drawings that document final sampling locations and which are separate from the field logbook must be referenced in the logbook. These maps or drawings must include the project name and number, site identification and location, and must be signed and dated by the person recording the locations.

Maps and drawings must include compass orientation and scale.

5.5 Photographs and Other Photo Documentation

Photo documentation, if permitted at the site, can provide invaluable information on site conditions, sample locations, and the sample itself.

Photographs, videos, or slides must be cross-referenced to entries in the field logbook or on a photo documentation log. Information to be recorded includes name of photographer, date, time, direction faced, description of subject, and sequential number of the photograph and roll number. An indication of scale is also helpful. Image-enhancing techniques (lenses, film) should also be noted.

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5.6 Electronic Files

Electronically captured data may include data logging systems and hand-held electronic recording devices such as PDAs, laptops, or tablet PCs.

Field data that is captured electronically must be cross-referenced in the field logbook. Information to be recorded includes the identity of the person recording the data, instrument make and model number, measurement time and date, and file identification.

Sufficient backup systems must be in place to protect against the loss of data. Electronic files must be saved to a disk or backed up immediately upon completion. The backup disk or other media (CD, flash drive) should then be stored in a secure location separate from the laptop, tablet, or PDA.

Files must be uniquely identified and should be stored in the project files on the network. An unedited version of the file must be maintained and all subsequent manipulations tracked.

6.0 Quality assurance / quality control

Field records provide evidence and support for technical decisions, interpretations, and judgments. It is therefore critical that procedures and systems be in place to ensure that they are legible, identifiable, and retrievable, and protected from loss or damage. In addition, client or regulatory requirements, or the end use of the data (e.g., to support litigation) may determine the format in which the data must be recorded. For example, some projects may require that all field information be recorded in the field logbook and may not allow the use of standardized forms. The requirements necessary to meet the data quality objectives for a particular project will be defined in the site-specific workplan and/or Sampling and Analysis Plan (SAP) hereafter referred to as the project plan.

The field records will be reviewed by the Field Team Leader, or by the Project Manager or his/her designate, for accuracy, completeness, and adherence to the requirements of this POP. At a minimum, this must occur at the end of the field event. For field activities of extended duration, it is recommended that this review occur more frequently (e.g., daily or weekly).

If information recorded in the field is transcribed to another format, the original record must be retained for comparison purposes.

Periodic copying of the field records should be considered to insure against the loss or destruction of the original documents.

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7.0 Data and records management

At the end of the field program, original field records must be placed in the project files and maintained for a certain retention time. The duration of record retention will be determined by project-specific requirements, or, in the absence of project requirements, by AECOM Corporate policy.

8.0 Personnel qualifications and training

The Project Manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan. In the absence of a Field Team Leader, the Project Manager is responsible for ensuring that field records are reviewed and approved as described below.

The Field Team Leader is responsible for reviewing and approving the field records for accuracy, completeness, and conformance to the procedures in this POP.

Field personnel are responsible for recording data according to the procedures outlined in this POP.

9.0 References

POP PPG 002 Chain of Custody Procedures

POP PPG 003 Packaging and Shipment of Environmental Samples

USACE. 2001. Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3. United States Army Corps of Engineers. 1 February 2001.

USEPA. 2004. Contract Laboratory Program Guidance for Field Samplers. OSWER 9240.0-35. EPA540-R-00-003. United States Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. August 2004.

USEPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. United States Environmental Protection Agency, Region 4, Athens, GA. November 2001.

USEPA. 1998. Test Methods for Evaluating Solid Wastes. Physical/Chemical Methods (SW-846). Third edition, including all final updates.

USEPA. 1992. RCRA Ground-water Monitoring: Draft Technical Guidance. United States Environmental Protection Agency, Office of Solid Waste, Washington, DC. November 1992.

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10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Table 1. Specific Information to Be Recorded

Site name and location
Personnel on site (AECOM, clients, site contacts, regulators, oversight personnel, subcontractors, general public)
Results of phone calls, conversations
Chronology of activities, including mobilization, investigatory activities, and demobilization
Weather conditions (initial and any changes; temperature, barometric pressure, wind conditions, precipitation)
Tidal stage (if applicable)
Inspections of equipment, materials, supplies (problems, corrective action)
Subcontractor name, description of services to be provided, and any issues (problems, stand by time)
Description of major equipment (drill rigs, backhoe, survey vessels, sampling platforms)
Field measurements • Description of procedure • Instruments (make, model, serial number, lamp) • Instrument calibration (date, time, personnel, standard, lot number, standard expiration date, true/measured results, units, corrective action, calibration checks and results) • Results (including units of measure, any correction factors applied, documentation of calculations (if applicable)) • Date and time of measurement • Identity of person performing the measurements • Atmospheric conditions (if applicable)
Equipment decontamination procedures and materials
Well information (depth to water, static water depth, condition of well)
Well purging information (procedure, equipment, volumes, pumping rate, criteria for acceptance, time and date)

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Presence and detection of immiscible layers, detection method, sampling method
Sampling information • Procedures and equipment (type and material) • Sample (soil) selection criteria/rationale (PID, staining, water table) • Sample location identification (e.g., boring, well identification) • Sample location description (sketch, GPS coordinates, compass and distance measurements from fixed points). • Sample depth • Sample flow rate/drawdown • Sample description (recovery, moisture, color, odor, texture, turbidity, artifacts) • Sample manipulations (filtration, homogenization, compositing, preservation) • Sample date and time • Unique sample ID • Identity of sampler • Sample parameters, containers (size/type), preservation • QC samples (field duplicates, trip blanks, field/equipment blanks, MS/MSDs, split samples) – include ID, associated field sample, method of collection
Any pertinent field observations that could affect data quality (instrument problems, contamination sources)
Deviations from approved plan (schedule modifications, relocation or elimination of sample locations, change orders), including rationale
Investigation-derived waste (IDW) types, volumes, storage, and disposal
Health and safety (H&S) meetings, personal protective equipment (PPE) worn, H&S monitoring

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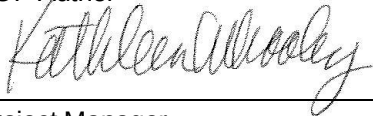
Procedure Number: PPG 002

Revision No.: 0

Revision Date: June 2010



POP Author



Project Manager

Date: 6/28/2010

Date: 6/28/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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1.0 Project Scope and applicability

Chain-of-custody (COC) is defined as the unbroken trail of accountability that ensures the physical security of samples, data, and records (EPA Glossary of Quality-Related Terms). This project operating procedure (POP) describes COC procedures applicable to environmental samples collected by AECOM during field sampling and analysis programs. Custody procedures within the laboratories analyzing the samples are not addressed.

Samples are physical evidence. The objective of COC procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements in legal or regulatory situations.

The National Enforcement Investigations Center (NEIC) of the U.S. Environmental Protection Agency (EPA) defines custody of evidence in the following manner:

- It is in your actual possession;
- it is in your view, after being in your physical possession;
- it was in your possession and then you locked or sealed it up to prevent tampering; or
- it is in a secure area.

This POP is to be utilized to conduct the work identified in the title of this POP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this POP are not applicable to the project, the POP will be updated as a subsequent revision.

2.0 Health and safety considerations

The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

The following may impact the legal or regulatory defensibility of the data:

- The samples are not accompanied by a COC form, and
- The information recorded on the COC form is incomplete, inaccurate, or differs from the information recorded on the sample containers.

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4.0 Equipment and materials

The following materials are relevant to this procedure:

- COC Form (Figure 1)
- Sample labels
- COC tape or seal (Figure 2)
- Indelible pen or Sharpie™
- Clear plastic sealing tape

Materials identified in related POPs may also be needed.

5.0 Procedures

5.1 Pre-sample collection activities

Some measurement methods require preparation of sample collection media or special treatment of sample containers prior to sample collection. In these cases, COC procedures should be initiated with the media preparation or container treatment. This requires that sample identification numbers or media/container identification numbers be assigned. These numbers should be entered on the COC form, leaving room for the subsequent recording of the associated sample numbers. In this variation, the custodian responsible for media preparation or container treatment has the responsibilities outlined in Section 5.2, and the sampler or field sample custodian has the responsibilities stated in Section 5.3 when he or she receives the prepared media or treated containers. There are a number of acceptable approaches to this variation, and the detailed procedures should be defined in the project-specific Quality Assurance Project Plan (QAPP).

5.2 Sample collection phase

- 5.2.1** As few people as possible should handle the samples. For certain programs, it is helpful if a single person is designated as the sample custodian (the person responsible for the care and custody of the samples until they are transferred to the laboratory for analysis).
- 5.2.2** While in the field, sampling personnel should be able to testify that tampering of the samples could not occur without their knowledge. Examples of actions taken may include sealing the sample containers with COC tape or locking the samples in a secure area.
- 5.2.3** If samples are to be shipped by commercial overnight carrier, the field sampler or sample custodian completes a COC form (Figure 1) for each cooler/package of samples and places the original of completed form inside the associated cooler/package before the package is sealed (a copy is retained and kept in the field record files). Each completed COC form should accurately list the sample

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identification numbers of the samples with which it is packaged, and should contain the identification number of the COC tape on the cooler/package. Representatives of commercial carriers are not required to sign the COC form. Refer to PPG POP 003 Packaging and Shipment of Environmental Samples for specific packaging procedures.

- 5.2.4** If samples are hand carried to a laboratory, the person hand carrying the samples is the sample custodian. If the carrier is a different person than the one who filled out the COC form and packaged the samples, then that person transfers custody to the carrier by signing and dating each form in the "Relinquished By" section. The carrier then signs and dates each form in the adjacent "Received By" section. When the carrier transfers the samples to the laboratory, he or she signs and dates each form in the next "Relinquished By" section, and the laboratory sample custodian signs and dates each form in the adjacent "Received By" section.
- 5.2.5** If samples are transmitted to the laboratory by courier, the procedures described in either Section 5.2.3 or 5.2.4 are followed, depending on whether the courier is a commercial courier or laboratory representative, and whether the cooler has been secured by COC seals prior to pick up by a laboratory courier.

5.3 Sample labeling

Labeling of samples occurs at the time of sample collection.

Waterproof, adhesive labels are preferred. Labels should be applied to the container, not the lid whenever possible. Additional interior labels may be required for certain biological samples.

Sample tags may be required for certain projects requiring a strict level of legal or regulatory data defensibility. If tags are utilized, their use will be addressed in the project-specific work plan or QAPP.

Labels should be completed in waterproof, indelible ink. Covering the label with clear plastic tape is recommended to protect the legibility of the label and to prevent the label from detaching from the sample container.

The following information should be recorded on the sample label:

- Project identification (project name and number/client/site)
- Field sample identification code (exactly as it appears on the COC form)
- Sampler's initials
- Date and time of sample collection
- Analyses requested
- Preservation

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5.4 Documentation of sample history

Sample history includes, but is not limited to, preparation of sample containers or collection media (for example, wipes), collection, handling (such as subsampling or compositing), storage, shipment, analytical preparation and analysis, reporting, and disposal.

Refer to PPG POP 001 Recording of Field Data, for specific guidance on documentation of field activities, field measurements, and sample collection.

5.5 Documentation of custody

It is recommended that a COC form (Figure 1 or equivalent) be initiated upon sample collection. If this is not feasible for a particular project, the COC form may be initiated at the time of sample packaging. If this is the case, the sample collection records will serve as the initial custody document and will document the collection of the sample (sample location and identification, date and time of collection, sampler, and parameters to be analyzed, including containers and preservatives).

The following information is recorded on the COC form:

- Project identification (AECOM project number, client, site name and location).
- Page number (for example, 1 of 2, 2 of 2).
- Field sample identification code. This code should be unique to the sampling event and to the program. This code should agree exactly with the field sample identification code recorded on the bottle label.
- Sampling point location (optional if recorded elsewhere in field records).
- Date and time of sample collection.
- Sample matrix (soil, water, air, etc.).
- Preservative.
- Analysis requested.
- Number of containers.
- Type of sample (grab or composite). Identifying if aqueous samples have been filtered in the field is recommended.
- Signature(s) of sampling personnel and signatures of all personnel handling, receiving, and relinquishing the samples.
- Date(s) and time(s) of each sample transfer.
- Sampler remarks. These comments may serve to alert the laboratory to highly contaminated samples or identify quality control (QC) sample requirements.
- Airbill number (if shipped by overnight commercial carrier).
- Laboratory name and address.

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5.6 COC tape numbers.

The COC is filled out completely and legibly in indelible ink. There should be no unexplained blank spaces. Blank lines should be lined out and initialed and dated.

Data will not be obliterated. Corrections are made, if necessary, by drawing a single line through and initialing and dating the error. The correct information is then recorded with indelible ink.

Information on the COC should agree exactly with that recorded on the sample containers. Discrepancies may result in the samples being incorrectly logged into the laboratory or delays in initiating sample analysis.

5.7 Sample receipt and inspection

Upon sample receipt, the coolers or packages are inspected for general condition and the condition of the COC tape. The coolers or boxes are then opened and each sample is inspected for damage.

Sample containers are removed from packing material and sample label information is verified against the COC form.

The condition upon receipt, including any discrepancies or problems, is documented and the COC form is completed by signing and recording the date and time of receipt.

Receipt and inspection of samples by subcontractor analytical laboratories will adhere to written procedures established by the laboratory.

6.0 Quality assurance / quality control

The records generated in this procedure are subject to review by the sampling team leader, project manager, or designee.

The records generated in this procedure will become a part of the evidence reviewed in the data validation process.

7.0 Data and records management

The records generated in this procedure are part of the permanent record supporting the associated measurements and may include, as applicable, the COC forms, sample tags, carrier waybills, and field and laboratory records of sample history (collection, handling, storage, analysis, etc.).

Unanticipated changes to the procedures or materials described in this POP (deviations) should be appropriately documented in the project records.

Records associated with the activities described in this POP should be maintained according to the document management policy for the project.

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8.0 Personnel qualifications and training

8.1 Qualifications and training

The individual executing these procedures should have read, and be familiar with, the requirements of this POP.

No specialized skills are necessary in order to implement these procedures; however, an understanding of the concept of custody is useful.

8.2 Responsibilities

The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

For certain sampling programs, the project manager, sampling team leader, or designee may assign an individual to serve as sample custodian. This individual is responsible for supervising the implementation of COC procedures in accordance with this POP and any project-specific work plans or QAPP.

9.0 References

American Society for Testing and Materials (ASTM). 2004. Standard Guide for Sample Chain-of-Custody Procedures. D 4840-99 (Reapproved 2004).

PPG POP 001 Recording of Field Data

PPG POP 003 Packaging and Shipment of Environmental Samples

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

10.0 Revision history

Revision	Date	Changes
0	June 2010	Original POP

[illegible]

Serial No.

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Figure 2. Chain-of-Custody Tape

No	Signature	_____
	Date	_____



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Packaging and Shipment of Environmental Samples

Procedure Number: PPG 003

Revision No.: 0

Revision Date: June 2010

POP Author

Date: 6/28/2010

Project Manager

Date: 6/28/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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1.0 Project Scope and applicability

1.1 Purpose and Applicability

This Project Operating Procedure (POP) describes the procedures associated with the packaging and shipment of environmental samples. Two general categories of samples exist: environmental samples consisting of water and soil submitted for routine environmental testing, and waste material samples which include non-hazardous solid wastes and/or hazardous wastes as defined by 40 CFR Part 261 submitted for environmental testing or bench/pilot-scale treatability testing. Packaging and shipping procedures will differ for the two sample categories.

This POP is applicable to packaging and shipment of environmental samples submitted for routine environmental testing. Environmental samples are not considered a hazardous waste by definition; therefore, more stringent Department of Transportation (DOT) regulations regarding sample transportation do not apply. Environmental samples do, however, require fairly stringent packaging and shipping measures to ensure sample integrity as well as safety for those individuals handling and transporting the samples.

This POP is designed to provide a high degree of certainty that environmental samples will arrive at their destination intact. This POP assumes that samples will often require shipping overnight by a commercial carrier service, therefore, the procedures are more stringent than may be necessary if a laboratory courier is used or if samples are transported directly to their destination by a sampling team member. Should the latter occur, the procedures may be modified to reflect a lesser degree of packaging requirements.

Respective state or federal agency (regional offices) protocols may require or recommend specific types of equipment for use in sample packaging or a specific method of shipment that may vary from the indicated procedures. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the project work plan, and must be documented in the field project notebook when they occur.

1.2 General Principles

Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

2.0 Health and safety considerations

Sampling personnel should be aware that packaging and shipment of samples involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate health and safety measures must be taken to protect sampling personnel from these potential hazards. The project Health and Safety Plan (HASP) generally addresses

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physical and other potential hazards. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed. In the absence of a HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

Not Applicable

4.0 Equipment and materials

- Sample coolers
- Sample containers
- Shipping labels
- Chain-of-custody records, custody seals
- Bubble wrap
- Vermiculite (granular), or styrofoam pellets
- "Blue Ice" refreezable ice packs, or ice cubes
- Transparent tape, or rubber bands
- Fiber tape
- Duct tape
- Zipper-lock plastic bags
- Trash bags
- Health and Safety supplies
- Equipment decontamination materials
- Field project notebook/pen

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5.0 Procedures

5.1 General Information

5.1.1 Regulatory Information

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when any of the following conditions are applicable:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis;
- Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

5.1.2 Sample Information:

The following information must accompany each shipment of samples on a chain-of-custody form (Figure 1) where each sample has an individual entry:

- Sample collector's name, mailing address and telephone number,
- Analytical laboratory's name, mailing address and telephone number,
- A unique identification of each sample,
- Sample description (matrix),
- Number and type of sample containers,
- Container size,
- Preservative,
- Type and method of analysis requested, and
- Date and time that the samples were collected and prepared for shipping,
- Special handling instructions, including notation of suspected high concentration samples.

5.1.3 Laboratory Notifications:

Prior to sample collection, the Project Manager, or designated alternative must notify the laboratory manager of the number, type and approximate collection and shipment dates for the samples. If the number, type or date of sample shipment changes due to program changes which may occur in the

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field, the Project Manager or alternate must notify the laboratory of the changes. Additional notification from the field is often necessary when shipments are scheduled for weekend delivery.

5.2 General Site Preparation

5.2.1 Small Projects

Small projects of one or two days duration may require packaging and shipment of samples using the field vehicle as the sample preparation area. If sample coolers will be sent via third party commercial carrier service, adequate sample packaging materials should be sent to the project location in advance of sampling or purchased from stores located near the site.

5.2.2 Large Projects

Multi-day or week sampling programs usually require rental of an office trailer or use of existing office/storage facilities for storage of equipment as well as for sample preparation. If possible, a designated area should be selected for storage of unused sample containers/coolers and another area for sample handling, packaging, and shipment. Handling of environmental samples should preferably be conducted in a clean area and away from unused sample containers to minimize the potential for cross contamination. Large quantities of packaging materials may require advance special ordering. Shipping forms/labels may be preprinted to facilitate shipping.

5.2.3 Cooler Inspection and Decontamination

Laboratories will often re-use coolers. Every cooler received at a project location should be inspected for condition and cleanliness. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded as their insulating properties are now compromised. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) can not be fashioned in the field. Replacement coolers may be purchased in the field if necessary.

The interior and exterior of each cooler should be inspected for cleanliness before using it. Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with POP PPG 014 Decontamination of Field Equipment prior to use. Drain plugs should be sealed on the inside with duct tape.

5.2.4 Other Considerations

VOC Samples - Sample containers used for VOC analysis may be grouped into a single cooler, with separate chain-of-custody record, to limit the number of trip blanks required for transportation and analysis. Individual VOC samples may also be placed into Zipper-lock bags to further protect the samples.

Contaminated Samples - Sample containers with presumed high contaminant concentrations should be isolated within their own cooler with each sample container placed into a Zipper-lock bag.

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5.3 Sample Packaging Method

Sample packaging should be conducted in the following manner:

Place plastic bubble wrap matting over the base of each cooler or shipping container as needed. A 2- to 3-inch thickness layer of vermiculite may be used as a substitute base material.

Insert a clean trash bag into the cooler to serve as a liner.

Check that each sample container is sealed, labeled legibly, and is externally clean. Re-label and/or wipe bottles clean if necessary. Clear tape should be placed over the labels to protect them. Wrap each sample bottle individually with bubble wrap secured with tape or rubber bands. Place bottles into the cooler in an upright single layer with approximately one inch of space between each bottle. Do not stack bottles or place them in the cooler lying on their side. If plastic and glass sample containers are used, alternate the placement of each type of container within the cooler so that glass bottles are not placed side by side.

Insert cooler temperature blanks if required.

Place additional vermiculite, bubble wrap, and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling.

Place cubed ice or cold packs in heavy duty Zip-lock type plastic bags, close the bags, and distribute the packages in a layer over the top of the samples. Cubed ice should be double-bagged to prevent leakage. Loose ice should never be used. Cold packs should be used only if the samples are chilled before being placed in the cooler.

Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.

Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain-of-custody form. Sign and date the chain-of-custody tape.

Complete the chain-of-custody form. If shipping the samples involves use of a third party commercial carrier service, sign the chain-of-custody record thereby relinquishing custody of the samples. Shippers should not be asked to sign chain of custody records. If a laboratory courier is used, or if samples are transported to the laboratory, the receiving party should accept custody and sign the chain-of-custody records. Remove the last copy from the form and retain it with other field notes. Place the original (with remaining copies) in a Zipper-lock type plastic bag and tape the bag to the inside lid of the cooler or shipping container.

Close the top or lid of the cooler or shipping container.

Place the chain of custody tape at two different locations (i.e., one tape on each side) on the cooler or container lid and overlap with transparent packaging tape.

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Packaging tape should be placed entirely around the sample shipment containers. A minimum of two full wraps of packaging tape will be placed at least two places on the cooler.

Repeat the above steps for each cooler or shipping container.

5.4 Sample Shipping Method

Packaged sample coolers should be shipped using one of the following options:

5.4.1 Hand Delivery

When a project member is transporting samples by automobile to the laboratory, the cooler should only be sealed with tape. In these cases, chain-of-custody will be maintained by the person transporting the sample and chain-of-custody tape need not be used. Chain-of-custody records should be relinquished upon delivery and a copy of the record retained in the project file.

5.4.2 Laboratory Courier

Laboratory couriers are usually employees of the analytical laboratory receiving the samples. As such, they will accept custody of the samples and must be asked to sign the chain-of-custody records. Chain-of-custody records do not need to be sealed in the cooler although it is recommended that the coolers be sealed with tape. All other packaging requirements generally apply unless otherwise specified in the SAP.

If the laboratory courier is not authorized to accept custody of the samples, or if the requirements of the project plan preclude transfer to the laboratory courier, samples will be handled as described below in Section 5.4.3.

5.4.3 Third Party Courier

If overnight shipment is required, a third party package delivery service should be used. Transport the cooler to the package delivery service office or arrange for package pick-up at the site. Fill out the appropriate shipping form or airbill and affix it to the cooler. Some courier services may use multi-package shipping forms where only one form needs to be filled out for all packages going to the same destination. If not, a separate shipping form should be used for each cooler. Keep the receipt for package tracking purposes should a package become lost. Please note that each cooler also requires a shipping label which indicates point of origin and destination. This will aid in recovery of a lost cooler if a shipping form gets misplaced. Never leave coolers unattended while waiting for package pick-up. Airbills or waybills will be maintained as part of the custody documentation.

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5.5 Sample Receipt

Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the tape number corresponds with the number on the chain-of-custody record. The laboratory will note the condition of the samples upon receipt and will identify any discrepancies between the contents of the cooler and chain-of-custody. The analytical laboratory will then forward the back copy of the chain-of-custody record to the project manager to indicate that sample transmittal is complete.

6.0 Quality assurance / quality control

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific work plan or QAPP. Proper quality assurance requirements should be provided which will specify sample packaging and shipment requirements if variations to the indicated procedures are necessary on a particular project.

The potential for samples to break during transport increases greatly if individual containers are not snugly packed into the cooler. Completed coolers may be lightly shake-tested to check for any loose bottles. The cooler should be repacked if loose bottles are detected.

Environmental samples are generally shipped so that the samples are maintained at a temperature of approximately 4°C. Temperature blanks may be required for some projects as a quality assurance check on shipping temperature conditions. These blanks usually are supplied by the laboratory and consist of a 40-ml vial or plastic bottle filled with tap water. Temperature blanks should be placed near the center of the cooler.

7.0 Data and records management

Documentation supporting sample packaging and shipment generally consists of chain-of-custody records and shipping records. In addition, a description of sample packaging procedures will be written in the field project notebook. All documentation will be retained in the project files following project completion.

8.0 Personnel qualifications and training

Sample packaging and shipment is a relatively simple procedure requiring minimal training and a minimal amount of equipment. It is, however, recommended that initial attempts be supervised by more experienced personnel. Sampling technicians should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present.

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8.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the procedures outlined within this POP and with specific sampling, quality assurance, and health and safety requirements outlined within the project-specific plans. The sampling technician is responsible for proper packaging and shipment of environmental samples and for proper documentation of sampling activities for the duration of the sampling program.

8.2 Sampling Coordinator

Large sampling programs may require additional support personnel such as a sampling coordinator. The sampling coordinator is responsible for providing management support such as maintaining an orderly sampling process, providing instructions to sampling technicians regarding sampling locations, and fulfilling sample documentation requirements, thereby allowing sampling technicians to collect samples in an efficient manner.

8.3 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the activities in accordance with the project plan and this POP. The project manager is also responsible for ensuring that proper arrangements have been made with the designated analytical laboratory. These arrangements include, but are not necessarily limited to, subcontractor agreements, analytical scheduling, and bottle/cooler orders. The project manager may delegate some of these responsibilities to other project staff.

9.0 References

Not applicable.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Serial No.

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Figure 2. Chain of Custody Tape

No	Signature	_____
	Date	_____



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Procedure Number: PPG 004

Revision No.: 0

Revision Date: June 2010

POP Author

Project Manager

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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1.0 Project Scope and applicability

1.1 Purpose and Applicability

This document describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

PIDs routinely used by AECOM personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive- biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range

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from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

1.3 Specifications

Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.

2.0 Health and safety considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

3.0 Interferences

Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

4.0 Equipment and materials

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated.

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- Regulator for calibration gas cylinder
- Approximately 6 inches of Teflon® tubing
- Tedlar bag (optional)
- Commercially-supplied zero grade air (optional)
- "Magic Marker" or "Sharpie" or other waterproof marker
- Battery charger
- Moisture traps
- Spare lamps
- Manufacturer's instructions
- Field data sheets or logbook/pen

5.0 Procedures

5.1 Preliminary Steps

Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

5.2 Calibration

The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.

Calibrate the instrument according to the manufacturer's instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.

If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 5.4).

5.3 Operation

Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

Calibrate the instrument as described in Section 5.2, following the manufacturer's instructions. Record the calibration information in the field records.

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The instrument is now operational. Readings should be recorded in the field records.

When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a “bump” test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.

At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 5.2) except that no adjustment will be made to the instrument. Record the information in the field records.

Recharge the battery after each use (Section 5.4).

When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

5.4 Routine Maintenance

Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer’s instructions for procedures and frequency.

All routine maintenance should be performed in a non-hazardous environment.

5.5 Troubleshooting Tips

One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

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When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or “flooded”. Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

6.0 Quality assurance / quality control

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within $\pm 10\%$. If the instrument responds outside this tolerance, it must be recalibrated.

Checks of the instrument response (Section 5.5) should be conducted periodically and documented in the field records.

7.0 Data and records management

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number.
- Instrument manufacturer, model, and identification number.
- Operator's signature.
- Date and time of operation.
- Calibration gas used.
- Calibration check at beginning and end of day (meter readings before adjustment).
- Span setting after calibration adjustment.
- Meter readings (monitoring data obtained).
- Instances of erratic or questionable meter readings and corrective actions taken.
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 5.5) or similar test.

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8.0 Personnel qualifications and training

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

The field operator is responsible for verifying that the PID is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this POP and the project plan.

9.0 References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SEDS, Enforcement and Investigations Branch, Athens, GA. November 2001.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Project Operating Procedure

Surface and Subsurface Soil Sampling Procedures

Procedure Number: PPG 005

Revision No.: 0

Revision Date: June 2010



POP Author



Project Manager

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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List of Attachments

Attachment 1. Example Boring Log

Attachment 2. En Core® Sampler Sampling Procedures

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1.0 Project Scope and applicability

This project operating procedure (POP) is applicable to soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pit, direct-push, and split-spoon equipment. The procedure includes soil sampling for volatile organic compounds (VOCs). For project specific information (e.g. sampling depths, equipment to be used, and frequency of sampling), refer to the Quality Assurance Project Plan (QAPP) and/or Work Plan, which take precedence over these procedures.

Surface soil sampling, typically considered to be up to two feet below ground surface by EPA standards, is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are considered subsurface samples, although normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval, without the need of extracting excess material above the target depth. These methods dramatically reduce time and cost associated with disposal of material from soil cuttings when compared to test pit sampling. In addition, direct-push and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials such as medium to fine sands, silts, and silty clay soils. Split-spoon sampling works well in all types of soil, but is somewhat slower than direct-push methods. Samples are composited so that each sample jar to be analyzed contains a homogenized representative portion of the interval samples. Due to potential loss of analytes, samples for volatile analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are collected, sealed, and sent directly to the laboratory for analysis. For undisturbed samples, the samples are not homogenized.

2.0 Health and safety considerations

All calibration, maintenance and servicing of soil sampling equipment and instrumentation should be performed in a safe area, away from hazardous locations.

Refer to the Site-Specific Health and Safety Plan for health and safety issues and equipment/instrumentation needed. General health and safety equipment includes a combustible gas indicator (CGI), photo/flame ionization detector (PID/FID), tyvek, gloves, safety glasses, and steel-toe boots.

The Site-Specific Health and Safety Plan should be followed during all site activities. Health and safety meetings should be held each day prior to the commencement of activities.

Before soil sampling commences, appropriate entities (e.g. DigSafe, New Jersey Call Before You Dig, local public works departments, company facilities, etc.) must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer,

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and gas. These entities will be notified by the drilling contractor at least three, but not more than ten business days prior to the start of drilling. Prior to conducting any intrusive operations, existing drawings and other available documentation will be reviewed to evaluate whether potential conflicts with underground utilities exist. If any doubt exists regarding the potential presence of subsurface utilities, a professional utility locating service will be retained to conduct surveys to clear proposed drilling locations. A variety of techniques are available to locate utilities, including ground penetrating radar, electromagnetic conductivity, radio frequency, audio frequency, and passive electric. The efficacy of each technique is dependent on the material used to construct the utility, type of utility, number and type of nearby utilities, and many other factors. As such, it is common practice to use more than one utility locating technique. The requirements for utility location and appropriate techniques will be determined once available information is gathered and evaluated. Soil boring, sampling, and monitoring well locations will be adjusted to avoid underground and overhead utilities. As an added precaution, vacuum boring to a depth of four feet or to the expected invert depth of the deepest utility at any given soil boring or well location may be conducted. However, if vacuum boring is required at certain locations, collection of shallow soil samples for laboratory analysis in the vacuumed zone will still be undertaken from the sidewall area of the vacuumed zone to ensure that shallow surface soil samples will be collected at all proposed off-site investigation locations. The shallow surface soil samples will be collected according to the General Soil Sampling procedures in Section 5.1 and Surface Soil Sampling procedures in Section 5.2. All underground utility identification will be performed in accordance with AECOM SH&E SOP No. 726, located in the site-specific Health and Safety Plan (HASP).

3.0 Interferences

Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and sufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.

Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect sample from soil with possible asphalt. Note the sampling depth(s) and the depths at which the presence of asphalt is suspected.

Instrumentation interferences addressed in POPs for Calibration of the PID, Headspace Screening for Total Volatile Organics, and Equipment Decontamination Procedures must also be considered.

Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

4.0 Equipment and materials

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the QAPP and/or Work Plan.

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The following details equipment typically needed for soil sampling, based on the various methods. See the QAPP and/or Work Plan for specific detail of equipment and supply needs.

Depending on the nature of suspected contamination, field screening instrumentation may be used to direct sampling. Appropriate instrumentation and calibration standards should be available. If volatile organic contaminants are suspected and a PID will be used, refer to the equipment and instrumentation listed in the POP PPG 004 Operation and Calibration of a Photoionization Detector. Equipment in this POP includes but is not limited to:

- PID
- Calibration gas
- Tedlar[®] gas bags (for calibration)

If field screening methods include jar headspace screening for volatile organics, refer to the equipment and procedure in the POP for Headspace Screening for Total VOCs. Equipment in this POP includes but is not limited to:

- Clean soil ("drillers jars") jars
- Aluminum foil

Appropriate decontamination procedures must be followed for sampling equipment. Refer to POP PPG 014 Decontamination of Field Equipment for the proper decon procedures.

The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls
- Stainless steel trowels
- Appropriate sample containers for laboratory analysis
- CGI (as necessary – i.e. sites where explosive gasses may be encountered)
- Personal Protective Equipment (PPE)
- Log Book
- Cooler and ice for preservation
- Stakes and flagging to document sampling location

The following additional equipment is needed for volatile organic sampling:

- Electronic pan scale and weights for calibration
- Syringes or other discrete soil core samplers

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The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

The following additional equipment may be needed for soil sampling from split-spoon equipment:

- Tape measure or folding carpenter's rule for recording the length of soil recovered in the split-spoon.

All subsurface drilling equipment will be provided and maintained by the subcontractor.

5.0 Procedures

5.1 General Soil Sampling Procedure for All Soil Sampling Methods

1. Record the weather conditions and other relevant on-site conditions.
2. Select the soil sampling location, clear vegetation if necessary, and record the sampling location identification number and pertinent location details.
3. Verify that the sampling equipment is properly decontaminated, in working order, and situated at the intended sampling location.
4. Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. Cover surfaces onto which soils or soil samplers will be placed (i.e. tables with polyethylene sheeting).
5. Follow the appropriate procedures listed below for either surface, split-spoon, direct push, or test pit sample collection (5.2, 5.3, 5.4, and 5.5 respectively).
7. For projects located in New Jersey, see Section 5.6 for New Jersey-specific requirements for soil samples collected for volatile organics analysis.
6. Collect soil samples according to procedures listed in Section 5.7 depending on project specific analyses.
7. Record date/time, sample ID, and sample descriptions in the field logbook for field form. A sketch or description of the location should also be recorded so the sample location can be re-constructed.
8. Immediately label (and tag if required) the sample containers and place them on ice, if required for preservation. Complete the COC form(s) as soon as possible.
9. Dispose of all excess excavated soil in accordance with the site-specific QAPP and/or Work Plan. Soils may either be segregated based on level of contamination, stockpiled, drummed for disposal, or put back into the hole from which the soil came.
10. Upon completion, clearly label a wooden stake or pin flag with indelible ink and stake or flag the sampling location.

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11. Decontaminate the sampling equipment according to POP PPG 014 Decontamination of Field Equipment.

5.2 Surface Soil Sampling

The following procedures are to be used to collect surface soil samples. Surface soils are considered to be soils that are up to one (1) foot below ground surface, though state regulations and project objectives may define surface soils differently; therefore, the QAPP and/or Work Plan should be consulted for direction on the depth from which to collect the surface soil samples. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs will be taken as needed or as specified in the QAPP and/or Work Plan.

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from excavation with a trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless steel bowl for homogenizing. Monitor the excavation as required in the site-specific HASP and/or QAPP and/or Work Plan (i.e., PID).

The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials)
 - Other relevant soil characteristics
 - Site features
 - Screening results
 - Predetermined sampling approach (i.e. grid or random)
 - Sampling objectives as provided in the QAPP and/or Work Plan
3. For VOC analyses, collect representative soil samples directly from the recently-exposed sidewall of the excavation using a syringe or other soil coring device (e.g., TerraCore[®], EnCore[®]). Follow procedures in Section 5.7.1 or 5.7.2 for VOC sampling.
 4. Collect sufficient soil to fill all remaining sample jars into a stainless steel bowl. Homogenize the soil samples to obtain a uniform soil composition which is representative of the total soil sample collected according to the following procedure:
 - a) Remove all rocks and non-soil objects using a stainless steel spoon or scoop. However, if the soils to be sampled contain chromite ore processing residue (COPR) nodules or chromate chemical production waste (CCPW) materials, **do not** remove these CCPW “non-soil objects” and document their presence in the field logbook.
 - b) Form a cone shaped mound with the sample material, then flatten the cone and split the sample into quarters.

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- c) Use the stainless steel spoon/scoop to mix the quarter samples that are opposite.
- d) After mixing the opposite quarters, reform the cone shaped mound.
- e) Repeat this procedure a minimum of five (5) times, removing any non-soil objects and breaking apart any clumps.

5.3 Split-Spoon Sampling

1. At each boring location, the frequency and depth of split-spoon samples will be determined from the QAPP and/or Work Plan. Split-spoon samples may be collected continuously, intermittently, or from predetermined depths.
2. Standard penetration tests will be conducted according to ASTM D1586-99, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils to record the number of hammer blows required to advance the sampler each 6 inches of depth in the boring log.
3. Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.
4. After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using a PID/FID. Scan the recovered soil by making a hole in the soil and placing the PID in or very close to the hole. Be very careful not to get soil on the tip of the PID. Take these PID scan readings every 6 inches along the split-spoon. Note any staining and/or presence of water. Record the highest PID reading and the depth at which it was observed along with other observations. If the project is in New Jersey, see Section 5.6 for state-specific procedures on determining where to collect VOC samples. All VOC samples should be collected (see Section 5.7.1 and 5.7.2) prior to logging the sample.
5. If headspace screening for VOCs is required in the QAPP and/or Work Plan, collect a soil sample and perform headspace screening according to the POP for Headspace Screening for Total VOCs.
6. Soils collected using the split-spoon sampler will be logged by the AECOM field representative using the procedure described in ASTM D2488-00 Standard Practice for Description and Identification of Soils. In addition to the description of the soils, blow counts, sample recovery, PID readings (headspace), and the depth to water will also be recorded.
7. Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 5.2.
8. The QAPP and/or Work Plan may specify that intervals to be sent to the laboratory be determined by visual observation and/or highest PID screening or headspace results,

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which can only be determined once the boring is complete. In this instance, a VOC sample should be collected at each interval. The remainder of the soil from that interval will be set aside in a clearly labeled stainless steel bowl covered with aluminum foil. Once the boring has been completed and the sample interval has been determined, the remainder of the soil can be homogenized according to Section 5.2 and submitted for laboratory analysis.

9. Once a boring is complete and all required samples have been collected, the boring may be filled or a monitoring well or piezometer may be installed. Borings must be completed as specified in the QAPP and/or Work Plan.

5.4 Direct Push Sampling

At each boring location, the frequency of direct-push samples will be determined from the QAPP and/or Work Plan. Typically, samples with direct-push equipment are collected in 4 ft intervals.

1. Sample using either 2' or 4' Macro-Core samplers with acetate liners to obtain discrete soil samples at specific depths.
2. Cut open the acetate liner, and immediately scan the recovered sampler for VOCs using a PID/FID. Note any staining and/or presence of water. Record the highest PID reading and the depth at which it was observed along with other observations. If the project is in New Jersey, see Section 5.6 for state-specific procedures on determining where to collect VOC samples. All VOC samples should be collected (see Section 5.7.1 and 5.7.2) prior to logging the sample.
3. If required in the QAPP and/or Work Plan, collect a soil sample and perform headspace screening according to the POP for Headspace Screening for Total VOCs.
4. Soils collected using the direct-push sampler will be logged by the AECOM field representative using the procedure described in ASTM D2488-00 Standard Practice for Description and Identification of Soils. In addition to the description of the soils and sample recovery, PID readings (headspace), and the depth to water will also be recorded.
5. Collect the remainder of the sample into a stainless steel bowl. Homogenize the soil collected so that the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 5.2.
6. Once a boring is complete and all required samples have been collected, the boring may be filled or a monitoring well or piezometer may be installed. Borings must be completed as specified in the QAPP and/or Work Plan.

5.5 Test Pit Sampling

1. Excavate the test pit to the desired depth.
2. Using the excavator bucket, collect soil samples as specified in the QAPP and/or Work Plan. Collect a sample and perform screening analyses as required by the QAPP and/or Work Plan. If VOCs contamination is suspected,

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perform headspace screening according to the POP for Headspace Screening for Total VOCs.

3. Collect the sample from center of the bucket to avoid potential contamination from the bucket.
4. VOC samples should also be collected from an undisturbed section soil in the excavator bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples. VOC samples should be collected according to the procedures in Section 5.7.1 and 5.7.2.
5. Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in section 5.2.
6. Dispose of all excavated soil according to the QAPP and/or Work Plan.

5.6 Special considerations for projects in New Jersey

5.6.1 All soil samples to be analyzed for volatile organics shall be collected as follows:

- A bulk sampling device that will collect an intact core (e.g., split-spoon) shall be used to minimize contaminant loss during sampling.
- Each core shall be field screened with a properly calibrated direct reading instrument equipped with a PID, flame ionization detector (FID), or other suitable instrument capable of detecting the contaminants pursuant to N.J.A.C. 7:26E-2.1(b) to select samples for volatile organics analysis using the following criteria if field measurement readings are above background:
 - o The coring shall be extended until either background readings are achieved, ground water is encountered, or bedrock is encountered; and
 - o An undisturbed sample from the six-inch interval registering the highest field measurement reading shall be collected, at a minimum, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4.
- If all intervals register the same field measurement reading or all field measurement readings do not exceed background:
 - o The coring shall be extended to ground water, bedrock, or 10 feet, whichever is encountered first;
 - o One undisturbed sample at a minimum, from the six-inch interval at the bottom of the soil boring shall be collected, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4; and

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- o Contaminants that cannot be detected with field-screening instruments shall be sampled in accordance with the requirements at N.J.A.C. 7:26E-3.4(a).
- In all cases, samples shall be collected in discrete six inch increments. If more or less than a six inch increment is sampled because of poor sample recovery or other field logistical problems, an explanation shall be provided in the soil log.

5.7 Sample Collection Methods

5.7.1 Volatile Organics Sampling – Closed System Vials with Organic Free Water (low-level) and Methanol (high level)

For soils collected for analyses of volatile organics, including Volatile Petroleum Hydrocarbons (VPH) or other purgable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include four 40-mL VOA vials and one soil jar. Two 40-mL VOA vials will contain 5 mL organic free water (OFA) and magnetic stir bars (i.e., low level vials), and two VOA vials will contain 15 mL methanol with no magnetic stir bar (i.e., high level vial). These vials are provided by the laboratory and are pre-weighed. No sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the VOA vial using indelible marker. The soil jar is provided for percent solids determination. For VOC or VPH analyses, samples are collected prior to sample homogenization. Collect the VOC sample in accordance with the procedure described below.

1. Prior to sampling, weigh the 40-mL VOA vials received from the laboratory. Record this weight to the nearest 0.1 gram. This weight will be used to determine if the proper amount of soil has been added to the vial. In addition, the weight should be within 0.2 grams of the tare weight on the sample label. If the weight is off by more than 0.2 grams, do not use this vial as some of the OFA may have been lost.
2. Determine the soil volume necessary for the required sample weight, typically 5 grams:
 - a) Prepare a 5 mL sampling corer (e.g., Terra Core[®]) or cut-off plastic syringe.
 - b) Tare the sampler by placing it on the scale, and zeroing the scale.
 - c) Draw back the plunger to the 5 gram mark or 5mL (5cc) mark on cut-off syringe, and insert the open end of the sampler into an undisturbed area of soil with a twisting motion, filling the sampler with soil. Note the location of the plunger with respect to the milliliter (cc) or other graduation printed on the sampler.

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- d) Weigh the filled sampler, and remove or add soil until the desired weight is obtained. Note the location of the plunger which corresponds to this weight. Do not use this sample for laboratory analysis.
 3. Once the required soil volume has been determined, pull the plunger back to this mark and hold it there while filling the syringe for each sample.
 4. Collect 5 grams of soil using the cut-off syringe or Terra Core[®] sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe[®] and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.
 5. Gently swirl the vial so that all of the soil is fully wedged with the preservative.
 6. Weigh the 40 mL vial with the sample contained. Sample weight should be within 0.5 grams ($\pm 10\%$) of the target weight. Record the sample weight.
 7. Fill the other low level 40 mL VOA vial in this manner,
 8. Repeat the process for the high level VOA vials.
- NOTE: Depending on the laboratory, some high level VOA vials contain 10 mL or 15 mL of methanol. If this is the case, either 10 grams total or 15 grams total, respectively, should be extruded into the high level VOA vial (i.e., 2 or 3 Terra Core[®] volumes). In other words, the mass of soil in grams should be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).
9. Collect any additional QC sample collected (e.g., field duplicate, MS, and MSD) in the same manner as above.
 10. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

5.7.2 Volatile Organics Sampling – En Core[®] Samplers

This preservation and sampling method employs the use of a small-diameter core sampler known as the En Core[®] sampler. The En Core[®] sampler is a one-time-use, volumetric sampling, storage and transportation device. It is designed to collect and store soil samples for transportation to the laboratory.

Soil should be collected using the En Core[®] sampler in accordance with the manufacturer's recommendations. A specially designed "T" handle, available from the manufacturer, is used to push the En Core[®] sampler into the soil matrix and to lock the sampler after collection. A copy of the manufacturer's instructions is provided as Attachment 2 of this POP.

A minimum of three (3) individual 5 gram En Core[®] samplers must be collected for each soil sample. Upon sample collection, label each En Core[®] sampler cap with the label provided by the manufacturer and return it to the airtight, resealable foil package. The 4-oz glass jar must be filled with soil from the same area from which

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the En Core[®] samplers were collected for the percent moisture determination. En Core[®] samplers should be iced (cooled to 4°C [+ 2°C]) or frozen (-7°C and -15°C) for later shipment to the laboratory. En Core[®] samplers can be shipped directly to the laboratory for VOC analysis; however, laboratory must extrude the soil from the En Core[®] sampler and analyze, chemically preserve or freeze the soil within 48 hours of sample collection. The soil samples must be extruded from the En Core[®] sampler into appropriate sample containers using a specially designed "T" handle push-rod tool available from the manufacturer. Soil cannot be scooped out of the En Core[®] sampler using a trowel or spatula as this can cause a significant loss of VOCs. The holding time for soil stored in an En Core[®] sampler can be extended if the soil is extruded by the laboratory within 48 hours to a sealed vial and frozen or chemically preserved until actual analysis. This method is appropriate for low- and medium-level analysis under USEPA CLP SOW and low and high-level analysis for USEPA SW846 Methodologies.

En Core[®] samplers must be stored in a contaminant free environment before use and during shipment. It is the responsibility of the field sampling team and sample container provider (i.e., the laboratory) to ensure contaminant free sample container integrity.

5.7.3 Soil Sampling Method (All other analyses except VOC/VPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 5.2. Collect sufficient volume to fill all of the remaining sample containers at least $\frac{3}{4}$ full for all other analyses. Homogenize the soil in a decontaminated stainless steel bowl, removing rocks, sticks, or other non-soil objects (with the exception of COPR nodules and CCPW materials) and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

6.0 Quality assurance / quality control

Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

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7.0 Data and records management

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site log books with permanent ink. Data recorded will include the following:

- weather conditions
- arrival and departure time of persons on site
- instrument type, lamp (PID), make, model and serial number
- calibration gas used
- date, time and results of instrument calibration and calibration checks
- sampling date and time
- sampling location
- samples collected
- sampling depth and soil type
- deviations from the procedure as written
- readings obtained

8.0 Personnel qualifications and training

All field staff are required to be OSHA 40-Hour Health and Safety certified with a current annual 8-hour refresher prior to engaging in any field collection activities.

Prior to implementation of these soil sampling procedures, the field sampler will be instructed by a person experienced with these procedures. The field staff will demonstrate to the field team leader the proper set-up, calibration, operation, and routine maintenance of the instrumentation and hand-held equipment, as well as the proper procedures, used to collect soil samples.

9.0 References

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

AECOM SH&E SOP No. 726 Identifying Underground Utilities

POP PPG 004 Operation and Calibration of a Photoionization Detector

POP PPG 014 Decontamination of Field Equipment

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ASTM D1586-99, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D2488-00 Standard Practice for Description and Identification of Soils

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

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Surface and Subsurface Soil Sampling Procedures

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Attachment 1. Example Boring Log

		Client:						Boring ID:			
		Project Number:									
		Site Location:						Sheet: 1 of 1			
		Coordinates:						Elevation:			
		Drilling Method:						Monitoring Well Installed:			
Sample Type(s):						Boring Diameter:		Screened Interval:			
Weather:						Logged By:		Date/Time Started:			
Drilling Contractor:						Ground Elevation:		Date/Time Finished:			
						Water Level:					
Depth (ft)	Geologic sample ID	Sample Depth (ft)	Blows per 6"	Recovery (inches)	Headspace (ppm)	U.S.C.S.	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)			Lab Sample ID	Lab Sample Depth (ft.)
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
NOTES:							Date	Time	Depth to groundwater while drilling		
Checked by _____							Date: _____				

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**Surface and Subsurface Soil Sampling
Procedures**

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Attachment 2. En Core® Sampler Sampling Procedures

Disposable En Core® Sampler



En Novative Technologies, Inc.

1795 Industrial Drive

Green Bay, WI 54302

Phone: 920-465-3960 • Fax: 920-465-3963

Toll Free: 888-411-0757

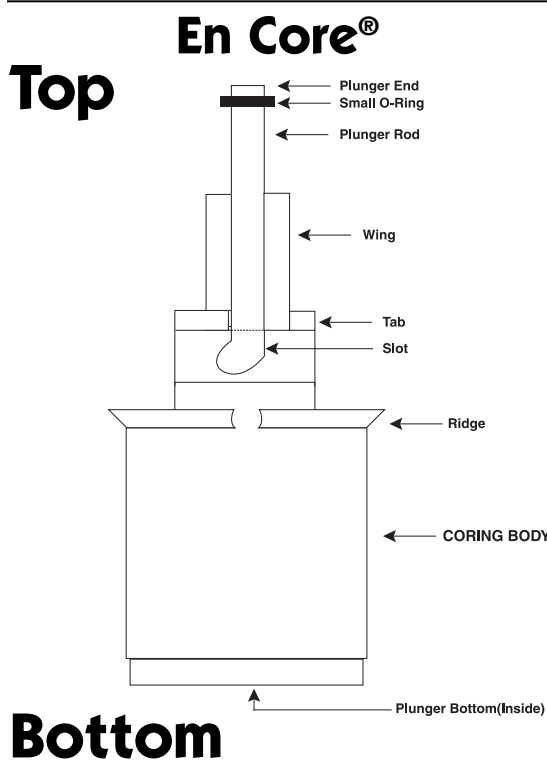
www.ennovativetech.com

Sampling Procedures

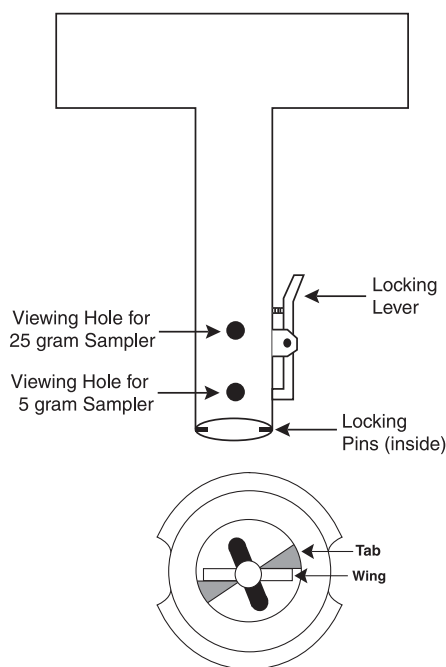
NOTE:

1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.
2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!
3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)

Using The En Core® T-Handle

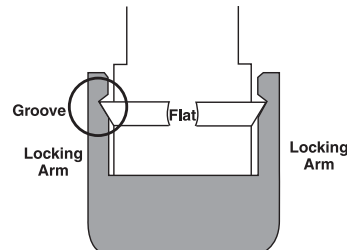


En Core® T-Handle



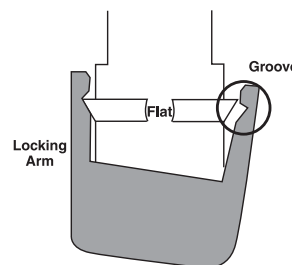
Sampler Correctly Capped

(Locking arm grooves seated over coring body ridge.)



Sampler Incorrectly Capped

(Cap appears crooked; locking arm grooves not fully seated over coring body ridge.)



BEFORE TAKING SAMPLE:

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

2. Depress **locking lever** on En Core T-Handle. Place coring body, **plunger end first**, into open end of T-Handle, *aligning the (2) slots on the coring body with the (2) locking pins in the T-Handle*. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.

TAKING SAMPLE:

3. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle **viewing hole**. Remove Sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while it is still on T-handle. Push cap over **flat** area of **ridge** and twist to lock **cap** in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram).**

PREPARING SAMPLER FOR SHIPMENT:

5. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.

Disposable En Core® Sampler

EXTRUSION PROCEDURES

USING THE En Core® EXTRUSION TOOL

CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.

1. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.

2. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)

3. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. Remove cap from Sampler by rotating cap until locking arms are aligned with the flat area of ridge and pull cap off. To release soil core push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE® SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

PRINCIPLE OF USE. The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

QUALITY CONTROL. The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

WARRANTY. En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b) Samplers that have been opened, taken apart or mishandled; (c) Samplers not used in accordance with the directions; and (d) Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

LIMITATION OF LIABILITY. IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES

BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE, DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.



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1795 Industrial Drive
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Toll Free: 888-411-0757

www.ennovativetech.com

The En Core™ Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending.

* Viton® is a registered trademark of DuPont Dow Elastomers.



Project Operating Procedure

Monitoring Well Construction and Installation

Procedure Number: PPG 006

Revision No.: 0

Revision Date: June 2010

POP Author

Date: 6/28/2010

Project Manager

Date: 6/28/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Project Operating Procedure

Monitoring Well Construction and Installation

POP No.: PPG 006
Revision: 0
Date: June 2010
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List of Attachments

Attachment 1. Example Monitoring Well Construction Log

Project Operating Procedure

Monitoring Well Construction and Installation

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1.0 Project Scope and applicability

1.1 Purpose and Applicability

This Project Operating Procedure (POP) provides guidance for installing groundwater monitoring wells. Monitoring wells are installed to monitor the depth to groundwater, to measure aquifer properties, and to obtain samples of groundwater for chemical analysis.

This POP is applicable to installation of single monitoring wells within a borehole. The construction and installation of nested, multilevel or other special well designs is not covered within this POP as these type of wells are not frequently constructed. This POP applies to both overburden and bedrock monitoring wells.

Some states and EPA Regions have promulgated comprehensive guidelines for monitoring well construction and for subsurface investigation procedures. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the applicable Remedial Investigation Work Plan, and must be documented in the field project notebook when they occur.

1.2 General Principles

Monitoring well construction and installation generally involves drilling a borehole using conventional drilling equipment, installing commercially available well construction and filter/sealing materials, and development of the well prior to sampling. This POP covers well construction and installation methods only. Borehole drilling and well development methods are covered under POP PPG 005 Surface and Subsurface Soil Sampling Procedures and POP PPG 007 Monitoring Well Development, respectively.

1.3 Quality Assurance Planning Considerations

Field personnel should follow specific quality assurance guidelines as outlined in the site-specific QAPP.

The following aspects of monitoring well design and installation procedures depend on project-specific objectives which are addressed in the QAPP and in the Remedial Investigation Work Plan:

- Borehole drilling method and diameter,
- Type of construction materials for well screen, riser, filter pack and seals,
- Diameter of well materials,
- Length of well screen,
- Location, thickness, and composition of annular seals, and
- Well completion and surface protection requirements.

Project Operating Procedure

Monitoring Well Construction and Installation

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2.0 Health and safety considerations

Monitoring well installation may involve chemical hazards associated with materials in the soil or groundwater being investigated; and always involves physical hazards associated with drilling equipment and well construction methods. When wells are to be installed in locations where the aquifer and/or overlying materials may contain chemical hazards, a Health and Safety Plan (HASP) must be prepared and approved by the Health and Safety Officer before field work commences. This plan must be distributed to all field personnel and must be adhered to as field activities are performed.

3.0 Interferences

3.1 Not Applicable

4.0 Equipment and materials

4.1 Well Construction Materials

Well construction materials are usually provided by the drilling subcontractor and most often consist of commercially available flush-threaded well screen and riser pipe constructed of PVC or stainless steel with a minimum 2-inch inside diameter. The length of the screen and the size of the screen slots should be specified in the Remedial Investigation Work Plan.

4.2 Well Completion Materials

Well completion materials include silica sand, bentonite, cement, protective casings and locks. Completion materials are generally provided by the drilling subcontractor.

4.3 Other required materials include the following:

- Potable water supply
- Fiberglass or steel measuring tape
- Water level indicator
- Well construction diagrams (A typical well construction diagram is presented as Figure 1)
- Waterproof marker or paint (to label wells)
- Health and Safety supplies
- Equipment decontamination materials
- Field project notebook/pen

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5.0 Procedures

5.1 General Preparation

5.1.1 Borehole Preparation

Standard drilling methods should be used to achieve the desired drilling/well installation depths specified in the Remedial Investigation Work Plan. Soil sampling, if conducted, should be conducted in accordance with POP PPG 005 Surface and Subsurface Soil Sampling Procedures.

The diameter of the borehole must be a minimum of 2 inches greater than the outside diameter of the well screen or riser pipe used to construct the well. This is necessary so that sufficient annular space is available to install filter packs, bentonite seals, and grout seals. Bedrock wells may require reaming after coring in order to provide a large enough borehole diameter for well installation.

Rotary drilling methods requiring bentonite-based drilling fluids, if selected, should be used with caution to drill boreholes that will be used for monitoring well installation. The bentonite mud builds up on the borehole walls as a filter cake and permeates the adjacent formation, potentially reducing the permeability of the material adjacent to the well screen.

5.1.2 Well Material Decontamination

Although new well materials (well screen and riser pipe) generally arrive at the site boxed and sealed within plastic bags, it is sometimes necessary to decontaminate the materials prior to their use. Well materials should be inspected by the Task Leader upon delivery to check cleanliness. If the well materials appear dirty, or if local or regional regulatory guidance requires decontamination, then well material decontamination should be performed by the drilling subcontractor.

5.2 Well Construction Procedure

5.2.1 Depth Measurement

Once the target drilling depth has been reached, the drilling subcontractor will measure the total open depth of the borehole with a weighted, calibrated tape measure. Adjustments of borehole depth can be made at this time by drilling further or installing a small amount of sand filter material to achieve the desired depth. If drilling fluids were used during the drilling process, the borehole should be flushed at this time using potable water. The water table depth may also be checked with a water level indicator if this measurement cannot be obtained with the calibrated tape.

5.2.2 Centralizers

Centralizers may be used but are not required. Centralizers are especially helpful for deep well installations where it may be difficult to position the well by hand.

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Centralizers may not be necessary on shallow water table well installations where the well completion depth is within 25 feet of the ground surface.

5.2.3 Well Construction

The well screen and riser pipe generally are assembled by hand as they are lowered into the borehole. Before the well screen is inserted into the borehole, the full length of the slotted portion of the well screen as well as the unslotted portion of the top and bottom of the screen should be measured with the measuring tape. These measurements should be recorded on the well construction diagram. The maximum length of well screen (or open borehole in bedrock wells) for monitoring wells is 25 feet. In cases where low-flow sampling is intended in newly installed monitoring wells, the wells should be installed with no more than five feet of screen.

After the above measurement has been taken, the drilling subcontractor may begin assembling the well. As the assembled well is lowered, care should be taken to ensure that it is centered in the hole if centralizers are not used. The well should be temporarily capped before filter sand and other annular materials are installed.

5.2.4 Filter Sand Installation

The drilling subcontractor should fill the annular space surrounding the screened section of the monitoring well to at least 1 foot above the top of the screen with an appropriately graded, clean silica sand or fine gravel. In general, the filter pack should not extend more than 3 feet above the top of the screen to limit the thickness of the monitoring zone. If coarse filter materials are used, an additional 1-foot thick layer of fine sand should be placed immediately above the filter pack to prevent the infiltration of sealing components (bentonite or grout) into the filter pack. As the filter pack is placed, a weighted tape should be lowered in the annular space to verify the depth to the top of the layer. Depending upon depth, some time may be required for these materials to settle. If necessary, to eliminate possible bridging or creation of voids, placement of the sand pack may require the use of a tremie pipe. Tremie pipe sandpack installations are generally suggested for deep water table wells and for wells which are screened some distance beneath the water table.

5.2.5 Bentonite Seal Installation

An approximate 1-foot thick layer of slurry seal will be installed by the drilling subcontractor immediately above the well screen filter pack in all monitoring wells. The purpose of the seal is to provide a barrier to vertical flow of water in the annular space between the borehole and the well casing. Bentonite is used because it swells significantly upon contact with water. As an option, powdered bentonite may be mixed with water into a very thick slurry and a tremie pipe used to inject the seal to the desired depth.

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5.2.6 Annular Grout Seal Installation

This grout seal should consist of a bentonite/cement mix with a ratio of bentonite to cement of between 1:5 and 1:20. The grout ratio should be chosen based on site conditions with a higher percentage of bentonite generally used for formations with higher porosity. A mud balance should be used if a specific mud density is required at a particular site. Grout slurry should be pumped into the annular space using a side-discharging tremie pipe located about 2 feet above the sand pack. Side discharge will help preserve the integrity of the sand pack.

In situations where the monitoring well screen straddles the water table, the seal will be in the unsaturated zone. Optionally, seals in this situation may be a cement/bentonite mixture containing up to 10 percent bentonite by weight. This type of mixture shall be tremied to the desired depth in the borehole.

Drill cuttings, even those known not to be contaminated, will not be used as backfill material.

5.2.7 Well Completion

The drilling subcontractor will cut the top of the well to the desired height and install a vented (if possible), locking cap. The upper portion of the well casing can optionally be drilled to allow venting. Well casings are usually cut to be a certain height above ground surface (typically 2.5 to 3 feet) or are cut to be flush with the ground surface.

5.2.8 Protective Casing/Concrete Pad Installation

The drilling subcontractor will install a steel guard pipe on the well as a protective casing. The borehole around the guard pipe will be dug out to an approximate 2 to 3-foot radius to a minimum depth of 1 foot at the center and 6 inches at the edges. After installing the protective casing, the excavation will be filled with a concrete/sand mix. The surface of the concrete pad will be sloped so that drainage occurs away from the well. Flush-mount protective casings may not require an extensive concrete pad and should be completed such that they are slightly mounded above the surrounding surface to prevent surface water from running over or ponding on top of the casing. It should be noted, however, that in areas subject to snowfall, flush-mount casings may have to be installed so that they are entirely flush with the ground surface as they may be damaged by snow plows.

Above-ground protective casings should also be vented or should have non-air tight caps. Flush mount installations should not be vented. Installation of additional guard pipes may be necessary around above-ground well completions in traffic areas. Protective casings should be lockable to prevent unauthorized access.

5.2.9 Well Numbering

The Task Leader will ensure that each well casing is identified with an indelible marker, paint, or stamp. This is particularly important with nested or paired wells to

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distinguish between shallow and deep wells. The well should be labeled on both the outside of the protective casing and inside beneath the protective casing lid.

5.2.10 Measuring Point Identification

The Task Leader will ensure that the measuring point from which water level measurements will be made at each well is marked along the upper edge of the well casing. PVC wells can easily be notched with a pocket knife or saw. Stainless steel wells (or PVC wells) can be marked with a waterproof marker on the outside of the well casing with an arrow pointing to the measuring point location. The measuring point is the point which will require surveying during the well elevation survey task.

5.2.11 Well Measurements

Upon completion, the following well measurements should be taken and recorded on the well construction diagram (Figure 1):

- Depth to static water level if water level has stabilized,
- Total length of well measured from top-of-well casing,
- Height of well casing above or below ground surface,
- Height of protective casing above ground surface,
- Depth of bottom of protective casing below ground surface (may be estimated).

Well screen filter pack, bentonite seal and annular seal thicknesses and depths should also be recorded on the well construction diagram.

5.2.12 Disposal of Drilling Wastes

Drill cuttings and other investigation-derived wastes such as drilling mud or well development/purge water must be properly contained and disposed of. Site-specific requirements for collection and removal of these waste materials should be outlined within the Remedial Investigation Work Plan. Containment of these materials should be performed by the drilling subcontractor.

5.2.13 Well Development

After installation of a well and prior to use of the well for water-level measurements or collection of water quality samples, development of the well shall be undertaken in accordance with POP PPG 007 Monitoring Well Development. Well development will be performed by the drilling subcontractor.

5.2.14 Well Elevation Survey

At the completion of the well installation program, all monitoring wells are to be surveyed by a surveying subcontractor in accordance with NJDEP requirements.

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5.2.15 Double Casing

In boreholes where a shallow water-bearing zone is encountered above a deeper water bearing zone, casing will be installed to prevent downward migration between the water-bearing zones in accordance with N.J.A.C. 7.9D. The casing will be installed to a sufficient depth to prevent migration between the water-bearing zones, and the annular space between the casing and borehole, as well as the annular space between water-bearing zones, will be grouted. The grout will be allowed to set for a minimum of 24 hours prior to further advancement of the borehole.

In accordance with the NJDEP FSPM, installation of well couplets (e.g., shallow and deep) and well triplets (e.g., shallow, intermediate and deep) will be installed in separate boreholes since grout is less likely to invade well intakes (screens) if the wells are installed in separate boreholes. Care will be taken to assure that any confining unit between aquifer zones is not breached without providing adequate protection of underlying/overlying aquifers.

In accordance with Subchapter 2 (Requirements and Procedures for the Construction, Installation, Operation and Maintenance of Wells) NJAC 7:9D-2.1(a), *"monitoring wells, air sparging wells, soil vapor extraction wells, recovery wells, and wells or well points installed for environmental remediation projects"* are considered Category 3 wells for the purposes of establishing general and specific well construction standards¹.

In accordance with NJAC 7:9D-2.4, the following specific requirements also apply to Category 3 wells in unconsolidated aquifers where a confining layer(s) exist shall be constructed in accordance with the following:

1. The screened interval or the filter pack shall not extend across the interface of a confining layer.
2. Monitoring wells will be constructed in accordance with Figure 6.14 on Page 173 of 188 of the August 2005 NJDEP Field Sampling Procedures Manual (see below). The outer casing shall be driven to a minimum of one foot below the drilled borehole.

¹ The requirements in NJAC 7:9D-2.1(b)1, requiring a minimum of 20 feet of outer-most well casing into the confining layer or to the base of the confining layer is intended for water supply wells and in areas where there is salt water intrusion where double casing is needed to protect the water supply.

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Field Sampling Procedures Manual

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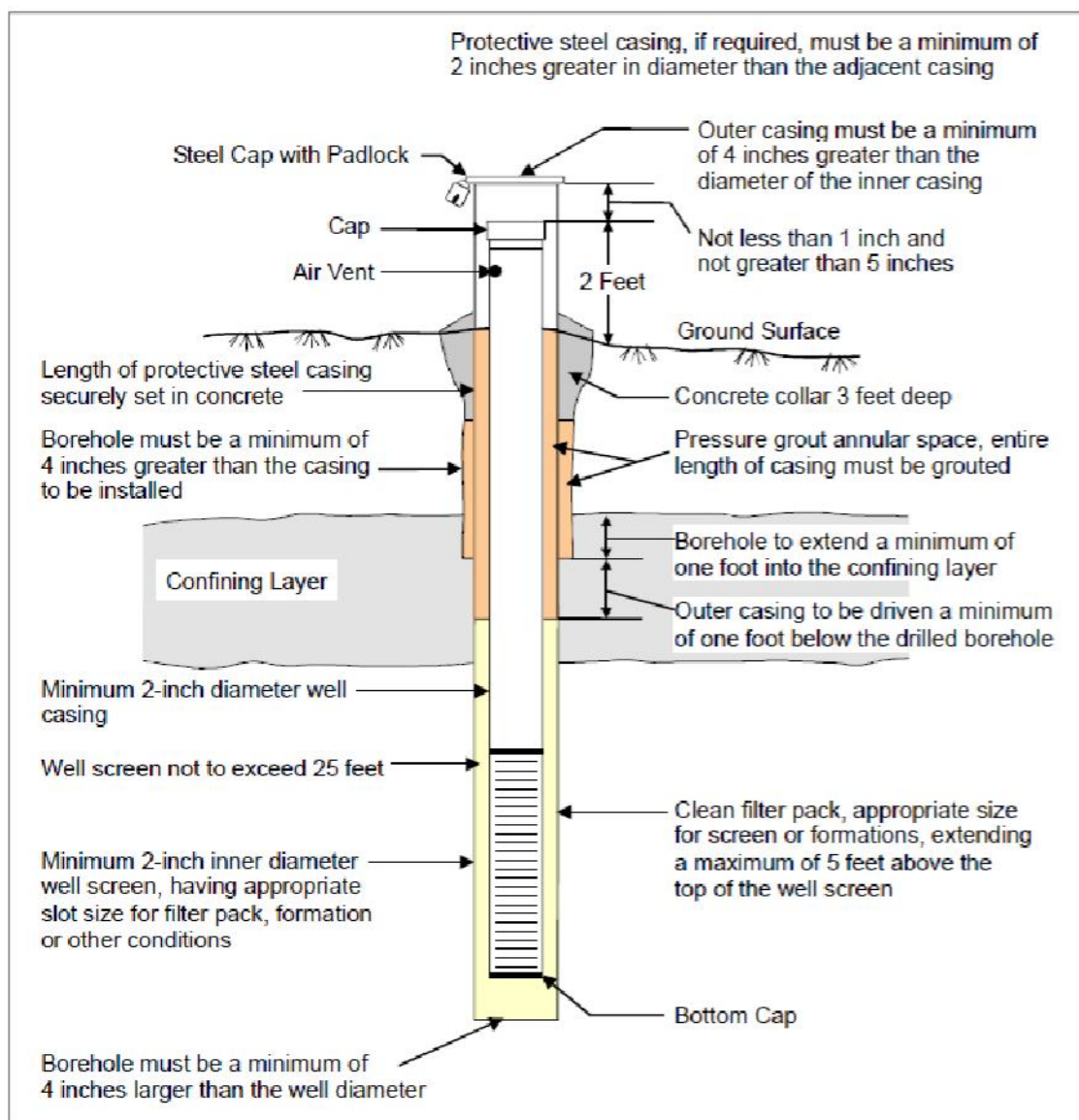


Figure 6.14 Confined Unconsolidated Aquifer Well

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6.0 Quality assurance / quality control

Certain quality control measures should be taken to ensure proper well completion.

- The borehole will be checked for total open depth, and extended by further drilling or shortened by backfilling, if necessary, before any well construction materials are placed.
- Water level and non-aqueous phase liquid (NAPL) presence will be checked during well installation to ensure that the positions of well screen, sand pack, and seal, relative to water level, conform to project requirements.
- The depth to the top of each layer of packing (i.e., sand, bentonite, grout, etc.) will be verified and adjusted if necessary to conform to project requirements before the next layer is placed.
- If water or other drilling fluids have been introduced into the boring during drilling or well installation, samples of these fluids may be required for analysis of chemical constituents of interest at the site.

7.0 Data and records management

All well construction data will be recorded on the Monitoring Well Construction Detail form. A typical Monitoring Well Construction Detail form is presented as Figure 1. All wells will be referenced onto the appropriate site map. A field notebook and/or boring log will be used as additional means of recording data. In no case will the notebook or boring log take the place of the well construction diagram.

8.0 Personnel qualifications and training

Well construction and installation requires a moderate degree of training and experience as numerous drilling situations may occur which will require field decisions to be made. Inexperienced personnel will be supervised until they are capable of working on their own. Experienced drillers will be utilized, as they are also of great assistance with problem resolution in the field. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present.

8.1 Project Manager

It is the responsibility of the Project Manager to ensure that each project involving monitoring well installation is properly planned and executed. The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

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8.2 Task Leader

The Task Leader for drilling activities will be a geologist or hydrogeologist. It is the responsibility of the Task Leader to directly oversee the construction and installation of the monitoring well by the drilling subcontractor to ensure that the well-installation specifications defined in the Remedial Investigation Work Plan are adhered to, and that all pertinent data are recorded on the appropriate forms.

8.3 Drilling Subcontractor

The drilling subcontractor is required to obtain the necessary permits and must be licensed in accordance with N.J.A.C. 7:9D. It is the responsibility of the drilling subcontractor to provide the necessary equipment for well construction and installation. Well construction materials should be consistent with project requirements. The drilling contractor will be licensed in accordance with applicable State regulations, and will be responsible for obtaining all necessary permits.

8.4 Surveying Subcontractor

It is the responsibility of the surveying subcontractor to provide one or more of the following well measurements as specified in the Remedial Investigation Work Plan: ground surface elevation, horizontal well coordinates, top of well casing elevation (i.e., top-of-casing, or measuring point elevation), and/or top of protective casing elevation.

9.0 References

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, WSC-310-91, 1991.

N.J.A.C. 7:9D Well Construction and Maintenance; Sealing of Abandoned Boreholes, 2007.

NJDEP "Field Sampling Procedures Manual," August 2005.

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

POP PPG 005 Surface and Subsurface Soil Sampling Procedures

POP PPG 007 Monitoring Well Development

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

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Attachment 1 – Monitoring Well Construction Log

		Client:		BORING ID:				
		Project Number:						
		Site Location:		Elevation:		Sheet:		
		Coordinates:		Drilling Method: <i>hollow-stem auger (Air - rotary)</i>		Monitoring Well Installation:		
		Sample Type(s): <i>Trowel, split-spoon sampling</i>		Boring Diameter: <i>6"</i>		Screened Interval:		
Weather:		Logged By:		Date/Time Started:		Depth of Boring:		
Drilling Contractor:		Ground Elevation:		Date/Time Finished:		Water Level:		
Depth (ft)	Geologic sample ID	Well Construction	Headspace w/ PID (ppm)	Depth to Water	MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known)		Lab Sample ID	Lab Sample Depth (ft.)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
NOTES: PRIVILEGED AND CONFIDENTIAL ATTORNEY CLIENT PRIVILEGED. PREPARED AT THE REQUEST OF COUNSEL. THIS IS A PRELIMINARY DRAFT. IT HAS BEEN PREPARED BASED ON PRELIMINARY INFORMATION AND ON ASSUMPTIONS. NO ONE MAY RELY ON THIS DRAFT. IT IS SUBJECT TO CHANGE AS ADDITIONAL INFORMATION BECOMES AVAILABLE OR IS CLARIFIED. Checked by _____ Date: _____					Date	Time	Depth to groundwater while drilling	

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POP Author



Project Manager

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

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1.0 Scope and Applicability

1.1 Purpose and Applicability

This POP describes the methods used for developing newly installed monitoring wells and/or existing wells which may require redevelopment/rehabilitation. This POP is applicable to monitoring wells and/or small diameter recovery wells and piezometers.

Monitoring well development and/or redevelopment is necessary for several reasons:

- To improve/restore hydraulic conductivity of the surrounding formations as they have likely been disturbed during the drilling process, or may have become partially plugged with silt,
- To remove drilling fluids (water, mud), when used, from the borehole and surrounding formations, and
- To remove residual fines from well filter materials and reduce turbidity of groundwater, therefore, reducing the chance of chemical alteration of groundwater samples caused by suspended sediments.

Respective state or federal agency (regional offices) regulations may require specific types of equipment for use or variations in the indicated method of well development. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the Work Plan or Quality Assurance Project Plan (QAPP), and must be documented in the field logbook when they occur.

1.2 General Principles

Well development generally involves withdrawal of an un-specified volume of water from a well using a pump, surge block or other suitable method such that, when completed effectively, the well is in good or restored hydraulic connection with the surrounding water bearing unit and is suitable for obtaining representative groundwater samples or for other testing purposes.

2.0 Health and Safety Considerations

Monitoring well development may involve chemical hazards associated with materials in the soil or aquifer being characterized and may involve physical hazards associated with use of well development equipment. When wells are to be installed and developed on hazardous waste investigation sites, a Health and Safety Plan must be prepared and approved by the Health and Safety Officer before field work commences. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all field project personnel, and must be adhered to as field activities are performed.

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3.0 Interferences

Well development performed with inappropriate techniques or improper procedures may lead to groundwater monitoring data that is not representative of the formation. Careful consideration should be given to the monitoring well development method selected, and the procedures should be followed as presented in this POP.

Monitoring well development will be conducted a minimum of 8 hours after completion of the well construction to allow the grout to set.

4.0 Equipment and Materials

Well development can be performed using a variety of methods and equipment. The specific method chosen for development of any given well is governed by the purpose of the well, well diameter and materials, depth, accessibility, geologic conditions, static water level in the well, and type of contaminants present, if any.

The following list of equipment, each with their own particular application, may be used to develop and/or purge monitoring wells.

4.1 Bailer Purging

A bailer is used to purge silt-laden water from wells after using other devices such as a surge block. In some situations, the bailer can be used to develop a well by bailing and surging, often accompanied with pumping. A bailer should be used for purging in situations where the depth to static water is greater than 25 feet and/or where insufficient hydraulic head is available for use of other development methods.

4.2 Surge Block Development

Surge blocks are commercially available for use with Waterra™-type pumping systems or may be manufactured using a rubber or teflon "plunger" attached to a rod or pipe of sufficient length to reach the bottom of the well. Well drillers usually can provide surge blocks if requested. A recommended design is shown in Figure 1.

4.3 Pump Development

A pump is often necessary to remove large quantities of silt-laden ground water from a well after using the surge block. In some situations, the pump alone can be used to develop the well and remove the fines by overpumping. Since the purpose of well development is to remove suspended solids from a well and surrounding filter pack, the pump must be capable of moving some solids without damage. The preferred pump is a submersible pump which can be used in both shallow and deep ground water situations. A centrifugal pump may be used in shallow wells but will work only where the depth to static ground water is less than approximately 25 feet. Pumping may not be successful in low-yielding aquifer materials or in wells with insufficient hydraulic head.

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4.4 Compressed Gas Development

Compressed gas, generally nitrogen from a tank or compressed air through a compressor, can be used to both surge and develop a monitoring well. The method works by injection of compressed gas at the bottom of the water column, driving sediment-laden water to the surface. Compressed gas can also be used for "jetting" - a process by which the gas is directed at the slots in the well screen to cause turbulence (thereby disturbing fine materials in the adjacent filter pack). Compressed gas is not limited by any depth range.

Since the compressed gas will be used to "lift" water from the monitoring well, provisions must be made for controlling the discharge from contaminated wells. This is generally accomplished by attaching a "tee" discharge to the top of the casing and providing drums to contain the discharged water. Gas-lifting should never be done in contaminated wells without providing a means to control discharge.

4.5 Other Required Materials:

- Well development records (Figure 2)
- Health and Safety equipment
- Equipment decontamination materials
- Water level indicator
- Water quality instrumentation: turbidity meter, pH, temperature, specific conductance meters, as required
- Field logbook/pen

5.0 Procedures

5.1 General Preparation

- 5.1.1** Well Records Review: Well completion diagrams should be reviewed to determine well construction characteristics. Formation characteristics should also be determined from review of available boring logs.
- 5.1.2** Site Preparation: Well development, similar to groundwater sampling, should be conducted in as clean an environment as possible. This usually requires, at a minimum, placing sheet plastic on the ground to provide a clean working area for development equipment.
- 5.1.3** Monitoring well development will occur a minimum of 8 hours after completion of monitoring well construction, to allow the grout to set.
- 5.1.4** IDW Containment: Provisions should be in place for collection and management of investigation-derived wastes (IDW), specifically well development water and miscellaneous expendable materials generated during the development process. The collection of IDW in drums or tanks may be required depending on project-specific requirements.

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- 5.1.5** Water Level/Well Depth Measurement: The water level and well depth should be measured with a water level indicator and written on the well development record. This information is used to calculate the volume of standing water (i.e., the well volume) within the well.
- 5.1.6** Equipment Decontamination: All down-well equipment should be decontaminated prior to use in accordance with the NJDEP Field Sampling Procedures Manual. Refer to POP PPG 014, Decontamination of Field Equipment.
- 5.1.7** Removal of Drilling Fluids: Drilling fluids such as mud or water, if used during the drilling and well installation process, should be removed during the well development procedure. It is recommended that a minimum of 1.5 times the volume of added fluid be removed from the well during development. Drilling muds should initially have been flushed from the drilling casing during the well installation procedure with water added during the flushing process. If the quantity of added fluid is not known or could not be reasonably estimated, removal of a minimum of 10 well volumes of water is recommended during the development procedure.

5.2 Development Procedures

5.2.1 Development Method Selection

The construction details of each well shall be used to define the most suitable method of well development. Some consideration should be given to the potential degree of contamination in each well as this will impact IDW containment requirements.

The criteria for selecting a well development method include well diameter, total well depth, static water depth, screen length, the likelihood and level of contamination, and characteristics of the geologic formation adjacent to the screened interval.

The limitations, if any, of a specific procedure are discussed within each of the following procedures.

5.2.2 General Water Quality Measurements

Measure and record water temperature, pH, specific conductance, and turbidity periodically during development using the available water quality instruments. These measurements will aid in determining whether well development is proceeding efficiently, will assist in identifying when well development is complete, will determine whether the development process is effective or not with any given well and, potentially, may identify well construction irregularities (i.e., grout in well, poor well screen slot-size selection). Water quality parameters should be checked a minimum of 3 to 5 times during the development process.

5.2.3 Bailer Procedure

- As stated previously, bailers shall preferably not be used for well development but may be used in combination with a surge block to remove silt-laden water from the well.
- When using a bailer to purge well water; select the appropriate bailer, then tie a length of bailer cord onto the end of it.

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- Lower the bailer into the screened interval of the monitoring well. Silt, if present, will generally accumulate within the lower portions of the well screen.
- The bailer may be raised and lowered repeatedly in the screened interval to further simulate the action of a surge block and pull silt through the well screen.
- Remove the bailer from the well and empty it into the appropriate storage container.
- Continue surging/bailing the well until sediment-free water is obtained. If moderate to heavy siltation is still present, the surge block procedure should be repeated and followed again with bailing.
- Check water quality parameters periodically.

5.2.4 Surge Block Procedure

- A surge block effectively develops most monitoring wells. This device first forces water within the well through the well screen and out into the formation, and then pulls water back through the screen into the well along with fine soil particles. Surge blocks may be manufactured to meet the design criteria shown in the example (Figure 1) or may be purchased as an adaptor to fit commercially available well purging systems such as the Waterra system.
- Insert the surge block into the well and lower it slowly to the level of static water. Start the surge action slowly and gently above the well screen using the water column to transmit the surge action to the screened interval. A slow initial surging, using plunger strokes of approximately 3 feet, will allow material which is blocking the screen to separate and become suspended.
- After 5 to 10 plunger strokes, remove the surge block and purge the well using a pump or bailer. The returned water should be heavily laden with suspended silt and clay particles. Discharge the purged water into the appropriate storage container.
- Repeat the process. As development continues, slowly increase the depth of surging to the bottom of the well screen. For monitoring wells with long screens (greater than 10 feet) surging should be undertaken along the entire screen length in short intervals (2 to 3 feet) at a time. Continue this cycle of surging and purging until the water yielded by the well is free of visible suspended material.
- Check water quality parameters periodically.

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5.2.5 Pump Procedure

- Well development using only a pump is most effective in monitoring wells that will yield water continuously. Theoretically, pumping will increase the hydraulic gradient and velocity of groundwater near the well by drawing the water level down. The increased velocity will move residual fine soil particles into the well and clear the well screen of this material. Effective development cannot be accomplished if the pump has to be shut off to allow the well to recharge.
- When using a submersible pump or surface pump, set the intake of the pump or intake line in the center of the screened interval of the monitoring well.
- Pump a minimum of three well volumes of water from the well and raise and lower the pump line through the screened interval to remove any silt/laden water.
- Continue pumping water from the well until sediment-free water is obtained. This method may be combined with the manual surge block method if well yield is not rapid enough to extract silt from the surrounding formations.
- Check water quality parameters periodically.

5.2.6 Compressed Gas Procedure

- Although the equipment used to develop a well using this method is more difficult to obtain and use, well development using compressed gas is considered to be a very effective method. This method is also not limited by well depth, well diameter, or depth to static water. Caution must be exercised, however, in highly permeable formations not to inject gas into the formation. Drilling subcontractors will often provide the necessary materials as well as perform this method, if requested. When using a compressor, an oil-less compressor should be used, or an oil trap/filter should be placed on the air discharge line which enters the well.
- Lower the gas line into the well, setting it near the bottom of the screened interval. Install the discharge control equipment (i.e., tee fitting) at the well head.
- Set the gas flow rate to allow continuous discharge of water from the well.
- At intervals during gas-lifting, especially when the discharge begins to contain less suspended material, shut off the air flow and allow the water in the well to backflush through the screened interval to disturb any bridging that may have occurred. Re-establish the gas flow when the water level in the well has returned to the pre-development level.
- Continue gas-lifting and/or jetting until the discharged water is free from suspended material.
- Check water quality parameters periodically.

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5.2.7 Special Considerations for Wells in Low-Permeability Formations

Wells installed in low-permeability formations may be difficult to develop due to the slow rate of recharge into the well resulting in the well purging dry before proper well development can be achieved. When developing wells under these circumstances, the addition of potable water to the well during development to maintain a sufficient well volume should be considered. Approval from all appropriate regulatory agencies, including permitting requirements, must be obtained prior to implementing this procedure modification. If implemented, the following must be followed:

- The well development record must document that the addition of potable water is being used to aid in the development of the well and the justification for doing so.
- The volume of water added to the well must be documented.

5.2.8 A minimum of 1.5 times the volume of water added to the well must be purged from the well. The total volume of water purged should be recorded on the well development record to document that this has been performed.

6.0 Quality Assurance / Quality Control

Field project personnel should follow specific quality assurance guidelines as outlined in the QAPP. The plan should indicate the preferred method of well development at a particular site based on project objectives, aquifer conditions, and agency requirements. Specific well performance criteria such as low turbidity values to be achieved following well development should also be specified as well as any requirements for collection/containerization and disposal of well development water.

A well has been successfully developed when one or more of the following criteria are met:

- The sediment load in the well has been eliminated or greatly reduced. Regulatory requirements may be in place which state that water turbidity values ranging from 5 to 50 NTU must be achieved at the end of the development procedure. Use of a turbidity meter is required during the well development procedure to measure water turbidity if meeting a specific turbidity value is required by the regulations. Attaining low turbidity values in fine-grained formations may be difficult to achieve.
- Permeability tests yield repeatable hydraulic conductivity values.

7.0 Data and Records Management

The Monitoring Well Development Record (Figure 2) will be completed by the geologist or hydrogeologist conducting the development. In addition, a field logbook should be maintained documenting any problems or unusual conditions which may have occurred during the development process.

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Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records. Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

Well development procedures vary in complexity. It is recommended that initial development attempts be supervised by more experienced personnel. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present. For wells that are located in New Jersey, all well development or redevelopment work shall be performed by a licensed well driller of the proper class in accordance with N.J.A.C. 7:9D-2.11(b).

8.1 Responsibilities

- 8.1.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.1.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, WSC-310-91, 1991.

N.J.A.C. 7:9D Well Construction and Maintenance; Sealing of Abandoned Boreholes, 2007.

NJDEP "Field Sampling Procedures Manual," August 2005.

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

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APPENDIX: DEFINITIONS

Bridging: A condition within the filter pack outside the well screen whereby the smaller particles are wedged together in a manner that causes blockage of pore spaces.

Hydraulic Conductivity: A characteristic property of aquifer materials which describes the permeability of the material with respect to flow of water.

Hydraulic Connection: A properly installed and developed monitoring well should have good hydraulic connection with the aquifer. The well screen and filter material should not provide any restriction to the flow of water from the aquifer into the well.

Permeability Test: Used to determine the hydraulic conductivity of the aquifer formation near a well screen. Generally conducted by displacing the water level in a well and monitoring the rate of recovery of the water level as it returns to equilibrium. Various methods of analysis are available to calculate the hydraulic conductivity from these data.

Static Water Level: The water level in a well that represents an equilibrium or stabilized condition, usually with respect to atmospheric conditions in the case of monitoring wells.

Well Surging: That process of moving water in and out of a well screen to remove fine sand, silt and clay size particles from the adjacent formation.

Well Purging: The process of removing standing water from a well to allow surrounding formation water to enter the well.

Well Screen: That portion of the well casing material that is perforated in some manner so as to provide a hydraulic connection to the aquifer. The perforated, or slotted, portion of a well is also known as the screened interval.

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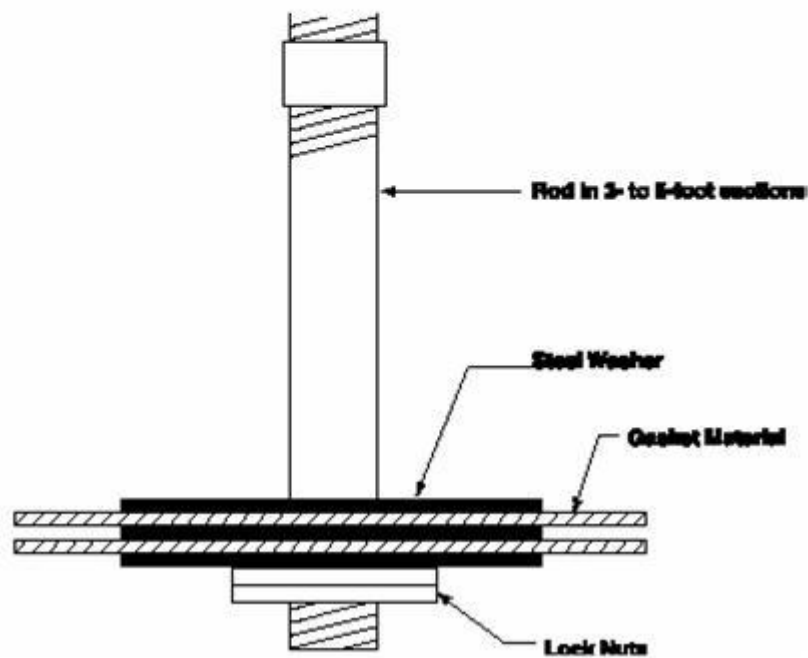
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Figure 1 Recommended Surge Block Design

SURGE BLOCK DESIGN (Not to Scale)

Steel washers should be 1/2" to 3/4" smaller in diameter than the well ID. Gasket can be rubber or leather and should be the same diameter or 1/8" smaller than the well ID to compensate for swelling of the leather. Rod can be steel, fiberglass, or plastic but must be strong and lightweight.



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Figure 2 Well Development Record

Well/Piez. ID: _____

Well/Piezometer Development Record

Client: _____

Project No: _____ Date: _____ Developer: _____

Site Location: _____

Well/Piezometer Data

Well ☐ Piezometer ☐ Diameter _____ Material _____

Measuring Point Description _____ Geology at Screen Interval (if known) _____

Depth to Top of Screen (ft.) _____

Depth to Bottom of Screen (ft.) _____ Time of Water Level Measurement _____

Total Well Depth (ft.) _____ Calculate Purge Volume (gal.) _____

Depth to Static Water Level (ft.) _____ Disposal Method _____

Headspace _____

Original Well Development ☐ Redevelopment ☐ Date of Original Development _____

DEVELOPMENT METHOD _____

PURGE METHOD _____

Time	Total Volume Purged (gal.)	Flow Rate (gpm)	Turbidity (NTU)	Color	pH	Temp	Other

ACCEPTANCE CRITERIA (from workplan)

Minimum Purge Volume Required _____ gallons	Has required volume been removed	Yes ☐	No ☐	N/A ☐
Maximum Turbidity Allowed _____ NTUs	Has required turbidity been reached	☐	☐	☐
Stabilization of parameters _____%	Has parameters stabilized	☐	☐	☐
If no or N/A explain below:				

Signature _____ Date: _____

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Revision Date: June 2010



POP Author



QA Reviewer

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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List of Figures

Figure 1: Low-Flow Setup Diagram

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Attachment 1: Monitoring Well Sampling Worksheet

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1.0 Project Scope and applicability

This procedure is for the collection of groundwater samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with the mobile particulates). The procedure emphasizes the need to minimize stress on the aquifer by using low pumping rates (below 1 liter per minute) and allowing minimal or no drawdown in order to collect samples with minimal alterations to water chemistry. The procedure also reduces the volume of purge water generated, thereby reducing disposal costs. A minimum purge volume, based on well screen length and whether the water level is below the top of the screen, is specified so that samples will be representative of the conditions of the groundwater flowing through the well screen.

The procedure is suited for monitoring wells that have a screen, or open interval, of 10 feet or less but is also applicable to wells with longer well screens. The monitoring wells must be sufficiently wide to simultaneously accept a submersible pump or intake tubing from a peristaltic pump, and the probe from an electronic water level indicator. The screened or open interval must be positioned to intercept the existing contaminant plume, and the monitoring well must be properly constructed, developed, and maintained. This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPL/DNAPL).

2.0 Health and safety considerations

All calibration, maintenance and servicing of the instrumentation should be performed in a safe area, away from hazardous locations.

Refer to the Site Specific Health and Safety Plan for additional Health and Safety issues.

3.0 Interferences

Contaminants that are known to adsorb to particulates, such as metals, PCBs, etc., will be impacted by elevated turbidity (i.e., >25 NTU). If the turbidity stabilizes above 25 NTU, samples for metals, PCBs, and other analyses that may be impacted by contaminants adsorbed to suspended particulates will be filtered using an in-line 0.45 micron filter prior to sample collection. However, groundwater samples to be used in Risk Assessment should not be filtered unless an unfiltered sample will also be submitted for the same analysis. Decisions to sample when turbidity remains above 10 NTU shall be made in consideration of the analyses that will be performed and the project objectives.

ORP is a difficult parameter to measure in the field because the length of time which is necessary for the probe to obtain an accurate measurement is too long to be conducive to use during low-stress monitoring. Consequently, ORP readings may continue to increase or decrease slowly over the purging period.

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Gas bubbles present in discharge tubing during purging and sampling are a problem: Their presence indicates off-gassing from groundwater or poor purging connections in the airline or groundwater tubing. Sunlight can exacerbate this problem when low pumping rates are used. Check connections at the surface. If bubbles persist, check connections at the pump. Erect an umbrella to shade and insulate the transparent flow-through cell and tubing to prevent exposure to direct sunlight. During purging and sampling, observe the flow of groundwater in the sample tubing and keep the tubing filled with groundwater, removing all air pockets and bubbles, to the extent possible. Gas bubbles may be reduced by increasing flow, if possible, and keeping tubing and the transparent flow-through cells shaded. Monitor the flow-through cell for trapped gases which can impact the readings. Placing the flow-through cell at a 45 degree angle with the port side facing upwards can help remove air bubbles from the flow-through cell (see Figure 1).

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Pump tubing lengths above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

4.0 Equipment and materials

4.1 Submersible pumps, bladder pumps, positive displacement pumps, or peristaltic pump

In selecting the appropriate pump, the sampler must consider the head pressure the pump must overcome (the distance between the water level and the highest point over which the purge water must be raised), the depth to the desired sampling interval, the inner diameter of the inner well casing, the analyses to be performed, and the associated logistics (power source, well accessibility). The pump selected must have sufficient lift capacity for the head pressure anticipated. Peristaltic pumps are effective up to a depth to water of approximately 27 feet (note that this must be measured from the highest point that the water must be raised, such as the top of the outer casing). The pump must be sufficiently small to fit into the well along with the water level indicator. The associated pressure lines, power lines, and purge and intake lines must be sufficiently long to reach to the intended sampling interval. As per EPA guidance, peristaltic pumps or other pumps that use suction shall be avoided for sampling volatile compounds, gases (methane, ethane, ethene), and other parameters that may be impacted by degassing and pH modification. For these analyses, peristaltic pumps must not be used when project decisions hinge on detection of low concentrations of VOCs. ***Peristaltic pumps will not***

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be used for collection of any samples that include hexavalent chromium or VOCs as part of the analytical suite.

4.2 Bladder Pump

The bladder pump system contains the following components: a pressurized cylinder of inert gas (typically nitrogen), a pump controller, air intake and discharge lines, and bladder pumps. Dedicated bladder pumps installed at some sites, may also have an extension designed to lower the pump intake below the level of the pump. The controller regulates total flow of nitrogen from the pressurized nitrogen cylinder to the pump assembly located in the well. AECOM typically samples one well per nitrogen cylinder. Note that if the bladder pumps are placed at the same depth in each well, multiple wells may be sampled simultaneously with one nitrogen cylinder. In this case, a three-way cross splitter with quick-connect air line fittings is attached to the tubing connected to the nitrogen cylinder. Up to three controllers can then be connected to the nitrogen cylinder. If nitrogen cylinders are not available, air compressors may be used to power the bladder pumps.

The tubing bundle connected to the pump has three components: an air line with fittings to the pump and the controller, a sample line, and a Teflon-coated support cable. The sample line, through which the purge water is removed, should be composed entirely of Teflon. In locations where dedicated bladder pumps are installed, the tubing bundle and support cable may be connected to a well plate recessed below the locking cap.

4.3 Peristaltic Pump

Peristaltic pumps are not submerged in the well, but remain outside of the well and function by pulling water to the surface. Use is therefore not approved for collection of samples requiring analysis for volatile organic compounds, gases, or other analyses that may be impacted by changes in pressure or pH, including hexavalent chromium. A peristaltic pump has a rotating pump head with stepless variable speed that compresses a short stretch of flexible (Pharmed) silicone tubing to pull water up from the well using mechanical peristalsis. The sample water does not come into direct contact with the pump. Teflon tubing is connected to either end of the silicone tubing. The pumps typically used by AECOM, the GeoPump or GeoPump II by GeoTech, operate off an external 12 V battery or 120 V AC power source. Commercially available "JumpStart" 12 volt batteries are typically preferred since electrical hookup is typically not available; since they are safe, easy to carry, and easy to recharge; and since the potential contamination issues associated with use of a generator are avoided.

4.4 Submersible Pump

Submersible pumps used are typically electrical centrifugal pumps. A centrifugal submersible pump consists of impellers or vanes that are spun or rotated by a sealed electric motor. The spinning of the impellers that causes water to be accelerated outward and then upward into the pump's discharge line. The higher the pumping rate, the greater the potential for sample alteration by sample agitation, increased turbulence and pressure changes in the sample. However, maintaining flow in the low-flow range (less than 1,000 mL per minute) is considered acceptable. A centrifugal submersible pump is usually suspended in a monitoring well by a support cable. Electrical submersible pumps typically used by AECOM are the Grundfos Redi-Flo 2, or similar. These are centrifugal pumps constructed of stainless steel and Teflon, and the motors are cooled and lubricated with water rather than with

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hydrocarbon-based coolants and lubricants that could contaminate groundwater samples. The pumps can achieve flow rates as low as 100 mL per minute. The pumps require a 115 or 230 volt electrical supply, therefore a generator is typically required. Pumps are available for wells 2" in diameter or larger.

4.5 Tubing suited to the pumps and flow-through cells to be used

Teflon or Teflon-lined polyethylene tubing are preferred for all parameters. Stainless steel tubing may be used for sampling organics, but is not recommended for inorganics. PVC, polypropylene or polyethylene may be used for sampling inorganics. Pharmaceutical-grade (e.g. Pharmed) silicon tubing shall be used around the rotor head of the peristaltic pump, and if necessary as a connecting tubing to the flow-through cells. Inner tubing diameter should be kept to the smallest size possible to reduce the generation of air pockets during low flow. Tubing typically used with the peristaltic pumps is Teflon of 1/4-inch outside diameter, and 3/16-inch outside diameter.

4.6 Electronic water level indicator: Solinst Model 101 or similar

Inner casing diameter and pump diameter should be considered in selecting a water level indicator that will fit into the well with the pump. A smaller diameter probe may be required for smaller wells.

4.7 High-Density Polyethylene (HDPE) Y connectors and tubing clamps

These allow for removal of an aliquot of purge water prior to the flow-through cell for turbidity analysis.

4.8 Flow controllers and compressed inert gases for submersible bladder pumps

QED Model MP-10 Flow controller and nitrogen gas are typically used unless nitrogen is an analyte of interest. Portable air compressors may be used in place of compressed gas (e.g., QED Well Wizard).

4.9 Power source

Marine battery, battery pack, compressed gas and flow-controller, or generator and heavy duty extension cords depending on pump

4.9.1 Bladder Pumps

For bladder pump operation, the cylinders of inert compressed gas or portable air compressors function with the flow controller as the power source, although the flow controller does require batteries.

4.9.2 Peristaltic Pumps

The peristaltic pumps typically used by AECOM require an external 12 volt battery or 120 volt AC power source. Commercially available 12 volt batteries designed for jump-starting a car battery ("JumpStart" or similar) are preferred since electrical hookup is typically not available; since they are safe, easy to carry, and easily rechargeable; and since the potential contamination issues associated with use of a generator are avoided.

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4.9.3 Submersible Pumps

An external power source is required. If use of a generator is required, precautions must be taken to avoid cross-contamination when handling fuel and when locating the generator to prevent contamination of the samples and sampling equipment by fumes and exhaust.

4.10 Water Quality Meter with Transparent Flow-Through Cell

YSI 6820 Water Quality Meter and transparent Flow-through cell with 610DM data manager, or similar model

4.11 Turbidity Meter

LaMotte 2020 turbidity meter, or similar model

4.12 Other Equipment

- Photoionization Detector (PID)
- Tarp, umbrellas, or other means to shade the tubing, flow-through cells, and water quality meters from direct sunlight
- Graduated cylinders
- Watch with seconds hand
- Graduated plastic purge buckets or carboys
- Well information consisting of well casing diameter, depth to bottom, depth to top and bottom of screened interval, desired depth for sample collection, depth of pump intake (if dedicated pumps are in place) and results of synoptic water level measurements and LNAPL/DNAPL survey.

5.0 Procedures

This section includes the procedures for performing field activities that should be conducted prior to sampling, procedures for purging the wells using the different pumps, and the sampling and post-sampling procedures (which are the same for the different pump types).

5.1 Pre-Sampling Field Activities

Prior to beginning sampling activities in any wells, all required synoptic water level measurements and well soundings should be completed in accordance with the POP for Water Level Measurements.

Wells should be inspected for the presence of DNAPL or LNAPL. Wells with NAPL cannot be sampled using low-flow techniques, and must be sampled with an alternative sampling method, such as bailing.

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All non-dedicated down-well measuring devices will be thoroughly decontaminated before sampling and between monitoring locations.

Sampling should begin at the monitoring well likely to have the lowest levels of contamination, generally upgradient or farthest from the site or suspected source, and proceed such that the most contaminated wells are sampled last.

Record the monitoring location identification number. Check the monitoring location for damage or evidence of tampering, and record observations.

Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. This helps to prevent contamination of the sampling equipment by the soil, reduces wear on the sampling equipment due to dirt, and reduces the likelihood that contaminated purge water will spill into the surface soil.

Unlock the protective outer casing (if present) and remove the outer well cap.

Remove the inner well cap, and measure the well headspace and breathing zone for total organic vapors. If it is windy, stand upwind of the well to conduct measurements. For well headspace, place the intake of the PID approximately two inches below the plane formed by the top of the inner casing. Measure the total volatile organic concentrations in the breathing zone. Record both readings. Use the breathing zone concentrations to determine appropriate health and safety measures in accordance with the site-specific health and safety plan.

5.2 Purging the Wells

The procedure for sampling with bladder pumps is as follows:

Connect all the lines to the pump. If a dedicated bladder pump is in place, the tubing will already be connected to the pump and is likely connected to the well plate.

Carefully lower the pump to the desired sampling depth using the suspension cable. Take care to minimize disturbance and contact with the well walls which could knock rust or other deposits into the standing water. Secure the pump using the suspension cable.

Connect the pump power cable to the power source. Bladder pumps are driven by compressed gas or air through a controller. The controller typically requires batteries. Connect the regulator, pressurized inert gas cylinder or air compressor, flow controller, and pump. If using compressed gas, use a crescent wrench to attach the regulator to the pressurized nitrogen cylinder. Connect the air line from the regulator to the intake valve of the flow controller. Connect the air line from the outflow valve of the flow controller to the airline to the dedicated bladder pump.

Carefully install a flow-through cell on the sonde. Avoid touching the oxygen probe. Connect a purge water discharge line to the flow-through cell of the water quality meter.

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Connect the purge water discharge line from the well to the water quality meter using a HDPE Y connector and pinch valve so that an aliquot of purge water can be obtained before the flow-through cell for turbidity measurements. Connect the discharge tubing from the well to the HDPE Y connector fitting using a short piece of silicone tubing. Attach a piece of silicone tubing to one end of the fitting and close it with a pinch valve or check valve unit. Samples for turbidity measurements will be collected by opening this pinch valve. Connect the other end of the Y connector fitting to the lower of the two openings in the flow-through cell using silicon tubing and short pieces of Teflon tubing. Connect a piece of Teflon tubing to the out flow of the flow-through cell to the purge bucket. Use a short piece of silicon tubing at the cell. Be sure to use a piece of Teflon tubing sufficiently long to allow purge water to flow easily into the purge bucket.

Mount the sonde and flow-through cell assembly at a 45 degree angle to allow air bubbles to escape from the cell, and position the sonde such that any groundwater spills will be directed away from the sample.

Slowly open the valve on the regulator attached to the nitrogen cylinder until the pressure gauge reads approximately 60 pounds per square inch (PSI). Adjust the regulator on the flow controller to approximately 10 - 20 PSI.

Re-measure the static water level.

Determine the minimum purge volume required for the well. Samples should only be collected after the required volume has been removed from the well. For screen lengths of ten feet or less, a minimum volume of one saturated screen length plus drawdown volume must be removed. For screen lengths greater than ten feet, a minimum purge volume of three saturated screen lengths plus drawdown volume must be removed.

If the depth to water is less than the depth to the top of the screen, the screen is fully saturated and the minimum purge volume is one saturated screen length plus drawdown volume for screens of ten feet or less or three saturated screen lengths plus drawdown volume for screens greater than ten feet.

If the depth to water is greater than the depth to the top of the screen, calculate the well volume. Subtract the difference between the depth to water and the depth to the top of the screen from the well screen length to obtain the saturated well screen length. Round the saturated well screen length up to the nearest foot, and calculate the well volume using the volume per foot of screen length. Multiply the saturated well screen volume by three if the well screen length is greater than 10 feet.

Record the saturated well screen length and the saturated well screen volume on the sampling worksheet.

Start the flow controller and begin purging at the slowest rate possible.

- Note the purge start time.
- Collect all purge water in a bucket or carboy.

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- Slowly increase the pressure at the controlled until discharge begins. The bladder pump controller should be set to allow for adequate recharge such that a maximum flow rate with no drawdown is achieved (generally 100-1,000 mL/min) and a smooth, even discharge flow is achieved. Refer to the historical flow controller settings for the well to select the starting controller pressure and intake and discharge intervals.
- Measure the flow rate using a graduated cylinder and time piece and monitor the water level and pumping rate.

Once drawdown has stopped and an acceptable flow rate established, begin monitoring indicator parameters and continue monitoring flow rate and water level.

- Record reading every three to five minutes, or as appropriate for the flow rate and flow-through cell volume. Use the water quality meter to monitor the following: temperature, pH, specific conductance, DO, and ORP. Use a turbidity meter to monitor turbidity.
- In the event that the well has extremely low recharge such that the lowest purge rate possible (100 mL/min or more, if equipment cannot effectively purge that slowly) continues to dewater the well, do not allow a water level that was above the top of the screen to drop below it, do not allow a water level already below the top of the screen to drop further, do not allow the water level to drop below the pump intake, and do not pump the well dry under any circumstances. Notify the field team leader of the situation. If all efforts to avoid dewatering the well have failed, a decision may be made to allow the well to recharge to a level sufficient to allow for collection of the necessary sample volume and to sample the well immediately. Record detailed notes concerning the sampling of the well.
- Stop purging when all parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:
 - $\text{pH} \pm 0.1$ unit
 - specific conductance and temperature $\pm 3\%$
 - turbidity < 10 NTU and $\pm 10\%$
 - $\text{DO} \pm 10\%$ (down to a detection limit of 0.5 mg/L)
 - $\text{ORP} \pm 10$ mV
- The reporting limits presented are the lowest concentrations to which the instrument is considered linear and therefore accurate. Three consecutive readings below the reporting limits presented are considered to be stable.
- Readings should be recorded approximately every 5 minutes for flows in the range of 200 to 500 mL/min. Readings should be taken less frequently if the maximum flow rate is less than 100 mL/min because of the retention time in the flow-through cell. Each reading should represent a fresh aliquot of groundwater in the flow-through cell.
- Record the time at which the required minimum volume was removed, and record the total volume removed prior to sampling.

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- If parameters do not stabilize, or turbidity remains greater than 5 NTU, or the minimum volume cannot be removed prior to the maximum purging time, contact the field team leader. Technical judgment will be used to ascertain when sampling should be commenced.

5.3 Sampling with Peristaltic Pumps

The procedure for sampling with peristaltic pumps is as follows:

Determine the depth at which the samples will be collected by referring to the QAPP. Samples are frequently collected from the most-contaminated interval, as determined by previous profiling investigations, or from the lower part of the screened interval, or the midpoint of the saturated screened interval. If possible, keep the pump intake at least two feet above the bottom of the well to minimize mobilization of sediment that may be present at the bottom of the well.

Connect the necessary tubing to the pump, using a Y connector fitting and pinch valve to split the flow prior to the flow-through cell in order to collect an aliquot for turbidity:

- Measure a new section of pharmaceutical-grade, 3/16-inch inner diameter (ID) silicon tubing and attach it to the peristaltic pump head.
- Note that the length of silicon tubing in contact with the sample should be kept to a minimum.
- Measure a new section of 3/16-inch ID Teflon tubing to extend from the depth of the intended sampling location to the intake end of silicon tubing. To do this and avoid contamination of the tubing, it is recommended that a decontaminated water level measurement tape be used to measure the tubing as it is lowered into the well. The water level indicator may be lowered into the well with the tubing, or allowed to run onto the clean plastic on the ground outside of the well. Since the tubing is typically stored on a roll, straightening the tubing as you put it into the well will help avoid catching the tubing on any obstructions in the well, such as the top of the well screen. Once the tubing is lowered to the desired depth, immediately secure the free end of the Teflon tubing to prevent it dropping into the well. Using a piece of silicon tubing, connect the outflow end of the Teflon tubing to the HDPE Y-connector. Then, using several pieces of Teflon tubing, connect the pinch valve and check valve units to one end of the Y-connector (through which samples for turbidity will be collected) and connect the other end of the Y-connector to the intake of the flow-through cell.

Connect the electrical clamps from the pump to the appropriate terminals on the 12 volt battery.

Note that reversing the connections will typically cause the pump to run in reverse, which could push air into the well and should be avoided.

Re-measure and record the static groundwater level after the tubing has been placed in the well, and the water level has been allowed to stabilize again.

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Determine the minimum purge volume required for the well. Samples should only be collected after the required volume has been removed from the well. For screen lengths of ten feet or less, a minimum volume of one saturated screen length plus drawdown volume must be removed. For screen lengths greater than ten feet, a minimum purge volume of three saturated screen lengths plus drawdown volume must be removed.

If the depth to water is less than the depth to the top of the screen, the screen is fully saturated and the minimum purge volume is one saturated screen length plus drawdown volume for screens of ten feet or less or three saturated screen lengths plus drawdown volume for screens greater than ten feet.

If the depth to water is greater than the depth to the top of the screen, calculate the well volume. Subtract the difference between the depth to water and the depth to the top of the screen from the well screen length to obtain the saturated well screen length. Round the saturated well screen length up to the nearest foot, and calculate the well volume using the volume per foot of screen length. Multiply the saturated well screen volume by three if the well screen length is greater than 10 feet.

Record the saturated well screen length and the saturated well screen volume on the sampling worksheet.

Commence purging at the slowest possible flow rate and slowly increase the speed until discharge occurs. The pump rate should be set to allow for maximum flow rate (100-1,000 milliliters per minute) with no drawdown. Refer to historical purge information for recharge information. Under no circumstances should the well be pumped dry and once pumping is begun, it should not be interrupted until all sample volume has been collected. Collect all purge water in a bucket or carboy.

Once the stagnant volume in the tubing has been removed (see below for volume equation), drawdown has stopped, and an acceptable flow rate has been established, begin monitoring indicator parameters and continue monitoring flow rate and water level. Record readings every three to five minutes, or as appropriate for the flow rate and flow-through cell volume. Use the water quality meter monitor the following: temperature, pH, specific conductance, DO, turbidity, and ORP. .

- Tubing radius = $r = 0.0104$ ft.
- Volume of tubing = $r^2 \times \text{length of tubing} = V$ (in ft³)
- $\text{ft}^3 \times 28.316 = \text{liters}$
- In the event that the well has extremely low recharge such that the lowest purge rate possible (100 mL/min or more, if equipment cannot effectively purge that slowly) continues to dewater the well, do not allow a water level that was above the top of the screen to drop below it,
- do not allow a water level already below the top of the screen to drop further,
- do not allow the water level to drop below the pump intake,
- do not pump the well dry under any circumstances.

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- Notify the field team leader of the situation. If all efforts to avoid dewatering the well have failed, a decision may be made to allow the well to recharge to a level sufficient to allow for collection of the necessary sample volume and to sample the well immediately.
- Record detailed notes concerning the sampling of the well.

Stop purging when all parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:

- $\text{pH} \pm 0.1$ unit
- specific conductance and temperature $\pm 3\%$
- turbidity < 10 NTU and $\pm 10\%$
- $\text{DQ} \pm 10\%$ (down to a detection limit of 0.5 mg/L)
- $\text{ORP} \pm 10$ mV

The reporting limits presented are the lowest concentrations to which the instrument is considered linear and therefore accurate. Three consecutive readings below the reporting limits presented are considered to be stable.

Readings should be recorded approximately every 5 minutes for flows in the range of 200 to 500 ml/min. Readings should be taken less frequently if the maximum flow rate is less than 100 ml/min because of the retention time in the flow-through cell. Each reading should represent a fresh aliquot of groundwater in the flow-through cell.

Record the time at which the required minimum volume was removed, and record the total volume removed prior to sampling.

If parameters do not stabilize, or turbidity remains greater than 10 NTU, or the minimum volume cannot be removed prior to the maximum purging time, contact the field team leader. Technical judgment will be used to ascertain when sampling should be commenced.

5.4 Sampling with Submersible Pumps

The procedure for sampling with submersible pumps is as follows:

Prior to placing any equipment in the well, measure and record the static water level as described in the water level measurement Standard operating procedure.

Note the water level in relation to the top of the screen. If the static water level is above the top of the screen, care should be taken to prevent the water level from dropping below the top of the screen.

Determine the depth at which the samples will be collected by referring to the QAPP. Samples are frequently collected from the most-contaminated interval, as determined by previous profiling investigations, or from the lower part of the screened interval, or the midpoint of the saturated

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screened interval. If possible, keep the pump intake at least two feet above the bottom of the well to minimize mobilization of sediment that may be present at the bottom of the well.

Connect the pump to the power source. Submersible pumps are driven by an external power source.

If the use of a generator is required, it should be placed downwind of the sampling location to prevent exhaust from impacting the samples.

Care must be taken in handling the generator and gasoline to preclude cross-contamination of the samples and sampling equipment.

At a minimum, samplers must change gloves after handling the fuel or generator prior to sampling.

Carefully lower the pump to the desired sampling depth using the suspension cable. Take care to minimize disturbance and contact with the well walls which could knock rust or other deposits into the standing water.

Secure the pump using the suspension cable, and connect the ground from the pump.

Connect the purge water discharge line to the water quality meter using a splitter and pinch valve so that an aliquot of purge water can be obtained before the flow-through cell for turbidity measurements.

Connect the outflow end of the purge water line to the HDPE Y connector using a short piece of silicone tubing if necessary. Attach a piece of silicone tubing to one end of the Y and close it with a pinch valve or check valve unit.

- Samples for turbidity measurements will be collected by opening this pinch valve.

Connect the other end of the Y connector to the lower of the two openings in the flow-through cell using Teflon tubing and short pieces of silicon tubing at the joints.

Connect a piece of Teflon tubing to the out flow of the flow-through cell to the purge bucket. Use a short piece of silicon tubing at the joint.

Be sure to use a piece of Teflon tubing sufficiently long to allow purge water to flow easily into the purge bucket.

Re-measure the static water level.

Determine the minimum purge volume required for the well.

Samples should only be collected after the required volume has been removed from the well.

For screen lengths of ten feet or less, a minimum volume of one saturated screen length plus drawdown volume must be removed.

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For screen lengths greater than ten feet, a minimum purge volume of three saturated screen lengths plus drawdown volume must be removed.

If the depth to water is less than the depth to the top of the screen, the screen is fully saturated and the minimum purge volume is one saturated screen length plus drawdown volume for screens of ten feet or less or three saturated screen lengths plus drawdown volume for screens greater than ten feet.

If the depth to water is greater than the depth to the top of the screen, calculate the well volume. Subtract the difference between the depth to water and the depth to the top of the screen from the well screen length to obtain the saturated well screen length. Round the saturated well screen length up to the nearest foot, and calculate the well volume using the volume per foot of screen length. Multiply the saturated well screen volume by three if the well screen length is greater than 10 feet.

Record the saturated well screen length and the saturated well screen volume on the sampling worksheet.

Start the pump and begin purging at the slowest rate possible.

- Note the purge start time. Slowly increase the speed until discharge begins.
- The pump should be set to allow for adequate recharge such that a maximum flow rate with no drawdown is achieved (generally 100-1,000 mL/min).
- Refer to the historical flow controller settings for the well to select the starting controller pressure and intake and discharge intervals.

Collect all purge water in a bucket or carboy.

Measure the flow rate using a graduated cylinder and time piece and monitor the water level and pumping rate during purging.

Under no circumstances should purging be interrupted until all sample volume has been collected.

Once drawdown has stopped and an acceptable flow rate established, begin monitoring indicator parameters and continue monitoring flow rate and water level. Record reading every three to five minutes, or as appropriate for the flow rate and flow-through cell volume. Use the water quality meter to monitor the following: temperature, pH, specific conductance, DO, turbidity and ORP.

In the event that the well has extremely low recharge such that the lowest purge rate possible (100 mL/min or more, if equipment cannot effectively purge that slowly) continues to dewater the well, do not allow a water level that was above the top of the screen to drop below it, do not allow a water level already below the top of the screen to drop further, do not allow the water level to drop below the pump intake, and do not pump the well dry under any circumstances. Notify the field team leader of the situation. If all efforts to avoid dewatering the well have failed, a decision may be made to allow the well to recharge to a level sufficient to allow for collection of the necessary sample volume and to sample the well immediately. Record detailed notes concerning the sampling of the well.

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Stop purging when all parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:

- pH $\pm$ 0.1 unit
- specific conductance and temperature $\pm$ 3%
- turbidity < 10 NTU and $\pm$ 10 %
- DO $\pm$ 10% (down to a detection limit of 0.5 mg/L)
- ORP $\pm$ 10 mV

The reporting limits presented are the lowest concentrations to which the instrument is considered linear and therefore accurate. Three consecutive readings below the reporting limits presented are considered to be stable.

Readings should be recorded approximately every 5 minutes for flows in the range of 200 to 500 ml/min. Readings should be taken less frequently if the maximum flow rate is less than 100 ml/min because of the retention time in the flow-through cell. Each reading should represent a fresh aliquot of groundwater in the flow-through cell.

Record the time at which the required minimum volume was removed, and record the total volume removed prior to sampling.

If parameters do not stabilize, or turbidity remains greater than 10 NTU, or the minimum volume cannot be removed prior to the maximum purging time, contact the field team leader. Technical judgment will be used to ascertain when sampling should be commenced.

5.5 Sampling

Once purging has been completed, test for oxidants and sulfides as required for the analyses to be conducted and in accordance with standard operating procedures. Prior to commencing sampling,

- measure and record final water level, temperature, pH, specific conductance, DO, ORP, turbidity, and flow rate.
- disconnect the purge tubing from the flow-through cell, such that sample water will be collected directly from the tubing.

For the PPG Site 114 project, samples will be collected in the following order:

- VOCs
- Total Organic Halogens (TOX)
- Total Organic Carbon (TOC)
- SVOCs
- EPH

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- PCBs
- Total Metals
- Dissolved Metals
- Phenols
- Cyanide
- Chloride
- Preserved Inorganics
- Non-preserved Inorganics

VOCs are always collected first, before other non-VOC parameters. During sample collection, allow the water to flow directly into and down the side of the sample container without allowing the tubing to touch the inside of the sample container or lid, in order to minimize aeration and maintain sample integrity.

5.6 Post-Sampling Field Activities

Preserve the samples as per standard operating procedures for preservation. Immediately label the sample containers with the sample collection date and time and place them on ice. Complete the COC forms as soon as possible.

Cease pumping and disassemble the purging and sampling equipment.

Replace the well cap and lock the outer protective casing.

Decontaminate the sampling equipment as per standard operating procedures for decontamination.

Dispose of all purge water as per the site-specific work plan.

6.0 Quality assurance / quality control

The tubing and lines associated with sampling pumps are typically long and awkward to handle, and careful handling is required to prevent introduction of contaminants into the well. It is therefore preferable for set-up and installation of sampling equipment to be performed by a team of at least two people in order to prevent contamination of equipment to be introduced into the well.

Duplicate measurements cannot effectively be taken using the flow-through cell, since two consecutive measurements taken are not measuring the same sample, and flow cannot be interrupted. Water quality parameters obtained should be compared to historical readings, and potential instrument issues should be considered in the event of major differences.

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6.1 Pollution Prevention and Waste Management

Purge water volume is kept to a minimum through the use of the low-stress sampling procedures. When available, historical information on sampling rates for each well will be used in an attempt to minimize time spent determining the equilibrium flow rate and thereby minimizing purge water volume.

Lengths of Teflon tubing remove from each roll of tubing will be tracked to maximize use and minimize waste of remaining pieces.

Disposable tubing will be disposed of in accordance with the site-specific sampling and analysis plan.

Purge water will be containerized until purging and sampling activities at the well are completed. Purge water will then be disposed of in accordance with the site-specific sampling and analysis plan

7.0 Data and records management

All documentation will be conducted in accordance with standard documentation procedures.

Groundwater sampling information specific to each well will be recorded on the monitoring well sampling worksheet. An example monitoring well worksheet is included as Attachment 1 of this POP. Activities common to more than one well, samples collected, deviations from the sampling and analysis plan, and any other unusual occurrences will also be documented in the field logbook in accordance with standard documentation procedures.

8.0 Personnel qualifications and training

All field samplers are required to take the 40-hour OSHA health and safety training course and annual 8-hour refresher courses prior to engaging in any field collection activities.

For projects in New Jersey, field personnel collecting water quality indicator parameters (i.e., DO, pH, temperature, ORP, specific conductivity, and turbidity) must be certified by NJDEP for those parameters for which certification is offered as required by N.J.A.C. 7:26E-2.1(a)1.vii.

The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

Samplers will have a minimum of one-week's experience performing low-stress sampling prior to sampling without supervision

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9.0 References

U.S. Environmental Protection Agency, Region 1. *Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*, Revision 2, July 30, 1996.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, *Influence of Dissolved Oxygen Convection on Well Sampling*, Ground Water Monitoring & Remediation 27, no. 3: 49-58.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Project Operating Procedure

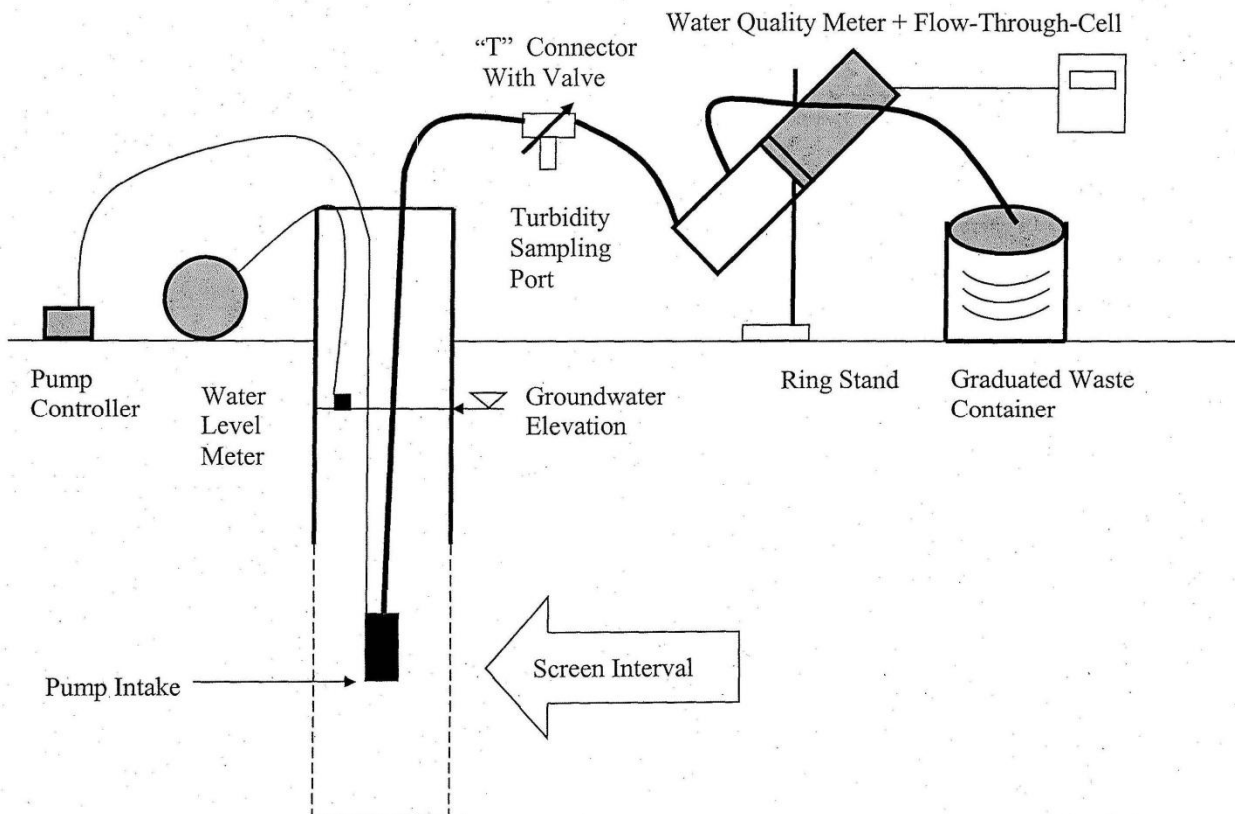
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Figure 1: Low-Flow Setup Diagram

Temp +/- 3%	ORP +/- 10 mv
Spec. Cond +/- 3%	DO +/- 10% for values greater than 0.5 mg/L.
pH +/- 0.1 SU	Turb +/- 10% or <5



Project Operating Procedure

Hydraulic Conductivity Tests – Pressure Transducer Method

Procedure Number: PPG 009

Revision No.: 0

Revision Date: June 2010

POP Author

Project Manager

Date: 6/28/2010

Date: 6/28/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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List of Attachments

Attachment 1. Example Hydraulic Conductivity Test Log

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1.0 Project Scope and applicability

1.1 Purpose and Applicability

This Project Operating Procedure (POP) describes the procedures for conducting rising head and falling head hydraulic conductivity tests (slug tests). Rising head/falling head tests are performed to determine the hydraulic conductivity of the soil or rock surrounding a monitoring well.

Hydraulic conductivity values are used for many purposes, including:

- To estimate rates of groundwater flow;
- To estimate responses of aquifers to applied stresses, such as pumping;
- To estimate the rate of movement of various chemicals in subsurface zones; and
- To construct and calibrate groundwater flow models.

In-situ tests to determine hydraulic conductivity can be conducted in open boreholes or in monitoring wells, and they can be variable-head tests or constant-head tests. The initial change in water levels required to begin the test can be produced by adding or removing a known volume of water using a pump or bailer, displacing water with a solid slug, or changing head conditions using pressurized gas. The water levels can be monitored using a water level tape or with a transducer. For the purpose of this POP, the method to perform a variable-head test in a monitoring well using a slug and transducer is outlined. Use of other test options must be fully described in the project-specific Work Plan.

Wells that contain high concentrations of contaminants or non-aqueous phase liquids may require specialized equipment which will not be damaged by the contaminants. Slug tests should not be performed in wells with non-aqueous phase liquid present.

1.2 General Principles

Hydraulic conductivity is a measure of the ability of a specific porous medium to transmit a specific fluid. Variable-head tests are performed by causing a sudden (instantaneous) rise or drop of the static water level in a well. Water levels are then monitored and recorded until the water level has returned to the condition prior to slug removal or insertion (i.e., static conditions) or sufficient data is collected to perform the hydraulic conductivity calculations.

1.3 Definitions

- 1.3.1** Hydraulic Conductivity: The measure of the ability of a specific porous medium to transmit a specific fluid.
- 1.3.2** Slug: Solid cylinder of teflon, PVC, or other material which is either lowered into the water inside the well to produce a temporary rise in the water level or removed to produce a temporary fall in the water level. If the cylinder is not solid, it should be sealed to prevent water leaking into the slug.

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- 1.3.3** Data Logger: A data logger is a computerized device which records in electronic memory the hydrostatic pressure (i.e., water level) measured by the transducer at specific, user-defined time intervals. The data logger and transducer may be combined in one device.
- 1.3.4** Transducer: A probe lowered into a well that measures hydrostatic pressure which can be used to calculate the water level. The data logger and transducer may be combined in one device.
- 1.3.5** Falling Head Test: Following the instantaneous rise in the static water level by inserting a slug, the drop in water level with respect to time is measured.
- 1.3.6** Rising Head Test: Following the instantaneous lowering of the static water by extracting the slug, the rise of the water level with respect to time is measured.

1.4 Quality Assurance Planning Considerations

Personnel shall follow specific quality assurance guidelines as outlined in the site-specific Work Plan and/or Quality Assurance Project Plan (QAPP), hereafter referred to as the project plans. Proper quality assurance requirements shall be provided which will allow project objectives to be met. Quality assurance requirements typically require the collection of both the rising head and falling head data for comparison or performing the same test twice, although falling head tests may not be required for monitoring wells screened in a water table aquifer. The minimum initial change in well or borehole water level achieved by the slug should be a minimum of one foot to ensure that the formation is sufficiently stressed so that meaningful hydraulic conductivity values can be determined.

The data collected during slug tests shall be reviewed and analyzed by a hydrogeologist or similarly qualified personnel. Many factors affect the appropriate interpretation of slug test data.

2.0 Health and safety considerations

Hydraulic conductivity testing may involve chemical hazards associated with the potentially contaminated groundwater the testing equipment comes in contact with. Adequate health and safety measures must be taken to protect project personnel from potential chemical exposures or other hazards. The health and safety considerations for the site, including both potential physical and chemical hazards, shall be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

3.1 Not Applicable

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4.0 Equipment and materials

Equipment required includes:

- Well records (boring, well logs, and well construction diagrams), if available
- Data logger(s)
- Transducer(s) with cable wire length sufficient to reach target depth and to reach from the well to the computer used to download data.
- Computer - with appropriate software and cables to download data from data logger
- Slugs - diameter dependent upon well diameter; the slug length is dependent on the length of the water column in the well but should provide a minimum of 1 foot displacement of the water column; slug materials may be specified by the project work plan.
- Nylon string
- Water level meter or steel tape
- Health and safety supplies
- Equipment decontamination supplies - Liquinox, buckets, brushes, plastic sheeting (around well to keep equipment clean), solvent (e.g., methanol), DI water, Kimwipes, and aluminum foil.
- Field logbook/standardized forms
- Pen

5.0 Procedures

5.1 Office Preparation

- 5.1.1** Review boring, well logs, and well construction diagrams to determine the geologic medium to be tested (sand, silt, clay, etc.) and well depth, depth-to-water, and screen placement.
- 5.1.2** Determine what slug diameter and length are to be used on the well. The larger the slug, the greater the water displacement, which results in more comprehensive data capture. The diameter of the well, the length of the water column, and the medium to be tested, will determine which slug to use. The slug must be short enough to be completely submerged beneath the static water level, thin enough to be placed in the well and have sufficient room for the transducer cable and there must be room beneath the bottom of the slug for the transducer.
- 5.1.3** Procure appropriate supplies based on well construction (transducer, cable length, slug sizes).

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5.2 General Site Preparation

- 5.2.1** The monitoring wells to be tested should have been previously developed and had sufficient time to equilibrate before the hydraulic conductivity testing is conducted. The water level in tightly sealed wells may need to equilibrate once opened and exposed to the atmosphere. Well construction diagrams are necessary to determine the well diameter, sand pack thickness, the depth of the monitoring well and the screened interval.
- 5.2.2** Measure the static water level and well depth in each well to be tested and record the level in the field logbook or on the standard form.
- 5.2.3** Confirm slug diameter and length to use in well. Record the slug length and diameter in the field logbook or on the standard form for use during data evaluation.
- 5.2.4** Record the make, model, and serial number of transducer and data logger in field log book or on the standard form. If data logger saves to an electronic file, record specified file name in field log book. File name protocols may be specified in the project plans.
- 5.2.5** Connect the transducer cable to the data logger, and program the logger in accordance with manufacturer's instructions. If using a device where the transducer and logger are combined in one unit, connect the unit to the computer and program it in accordance with manufacturer's instructions. A logarithmic time or very short time interval (typically 3 seconds or less) should be used for recording slug test data. The specified time interval should be outlined in the project plans, and the transducer should have sufficient memory to record data for the entire test duration.
- 5.2.6** Lower the transducer into the well. The transducer must be set at a level that will not be disturbed during the test, especially at the insertion or removal of the slug. Ideally, the entire slug length should be below the water surface; however, due to well geometry, this may not be possible. Also, if possible, the transducer should be set a few feet above the base of the well, above the level of any sediment that may be present and may potentially interfere with transducer readings. If these ideal conditions are not present, appropriate notes shall be recorded in the field note book or on the standard form.
- 5.2.7** The cable of the transducer should be fixed (e.g., with tape or a clamp) at the top of the well to stabilize it and hold it in place.
- 5.2.8** Allow the water level to equilibrate to the static level (i.e., the water level observed prior to installing the transducer). Monitor with the transducer and/or the water level meter.
- 5.2.9** When the water has returned to the static water level following installation of the transducer, measure the depth to water using a water level meter and record in the field log book or on the standard form. Also, measure and record an instantaneous pressure reading, if possible. This allows pressure readings to be tied to hydraulic head values. If the data logger requires input of a reference elevation, enter into the data logger an appropriate reference elevation that corresponds to the measured

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depth to water. Reference elevations may be set to zero, to the depth to water, or to a calculated hydraulic head (preferred). Record the reference elevation method in field log book or on the standard form.

- 5.2.10** Tie nylon string to the slug and cut it to a length that will allow the top of the slug to be submerged beneath the static water level. The length of the string should not allow the slug to touch the transducer.

5.3 Falling Head Test

- 5.3.1** Lower the slug into the well so that the bottom of the slug is just above the water surface.
- 5.3.2** Start the data logger recording and immediately lower the slug into the water in the well. The data logger should record a few measurements of static water level in the few seconds it takes to lower the slug. Care should be taken to lower the slug fast enough to produce a nearly instantaneous rise in the water level, but not so fast as to produce a wave when the slug enters the water. The top of the slug should be below the static water level, completely submerged.
- 5.3.3** Monitor the data logger so that when the water level returns to the static level, the rising head test can be started (Sec. 5.4).
- 5.3.4** If the hydraulic conductivity is low, it may take hours or more for the water level to return to static. In this situation the project hydrogeologist should determine a maximum duration for each test (typically 30 minutes).

5.4 Rising Head Test

- 5.4.1** When the falling head test is over, reset the data logger to begin a new test sequence. There should be no reason to re-set the reference elevation, unless the transducer moved during testing.
- 5.4.2** Start the data logger recording. The data logger should record a few measurements of static water level prior to removal of the slug. The slug should be removed quickly so that an instantaneous fall in the water level occurs. Take care not to disturb the transducer when removing the slug.
- 5.4.3** Terminate the rising head test when the water has returned to a static condition or the maximum test length duration determined by the project hydrogeologist has elapsed.
- 5.4.4** If the hydraulic conductivity is low it may take hours or more for the water level to return to static. In this situation the project hydrogeologist should determine a maximum duration for each test (typically 30 minutes).

5.5 Data Review and Download

- 5.5.1** Some data logging equipment allows collected data to be reviewed and plotted on a graph in the field. Prior to moving to the next well location, it is beneficial to review the collected data to see if it appears acceptable. Common problems are that a well was insufficiently stressed (i.e., water level change from static less than 1 foot) or the transducer moved. Contact the project hydrogeologist if uncertain on the

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acceptability of test results. If the data is not acceptable or the project plans require it, the test should be repeated. Make appropriate notes in field log book or on standard form.

The collected data from all tests must be downloaded into a computer for quantitative analysis. This may be performed in the field or in the office but in the field is preferred. If renting equipment, do not return until the project hydrogeologist can preliminarily review downloaded data for completeness. Follow manufacturer's instructions.

5.6 Equipment Decontamination

- 5.6.1** All equipment which comes into contact with the groundwater (slugs, transducer, and water level tape) shall be decontaminated in accordance with POP PPG 014 Decontamination of Field Equipment before moving to the next location. The string, plastic sheeting, and any health and safety supplies (e.g. gloves) shall be properly disposed of in accordance with site requirements.

5.7 Data Analysis

- 5.7.1** Several methods are available for analyzing data obtained from hydraulic conductivity tests. Most methods incorporate graphical techniques, such as semi-log and log-log plots, to evaluate the data and select values for the calculations. Computer software is available to aid in evaluation.

Inherent in all analytical methods are simplifying assumptions concerning the aquifer properties and test methods. When selecting a particular analytical method, it is important to consider the basic assumptions that underlie the mathematical expressions. In many cases it may be advisable to evaluate the data using several methods and examine the range of hydraulic conductivities that are obtained. When reporting a calculated in-situ hydraulic conductivity, the analytical method(s) used should be referenced.

One of the major issues in determining the method to use is whether the aquifer is a water table (unconfined) aquifer or a confined aquifer. Falling head tests may overestimate hydraulic conductivity in water table aquifers if the screened interval is not fully submerged. Although the tests may be performed under such conditions and analyzed for comparative purposes to rising head tests, the limitations of falling head tests conducted in a water table aquifer should be appropriately considered and noted when reporting results or computing average values.

6.0 Quality assurance / quality control

The slug test and data analysis shall be performed under the supervision of a hydrogeologist or other qualified personnel. A hydrogeologist shall review all calculations and results.

Both rising and falling head tests or replicate tests may be conducted for quality control. If the rising and falling head results are not comparable, assess whether the transducer recorded accurate data.

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Hydraulic Conductivity Tests – Pressure Transducer Method

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The falling head test is not accurate for wells with screens that bracket the stabilized water table, because they will overestimate hydraulic conductivity. These tests may be performed in water table wells, but the results should not be used quantitatively.

7.0 Data and records management

Documentation for the field component of hydraulic conductivity tests shall include a minimum of the following:

- Project and site identification
- Measured groundwater levels (with water level tape and/or electronic files from the data logger)
- Slug dimensions
- Data logger / transducer number or instrument identification number/model
- Reference elevations, if available
- Other data logger programming inputs
- Relevant dates and times for start / finish and subsequent water-level measurements
- Weather conditions
- Identities of personnel performing the measurements
- Description of any events or conditions that could impact the quality of the test results

The information shall be recorded in a field logbook or on a standard field form (see Attachment 1). Analysis and results of the tests shall be documented in a technical memorandum and/or report as specified in the project plans.

8.0 Personnel qualifications and training

The field technician shall be properly trained in the process of hydraulic conductivity measurement and shall have specialized training and supervision in using the transducer and data loggers.

The slug test and data analysis shall be performed by or under the supervision of a hydrogeologist or other qualified personnel. A hydrogeologist shall review all calculations and results.

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Hydraulic Conductivity Tests – Pressure Transducer Method

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8.1 Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plans.

8.2 Field Technician

It is the responsibility of the field technician to be familiar with the general principles of hydraulic conductivity testing and the testing equipment. The field technician is responsible for verifying that the equipment is in proper operating condition prior to use and for implementing the measurement procedures in accordance with this POP and the project plans.

8.3 Project Hydrogeologist

It is the responsibility of the project hydrogeologist to provide guidance to the field technician necessary to perform the measurements in accordance with this POP and the project plans and to perform and/or supervise the analysis of the data collected.

9.0 References

9.1 Not Applicable.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Project Operating Procedure

**Hydraulic Conductivity Tests – Pressure
Transducer Method**

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Attachment 1 – Hydraulic Conductivity Test Log

Slug Test Data Form

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DATE: _____

SITE ID: _____

SLUG VOLUME (ft³): _____

LOCATION ID: _____

LOGGER: _____

TEST METHOD: _____ SLUG INJECTION _____ SLUG WITHDRAWAL

COMMENTS: _____

Time Beginning of Test #1 _____

Time Beginning of Test #2 _____

Time End of Test #1 _____

Time End of Test #2 _____

ELAPSED TIME
(MIN)DEPTH TO
WATER (FT)ELAPSED TIME
(MIN)DEPTH TO
WATER (FT)

Project Operating Procedure

Chip Sampling

Procedure Number: PPG 010

Revision No.: 0

Revision Date: June 2010



POP Author



QA Reviewer

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

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Chip Sampling

POP No.: PPG 010
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Chip Sampling

POP No.: PPG 010
Revision: 0
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1.0 Scope and Applicability

- 1.1** This Project Operating Procedure (POP) defines the procedures for the collection of chip samples to determine surficial contamination on porous surfaces (e.g., cement, brick, wood). These procedures are intended for samples to be analyzed for non-volatile analyses (e.g., PCBs, TCDD, and TCDF), and should not be used for volatile organic compound (VOC) analysis. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, and available surface area. Suggested sampling points include floors near process vessels and storage tanks, loading dock areas, etc. The sampling area should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits). To facilitate the calculations once the analytical data is received, the area sampled should be measured.

2.0 Health and Safety Considerations

- 2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- 3.1** Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

4.0 Equipment and Materials

To collect a chip sample, the following equipment is needed:

- Ruler, measuring tape, measuring wheel, or other similar measuring device
- Chalk
- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific HASP.
- Decontaminated beryllium copper or stainless steel chisel
- Hammer or electric hammer

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Chip Sampling

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- Dedicated natural bristle brush and a dust pan lined with aluminum foil or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern
- Glass sample containers
- Field logbook and pen with indelible ink

5.0 Procedures

- 5.1 Mark off the sample collection location with chalk and measure the area.
- 5.2 Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific HASP.
- 5.3 Using the decontaminated chisel and hammer, break up the surface of the location to be sampled. An effort should be made to avoid scattering pieces out of the marked sampling area boundary. Any pieces that fall outside the sampling area should not be used. The area should be chipped to less than ¼" and preferably ⅛".
- 5.4 Record how deep chips were taken in the field logbook or field data sheet.
- 5.5 Collect the chipped pieces using a dedicated, decontaminated dustpan and natural bristle brush and transfer the sample directly into the sample container.
- 5.6 Repeat the process for each location to be sampled. Use new or decontaminated equipment at each location. Outer gloves must be changed before each sample is collected.
- 5.7 Decontaminate the sampling equipment in accordance with POP PPG 014 Decontamination of Field Equipment.

6.0 Quality Assurance / Quality Control

- 6.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.
- 6.2 Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

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7.0 Data and Records Management

- 7.1 All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.
- 7.2 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.3 Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

8.1 Qualifications and training

- 8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
- 8.1.2 The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

8.2 Responsibilities

- 8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2 The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

POP PPG 014 Decontamination of Field Equipment

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Revision: 0

Date: June 2010

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10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Project Operating Procedure

Wipe Sampling

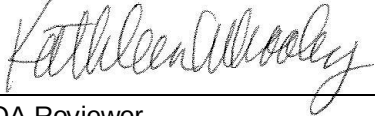
Procedure Number: PPG 011

Revision No.: 0

Revision Date: June 2010



POP Author



QA Reviewer

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Project Operating Procedure

Wipe Sampling

POP No.: PPG 011
Revision: 0
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Wipe Sampling

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1.0 Scope and Applicability

- 1.1** This Project Operating Procedure (POP) defines the procedures for the collection of wipe samples to determine surficial contamination on non-porous surfaces (e.g., metal, glass). Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, and available surface area. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, migration pathways and available surface area. Suggested sampling points include process vessels, ventilation ducts and fans, exposed beams, windowpanes, etc. The area wiped should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits).

2.0 Health and Safety Considerations

- 2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- 3.1** To facilitate the collection of a wipe sample, a 3" x 3" gauze pad should be utilized. The use of filter paper for wipe sampling is not recommended. Filter paper will tend to rip and crumble if the surface wiped is slightly rough. If filter paper is to be used, it should be 4" diameter heavy gauge paper, such as Whatman #4 Filter Paper.
- 3.2** Occasionally samples are desired from painted or waxed surfaces. Since hexane may degrade the finish or pick up interfering substances, an alternate solvent should be used. In this case, methanol or distilled/deionized water for semi-volatiles, pesticides and PCBs and distilled and deionized water alone for metals should be used. Surface interference should be recorded in the field logbook.

When samples are submitted for analysis, the laboratory should be instructed to rinse the sample jars with the appropriate extraction or digestion solvent, depending on the analysis to be performed, when transferring the sample to the extraction/digestion glassware. This will ensure that the entire sample has been removed from the sample container.

4.0 Equipment and Materials

To collect a chip sample, the following equipment is needed:

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Wipe Sampling

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- Ruler or measuring tape
- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific HASP.
- Sterile, wrapped, 3" x 3" gauze pad
- Glass sample containers with appropriate pesticide-grade solvent or distilled/deionized water
- Field logbook and pen with indelible ink

5.0 Procedures

- 5.1** Mark off the sample collection location. It is recommended that an area be premeasured (e.g. 25 cm x 25 cm) to allow for easier calculation of the final results. However, this is not always feasible and may be done after the area is wiped.
- 5.2** Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific HASP.
- 5.3** Remove the gauze pad from its sterile wrapping and soak it with the appropriate solvent. The solvent of choice may change based upon the analytes of interest and surface being sampled. Gauze pads for semi-volatiles, pesticide and PCB samples should be moistened in a 1:4 acetone/hexane mixture and those for metals with distilled/deionized water. The gauze pad should be soaked and excess squeezed out immediately before the collection of each sample. **Use of presoaked pads is not acceptable.** Alternate solvents may be acceptable for certain parameters, however, their approval for use will be at the discretion of NJDEP.
- 5.4** Wipe the entire area to be sampled once in the horizontal direction and once in the vertical direction, applying moderate pressure. Wipe the entire area so that all the sample material is picked up.
- 5.5** Place the gauze pad into the sample container.
- 5.6** Repeat the process for each location to be sampled. Outer gloves must be changed before each sample is collected.
- 5.7** A blank must always be collected for each wipe-sampling event at the frequency specified in the QAPP and/or Work Plan in order to ensure the quality of the data. The blank will help to identify potential introduction of contaminants from the pad, solvent, sample container or ambient air conditions. Collect the wipe blank as follows:
- Don a new pair of nitrile gloves
 - Wet a gauze pad with the solvent or distilled/deionized water (for each collection parameter) and place the pad directly into the sample bottle.

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6.0 Quality Assurance / Quality Control

- 6.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.
- 6.2 Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

7.0 Data and Records Management

- 7.1 All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.
- 7.2 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.3 Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

- 8.1 Qualifications and training
 - 8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
 - 8.1.2 The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.
- 8.2 Responsibilities
 - 8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
 - 8.2.2 The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

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9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP



Project Operating Procedure

Concrete Core Sampling

Procedure Number: PPG 012

Revision No.: 0

Revision Date: April 2010

POP Author

Date: _____

Project Manager

Date: _____

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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Concrete Core Sampling

POP No.: PPG 012
Revision: 0
Date: April 2010
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Concrete Core Sampling

POP No.: PPG 012
Revision: 0
Date: April 2010
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1.0 Scope and Applicability

- 1.1** This Project Operating Procedure (POP) defines the procedure that will be used for the collection of concrete core samples. Selected concrete cores will be removed from floor slabs, foundations, and other concrete structures. Subsamples of the cores will be obtained at various depth intervals using the procedure described hereinafter.
- 1.2** A carbide drill bit attached to a rotary hammer will be used to obtain cuttings from a solid core. The cuttings are taken from the side of the core at selected intervals, based on visual evidence of chromium or other criteria (such as depth). Cores containing a thin band (<0.25 inch) of chromium at the bottom, will be chip sampled using a beryllium chisel. If the core disintegrates during sampling, the remaining portions will be pulverized with a beryllium hammer to obtain a representative sample.

2.0 Health and Safety Considerations

- 2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- 3.1** Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

4.0 Equipment and Materials

- Decontaminated carbide drill bit, 1 inch to 2 inch in diameter and approximately six inches in length;
- Power rotary hammer;
- Decontaminated beryllium copper or stainless steel chisel;
- Hammer;
- Engineers rule;
- Bristle brush, dedicated;
- Decontaminated glass bowl;

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Revision: 0
Date: April 2010
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- Decontaminated/dedicated polyethylene or Teflon spoon;
- Polyethylene sheeting;
- Disposable nitrile gloves;
- Safety glasses; and
- Field logbook and pen with indelible ink

5.0 Procedures

- 5.1** Photograph, in color, the core from the top, bottom and side. Record the photograph number in the field logbook. Sketch the specifics of each core (dimensions, staining, etc) in the field logbook.
- 5.2** Brush the loose dirt from the bottom of the core.
- 5.3** Measure the dimensions of the core to be sampled and select the sample intervals for the collection of the drill cuttings. Sketch specifics of the sample intervals in the field logbook.
- 5.4** Beginning at the top of the core, drill holes around the perimeter at the first sampling interval and collect the cuttings on the polyethylene sheeting or in the glass bowl. Drill each hole approximately 3/8ths of the way through the core and stop. Rotate the core 90 degrees and drill again. Continue drilling holes around the perimeter of the core until enough sample cuttings are produced to sufficiently fill the sample collection jar for the analyses requested.
- If the core breaks during drilling, collect the remaining portion of that interval with a dedicated beryllium chisel and hammer, and pulverize the chips on new polyethylene sheeting. The final pieces should be no larger than 1 centimeter in diameter.
- 5.5** Transfer the sample cuttings from the sheeting or bowl to the sampling jar with a polyethylene or Teflon spoon.
- 5.6** Repeat the process for each interval. Use new or decontaminated equipment at each interval. Outer gloves must be changed before each sample is collected.
- 5.7** Decontaminate the sampling equipment in accordance with POP PPG 014 Decontamination of Field Equipment.

6.0 Quality Assurance / Quality Control

- 6.1** Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.
- 6.2** Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency

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and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

7.0 Data and Records Management

- 7.1 All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site log books with permanent ink.
- 7.2 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.3 Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

8.1 Qualifications and training

- 8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
- 8.1.2 The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

8.2 Responsibilities

- 8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2 The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

POP PPG 014 Decontamination of Field Equipment

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Date: April 2010

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10.0 Revision History

Revision	Date	Changes
0	April 2010	Original POP

Project Operating Procedure

Sweep Sampling

Procedure Number: PPG 013

Revision No.: 0

Revision Date: June 2010



POP Author



Project Manager

Date: 6/28/2010

Date: 6/28/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

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Sweep Sampling

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Sweep Sampling

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1.0 Scope and Applicability

- 1.1** This Project Operating Procedure (POP) defines the procedures for the collection of sweep samples to determine surficial contamination on porous (e.g., asphalt) or non-porous (e.g., metal) surfaces. These procedures are intended for samples to be analyzed for non-volatile analyses (e.g., PCBs, TCDD, and TCDF), and should not be used for volatile organic compound (VOC) analysis. Sweep sampling allows collection of dust/residue samples that may help in the assessment of contaminant determination and delineation. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, migration pathways and available surface area. Suggested sampling points include ventilation systems where dust can collect, floor surfaces near process vessels and storage tanks, or street gutters where contaminated sediments may have migrated and accumulated. The area sampled should be large enough to provide a sufficient amount of sample for analysis.

2.0 Health and Safety Considerations

- 2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- 3.1** Cross contamination from sampling equipment will be prevented by using dedicated sampling equipment and/or sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

4.0 Equipment and Materials

To collect a sweep sample, the following equipment is needed:

- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific HASP.
- Dedicated natural bristle brush
- Stainless steel spatula or dedicated spatula
- Dust pan lined with aluminum foil or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern

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- Glass sample containers
- Field logbook and pen with indelible ink
- Camera (optional)

5.0 Procedures

- 5.1 Identify the location to be sampled and document its description in the field log book or field data sheets. If necessary, take a picture of the location.
- 5.2 Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific HASP.
- 5.3 Using the dedicated natural bristle brush, sweep all residue in the area to be sampled into a decontaminated or dedicated dustpan.
- 5.4 Use the decontaminated stainless steel or dedicated spatula to transfer the sample from the dustpan to the sample bottle(s).
- 5.5 Repeat the process for each location to be sampled. Use dedicated or decontaminated equipment at each location. Outer gloves must be changed before each sample is collected.
- 5.1 Decontaminate the sampling equipment in accordance with POP PPG 014 Decontamination of Field Equipment.

6.0 Quality Assurance / Quality Control

- 6.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.
- 6.2 Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

7.0 Data and Records Management

- 7.1 All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.

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- 7.2** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.3** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

8.1 Qualifications and training

- 8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
- 8.1.2** The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

8.2 Responsibilities

- 8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

POP PPG 014 Decontamination of Field Equipment

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

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Decontamination of Field Equipment

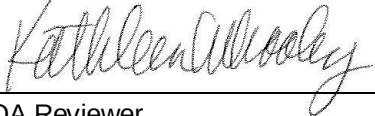
Procedure Number: PPG 014

Revision No.: 0

Revision Date: June 2010



POP Author



QA Reviewer

Date: 6/28/2010

Date: 6/28/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

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Decontamination of Field Equipment

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Decontamination of Field Equipment

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1.0 Project Scope and applicability

1.1 Purpose and Applicability

This POP describes the methods to be used for the decontamination of field equipment used in the collection of environmental samples. The list of field equipment may include a variety of items used in the collection of soil and/or water samples, such as split-spoon samplers, trowels, scoops, spoons, bailers and pumps. Heavy equipment such as drill rigs and backhoes also require decontamination, usually in a specially constructed temporary decontamination area.

Decontamination is performed as a quality assurance measure and a safety precaution. Improperly decontaminated sampling equipment can lead to misinterpretation of environmental data due to interference caused by cross-contamination. Decontamination protects field personnel from potential exposure to hazardous materials. Decontamination also protects the community by preventing transportation of contaminants from a site.

This POP emphasizes decontamination procedures to be used for decontamination of reusable field equipment. Occasionally, dedicated field equipment such as well construction materials (well screen and riser pipe) or disposable field equipment (bailers or other general sampling implements) may also require decontamination prior to use. The project-specific work plan should indicate the specific decontamination requirements for a particular project.

Respective state or federal agency (regional offices) regulations may require specific types of equipment or procedures for use in decontamination of field equipment. The project manager should review the applicable regulatory requirements, if any, prior to the start of the field investigation program.

1.2 General Principles

Decontamination is accomplished by manually scrubbing, washing, or spraying equipment with detergent solutions, tap water, distilled/deionized water, steam and/or high pressure water, or solvents. The decontamination method and agents are generally determined on a project-specific basis and must be stated in the Quality Assurance Project Plan (QAPP) and/or Work Plan.

Generally, decontamination of equipment is accomplished at each sampling site between collection points. Waste decontamination materials such as spent liquids and solids will be collected and managed as investigation-derived waste for later disposal. All decontamination materials, including wastes, should be stored in a central location so as to maintain control over the quantity of materials used or produced throughout the investigation program.

2.0 Health and safety considerations

Decontamination procedures may involve chemical exposure hazards associated with the type of contaminants encountered or solvents employed and may involve physical hazards associated with decontamination equipment. When decontamination is performed on equipment which has been in contact with hazardous materials or when the quality assurance objectives of the project require decontamination with chemical solvents, the measures necessary to protect personnel must be

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addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing equipment decontamination, and must be adhered to as field activities are performed.

3.0 Interferences

Improper decontamination can result in sample contamination and affect the accuracy of data.

4.0 Equipment and materials

- Decontamination agents (per work plan requirements):
 - LIQUI-NOX, ALCONOX, or other phosphate-free biodegradable detergent,
 - Tap water,
 - Distilled/deionized water,
 - Nitric acid and/or hydrochloric acid,
 - Methanol and/or hexane, acetone, isopropanol.
- Health and Safety equipment
- Chemical-free paper towels
- Waste storage containers: drums, 5-gallon pails w/covers, plastic bags
- Cleaning containers: plastic buckets or tubs, galvanized steel pans, pump cleaning cylinder
- Cleaning brushes
- Pressure sprayers
- Squeeze bottles
- Plastic sheeting
- Aluminum foil
- Field logbook and pen with indelible ink

5.0 Procedures

5.1 General Preparation

- 5.1.1** It should be assumed that all sampling equipment, even new items, are contaminated until the proper decontamination procedures have been performed on them or unless a certificate of analysis is available which demonstrates the items cleanliness.

Field equipment that is not frequently used should be wrapped in aluminum foil, shiny side out, and stored in a designated "clean" area. Small field equipment can also be

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stored in plastic bags to eliminate the potential for contamination. Field equipment should be inspected and decontaminated prior to use if the equipment appears contaminated and/or has been stored for long periods of time. Unless customized procedures are stated in the QAPP and/or Work Plan for decontamination of equipment, the standard procedures specified in this POP shall be followed.

- 5.1.2** Establish the decontamination station within an area that is convenient to the sampling location. If single samples will be collected from multiple locations, then a centralized decontamination station, or a portable decontamination station should be established.
- 5.1.3** An investigation-derived waste (IDW) containment station should be established at this time also. The project-specific work plan should specify the requirements for IDW containment. In general, decontamination solutions are discarded as IDW between sampling locations. Solid waste is disposed of as it is generated.
- 5.2** Sampling conducted using bailers
 - 5.2.1** Field decontamination of bailers will not be conducted on this project. Only dedicated disposable bailers or laboratory decontaminated bailers will be used for sample collection in accordance with the FSPM.
- 5.3** Decontamination for Organic Analyses
 - 5.3.1** This procedure applies to soil sampling and groundwater sampling equipment used in the collection of environmental samples submitted for organic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items. Submersible pump decontamination procedures are outlined in Section 5.4.
 - 5.3.2** Decontamination is to be performed before sampling events and between sampling points.
 - 5.3.3** After a sample has been collected, remove all gross contamination from the equipment or material by brushing and then rinsing with available tap water. This initial step may be completed using a 5-gallon pail filled with tap water. Steam or a high-pressure water rinse may also be conducted to remove solids and/or other contamination.
 - 5.3.4** Wash the equipment with a phosphate-free detergent and tap water solution. This solution should be kept in a 5-gallon pail with its own brush.
 - 5.3.5** Rinse with tap water or distilled/deionized water until all detergent and other residue is washed away. This step can be performed over an empty bucket using a squeeze bottle or pressure sprayer.
 - 5.3.6** Rinse with methanol or other appropriate solvent using a squeeze bottle or pressure sprayer. Rinsate should be collected in a waste bucket.
 - 5.3.7** Rerinse with deionized water to remove any residual solvent. Rinsate should be collected in the solvent waste bucket.
 - 5.3.8** Allow the equipment to air-dry in a clean area or blot with chemical-free paper towels before reuse. Wrap the equipment in tin foil and/or seal it in a plastic bag if it will not be reused for a while.

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- 5.3.9** Dispose of soiled materials and spent solutions in the designated IDW disposal containers.
- 5.4** Decontamination for Inorganic (Metals) Analyses
 - 5.4.1** This procedure applies to soil sampling equipment used primarily in the collection of environmental samples submitted for inorganic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items.
 - 5.4.2** For plastic and glass sampling equipment, follow the steps outlined in 5.2 above, however, use a 10% nitric acid solution (acid in water) in place of the solvent rinse.
 - 5.4.3** For metal sampling equipment, follow the steps outlined in 5.2 above, however, use a 10% hydrochloric acid solution (acid in water) in place of the solvent rinse.
- 5.5** Decontamination of Submersible Pumps
 - 5.5.1** This procedure will be used to decontaminate submersible pumps before and between ground-water sample collection points. This procedure applies to both electric submersible and bladder pumps. This procedure also applies to discharge tubing if it will be reused between sampling points.
 - 5.5.2** Prepare the decontamination area if pump decontamination will be conducted next to the sampling point. If decontamination will occur at another location, the pump and tubing may be removed from the well and placed into a clean trash bag for transport to the decontamination area. Pump decontamination is easier with the use of 3-foot tall pump cleaning cylinders (i.e., Nalgene cylinder) for the various cleaning solutions, although the standard bucket rinse equipment may be used.
 - 5.5.3** Sample tubing shall not be decontaminated in the field. Only dedicated tubing will be used for each well and disposed of upon completion of well sampling.
 - 5.5.4** Once the decontamination station is established, the pump should be removed from the well and the discharge tubing and power cord coiled by hand as the equipment is removed. If any of the equipment needs to be put down temporarily, place it on a plastic sheet (around well) or in a clean trash bag. If a disposable discharge line is used it should be removed and discarded at this time.
 - 5.5.5** As a first step in the decontamination procedure, use a pressure sprayer with tap water to rinse the exterior of the pump, discharge line, and power cord as necessary. Collect the rinsate and handle as IDW.
 - 5.5.6** Cut a short piece of dedicated tubing and attach it to the pump. Place the pump into a pump cleaning cylinder or bucket containing a detergent solution (detergent in tap water). Bend the tubing so that decontamination fluids can be recirculated back into the bucket. Holding the tubing/power cord, pump solution through the pump system. A minimum of one gallon of detergent solution should be pumped through the system. Collect the rinsate and handle as IDW.
 - 5.5.7** Place the pump into another cylinder/bucket containing a 10% solution of solvent (methanol, or other designated solvent) in distilled/deionized water. Bend the tubing so that decontamination fluids can be recirculated back into the bucket. Pump until the detergent solution is removed in accordance with the NJDEP FSPM, Chapter 2A,

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Section 2.4.4, page 17. Circulate the rinse solution for three or more system cycles. Collect the rinsate and handle as IDW.

- 5.5.8** Place the pump into another cylinder/bucket containing distilled/deionized water. Bend the tubing so that decontamination fluids can be recirculated back into the bucket. Pump a minimum of 3 to 5 pump system volumes (pump and tubing) of water through the system. Vary the pump speed during decontamination and briefly raise the pump to introduce air during the decontamination procedure. Collect the rinsate and handle as IDW.
- 5.5.9** Remove the pump from the cylinder/bucket and if the pump is reversible, place the pump in the reverse mode to discharge all removable water from the system. If the pump is not reversible the pump and discharge line should be drained by hand as much as possible. Collect the rinsate and handle as IDW.
- 5.5.10** Refill the cylinder/bucket with clean potable water and run pump for 3 to 5 pump system volumes. Collect the rinsate and handle as IDW. Then, using a pressure sprayer with distilled/deionized water, rinse the exterior of the pump, discharge line, and power cord thoroughly, shake all excess water, then place the pump system into a clean trash bag for storage. If the pump system will not be used again right away, the pump itself should also be wrapped with aluminum foil before placing it into the bag.
- 5.6** Decontamination of Bladder Pumps

 - 5.6.1** Most bladder pumps cannot be easily decontaminated in the field due to their unique construction. For that reason, bladder pumps are not employed on a well-to-well basis **unless** they are constructed with easy to clean parts and *disposable* bladders. If they are constructed with disposable bladders, proper decontamination should include removal, disposal, and replacement of the used bladder and a thorough eight-step decontamination procedure. Field cleaning of bladder pumps is acceptable only if the following conditions are met: 1) the bladder pump housing is constructed of stainless steel with an internal disposable bladder and 2) either the eight-step, Cold Regions decontamination method or the ultra clean decontamination method is employed as discussed in the NJDEP FSPM.
- 5.7** Decontamination of Peristaltic Pumps

 - 5.7.1** A peristaltic pump is a self-priming suction lift (negative air pressure) pump utilized at the ground surface, which consists of a rotor with ball bearing rollers. One end of dedicated tubing is inserted into the well. The other end is attached to a short length of flexible tubing, which has been threaded around the rotor, out of the pump, and connected to a discharge tube. The liquid moves totally within the tubing, thus no part of the pump contacts the liquid. Tubing used for well evacuation may also be used for sample collection. Teflon®-lined polyethylene tubing is recommended for sampling. Tubing will be discarded and properly disposed of after each sample is collected.
- 5.8** Decontamination of Large Equipment

 - 5.8.1** Consult the QAPP and/or Work Plan for instruction on the location of the decontamination station and the method of containment of the wash solutions. On large projects usually a temporary decontamination facility (decontamination pad) is required which may include a membrane-lined and bermed area large enough to

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drive heavy equipment (drill rig, backhoe) onto with enough space to spread other equipment and to contain overspray. Usually a small sump with pump is necessary to collect and contain rinsate. A water supply and power source is also necessary to run steam cleaning and/or pressure washing equipment.

- 5.8.2** Upon arrival and prior to leaving a sampling site, all heavy equipment such as drill rigs, trucks, and backhoes should be thoroughly cleaned and then the parts of the equipment which come in contact or in close proximity to sampling activity should be decontaminated. This can be accomplished in two ways, steam cleaning or high pressure water wash and manual scrubbing. Following this initial cleaning, only those parts of the equipment which come in close proximity to the sampling activities (i.e., auger stems, rods, backhoe bucket) must be decontaminated in between sampling events.
- 5.8.3** Occasionally, well construction materials such as well screen and riser pipe may require decontamination before the well materials are used. These materials may be washed in the decontamination pad, preferably on a raised surface above the pad (i.e., on sawhorses), with clean plastic draped over the work surfaces. Well materials usually do not require a multistep cleaning process as they generally arrive clean from the manufacturer. Usually, a thorough steam-cleaning of the interior/exterior of the well materials will be sufficient. The QAPP and/or Work Plan should provide specific guidance regarding decontamination of well materials.

6.0 Quality assurance / quality control

6.1 General Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP. The QAPP guidelines typically require collection of equipment blank samples in order to determine the effectiveness of the decontamination procedure.

The decontamination method, solvent, frequency, location on site and the method of containment and disposal of decontamination wash solids and solutions are dependent on site logistics, site-specific chemistry, and nature of the contaminated media to be studied and the objectives of the study. Each topic must be considered and addressed during development of a decontamination strategy and should be outlined in the QAPP and/or Work Plan.

6.2 Solvent Selection

There are several factors which need to be considered when deciding upon a decontamination solvent. The solvent should not be an analyte of interest. The sampling equipment must be resistant to the solvent. The solvent must be evaporative or water soluble or preferably both. The applicable regulatory agency may have specific requirements regarding decontamination solvents. The QAPP and/or Work Plan should specify the type of solvent to be used for a particular project.

The analytical objectives of the study must also be considered when deciding upon a decontamination solvent. Pesticide-grade methanol is the solvent of choice for general organic analyses. It is relatively safe and effective. Hexane, acetone, and isopropanol are sometimes used as well. A 10% nitric acid in deionized water solution is the solvent of choice for general metals analyses. Nitric acid can be

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used only on Teflon, plastics and glass. If used on metal equipment, nitric acid will eventually corrode the metal and lead to the introduction of metals to the collected samples. Dilute hydrochloric acid is usually preferred over nitric acid when cleaning metal sampling equipment.

Equipment decontamination should be performed a safe distance away from the sampling area so as not to interfere with sampling activities but close enough to the sampling area to maintain an efficient working environment. If heavy equipment such as drill rigs or backhoes are to be decontaminated, then a central decontamination station should be constructed with access to a power source and water supply.

6.3 Field Blank Sample Collection

General guidelines for quality control check of field equipment decontamination usually require the collection of one field blank from the decontaminated equipment per day. The QAPP should specify the type and frequency of collection of each type of quality assurance sample.

Field blanks are generally made by pouring laboratory-supplied deionized water into, over, or through the freshly decontaminated sampling equipment and then transferring this water into a sample container. Field blanks should then be labeled as a sample and submitted to the laboratory to be analyzed for the same parameters as the associated sample. Field blank sample numbers, as well as collection method, time and location should be recorded in the field notebook.

7.0 Data and records management

Specific information regarding decontamination procedures should be documented in the project-specific field notebook. Documentation within the notebook should thoroughly describe the construction of each decontamination facility and the decontamination steps implemented in order to show compliance with the project work plan. Decontamination events should be logged when they occur with the following information documented:

- Date, time and location of each decontamination event
- Equipment decontaminated
- Method
- Solvents
- Notable circumstances
- Identification of field blanks and decontamination rinsates
- Method of blank and rinsate collection
- Date, time and location of blank and rinsate collection
- Disposition of IDW

Repetitive decontamination of small items of equipment does not need to be logged each time the item is cleaned.

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8.0 Personnel qualifications and training

All sampling technicians performing decontamination must be properly trained in the decontamination procedures employed, the project data quality objectives, health and safety procedures and the project QA procedures. Specific training or orientation will be provided for each project to ensure that personnel understand the special circumstances and requirements of that project. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous materials may be present.

8.1 Sampling Technician

It is the responsibility of the sampling technician to be familiar with the decontamination procedures outlined within this POP and with specific quality assurance, and health and safety requirements outlined within project-specific work plans (HASP, QAPP, Work Plan, etc.). The sampling technician is responsible for decontamination of field equipment and for proper documentation of decontamination activities. The sampling technician is also responsible for ensuring that decontamination procedures are followed by subcontractors when heavy equipment requires decontamination.

8.2 Field Project Manager

The field project manager is responsible for ensuring that the required decontamination procedures are followed at all times. The project manager is also responsible for ensuring that subcontractors construct and operate their decontamination facilities according to project specifications. The project manager is responsible for collection and control of IDW in accordance with project specifications.

9.0 References

Not applicable.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Project Operating Procedure

Procedures for Acid Testing of Green-Gray Mud and COPR

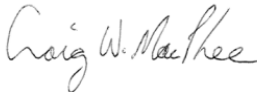
Procedure Number: PPG 015

Revision No.: 0

Revision Date: March 19, 2010



POP Author



Project Manager

Date: March 19, 2010

Date: March 19, 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Project Operating Procedure
**Procedures for Acid Testing of Green-
Gray Mud and COPR**

POP No.: PPG 015
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Date: March 19, 2010
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Project Operating Procedure

Procedures for Acid Testing of Green-Gray Mud and COPR

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1.0 Scope and Applicability

- 1.1** This Project Operating Procedure (POP) is for acid testing of material suspected to be Green-Gray Mud or chromite ore processing residue (COPR). This procedure will be used on material that cannot be definitively identified as Green-Gray Mud or COPR through other techniques (e.g., visual, magnetic, XRF). The results of the procedure will be used as part of a weight-of-evidence approach to determine whether the material in question is Gray/green mud or COPR.

High levels of calcium (i.e., percent levels) are expected in Green-Gray Mud and possibly COPR. Hydrochloric acid (HCl) will be used in a controlled manner to determine if the suspected material contains calcium and is potentially Green-Gray Mud or COPR. The HCl will be added to the suspected material in a drop-wise manner and the material will be observed for a reaction.

2.0 Health and Safety Considerations

- 2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.
- 2.2** Due to the use of hydrochloric acid (HCl) this procedure, field personnel will be required to wear safety glasses and gloves when performing this procedure. The plastic dropper bottle for the HCl must be stored in a plastic container that is lined with acid neutralizing sorbent paper. The plastic container and dropper bottle must be labeled as HCl and also have a United Nations (UN) 1789 label (Figure 1). Refer to the job safety analysis (JSA) for this activity in the site-specific HASP for more detail.

3.0 Interferences

- 3.1** Soils that contain carbonate salts/minerals other than calcium will also react with the HCl and may lead to false conclusion that calcium is present.

4.0 Equipment and Materials

- 16 ounce (oz) clear glass jars

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- Labeled plastic dropper bottle containing 1:1 HCl (i.e., 6 normal [N] HCl)
- Labeled plastic storage container lined with acid neutralizing sorbent paper for plastic dropper bottle
- Extra acid neutralizing sorbent paper for spills
- Plastic scoop
- Nitrile gloves
- Safety glasses
- Field logbook and pen
- Site HASP
- Project Feasibility Study Work Plan (FSWP)
- Camera (optional)

5.0 Procedures

5.1 Don safety glasses and nitrile gloves as instructed in the site-specific HASP.

5.2 Use the plastic scoop to transfer a small amount (e.g., 5-10 grams) of the suspected material into a 16 oz clear glass jar.

Remove the plastic dropper bottle from its plastic storage container. Carefully open the dropper bottle and drop 2-3 drops of HCl onto the suspected material in the 16 oz clear glass jar. Observe the material for any reaction. If calcium or other carbonate salts/minerals are present, effervescing/foaming should occur. Observe the material for approximately 30 seconds and record the observations in the field logbook. If necessary, a camera can be used to photodocument the presence or absence of a reaction.

5.3 Once the test is complete, replace the cap on the dropper bottle, and return the dropper bottle to its plastic storage container.

5.4 Wait for any reaction that is occurring to subside, and dispose of the material in the soil stockpile.

5.5 Rinse the 16 oz clear glass jar and dispose of the rinse water in accordance with the investigative derived waste (IDW) procedures for the site.

6.0 Quality Assurance / Quality Control

6.1 The field notes generated from this procedure will be reviewed by the sampling team leader, project manager, or designee.

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7.0 Data and Records Management

- 7.1 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.2 Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

8.1 Qualifications and training

- 8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
- 8.1.2 Each person who performs this procedure will be trained by someone familiar with the procedure such that the procedure is performed in a consistent manner throughout the duration of the project. No field staff will perform this procedure without one-on-one training from another field staff that is familiar with the procedure.

8.2 Responsibilities

- 8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2 The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

10.0 Revision History

Revision	Date	Changes
0	March 2010	Original POP

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**Procedures for Acid Testing of Green-
Gray Mud and COPR**

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Figure 1 – UN 1789 Label





Project Operating Procedure

Wet Sieve for Grain Size Analysis for Soils with Chromium Procedures

Procedure Number: PPG 016

Revision No.: 0

Revision Date: June 2010

Kristen Streit POP Author

Date: 6/29/2010

Project Manager

Date: 6/29/2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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Wet Sieve

POP No.: PPG 016
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Wet Sieve

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1.0 Scope and Applicability

- 1.1 This Project Operating Procedure (POP) defines basic techniques for field screening of wet soil to determine the percent by weight of COPR particles and grain size. Sieving will be done wet to avoid generation of dust.

2.0 Health and Safety Considerations

- 2.1 The work will be conducted in accordance with the site specific HASP and the Job Safety Analysis. This procedure is specifically designed to prevent dusty conditions during soil handling. Due to the possibility of release of volatile organics and contamination of equipment, soil with MGP material and/or photoionizing detector readings over 10 ppm will not be processed.

3.0 Interferences

- 3.1 Debris (twigs, roots, trash, etc) that is not removed from the soil prior to and during screening can lead to high bias in the amount for each screen. The addition of water may slightly increase the estimated weight of COPR nodules. The goal is to measure weight percent COPR to $\pm 5\%$.

4.0 Equipment and Materials

- 5-gallon buckets
- 5-gallon bucket with holes drilled and lined with fine mesh
- 2-4 bricks
- Level D PPE with tyvek suit with booties and nitrile gloves
- Ear plugs
- Half face respirator (in the case of exceedence of air action levels)
- Scale capable of weighing at least 50 lbs $\pm$ 0.1 pounds
- Shovel
- 2", 1", $\frac{1}{2}$ ", $\frac{1}{4}$ " and No. 7 sieve screens

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- Additional screens No. 14 and No. 200
- Plastic tubs (One 14-gallon tub and at least 10 smaller tubs)
- Munsell color chart
- Field Screening for Grain Size Field Form (Attachment 1)
- Field logbook and pen
- Site HASP
- Work Plan
- Screen Shaker
- Camera (optional)

5.0 Procedures

5.1 Prior to initiation of sieving prepare the following equipment:

5.1.1 A 5-gallon bucket with holes and mesh. Drill small diameter holes (3/8") in the bottom on the sides of a 5-gallon bucket. Adhere a fine mesh (No. 200) to the bottom and sides of the inside of the bucket. Make sure the mesh is smaller than the smallest tray being used in the shaker.

5.1.2 Obtain two dedicated plastic containers for each sieve tray. Weigh each container and note the weight in both the field book and on the container. For each sieve size mark two plastic containers with the sieve size. You should have two plastic containers for each sieve size; one for the entire sieve size and one for chromium nodules.

5.1.3 Place the sieve machine in a bermed area on a plastic sheet.

5.2 Don the modified Level D PPE including tyvek suit with booties, nitrile gloves and hearing protection as instructed by the site-specific HASP.

5.3 Inspect the five gallon bucket prior to processing. Each bucket should have a grid designation and a depth interval. These should be noted on the sieve collection form. Review the soil classification data sheet. If the sample contains MGP material or PID readings over 10 ppm, do not process and call the project manager.

5.4 Place the 5-gallon bucket on the scale and record the weight on the field form.

5.5 Soil will be collected from the excavation under a separate POP (see the Sample Collection POP for details).

5.6 Weight the bucket containing the soil and record the weight on the field form.

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- 5.7 Fill the bucket with water so that it covers the soil. Allow the soil to soak in the water for at least 15 minutes to allow soil to soften.
- 5.8 Place two bricks in the bottom of a 14 gal or greater plastic tub. Place the 5-gallon bucket with holes and mesh on top of the bricks.
- 5.9 Transfer the soil and water that has been soaking in the bucket into the 5-gallon bucket with holes. Allow the water to drain from the bucket but make sure the soil does not dry out. Make sure the bottom of the bucket is not sitting in standing water (add more bricks if necessary to insure the bucket is out of the water).
- 5.10 Dispose of the water in the frac tanks for off-site disposal.
- 5.11 Weigh the filled 5-gallon bucket and record the weight on the field form. Subtract the initial weight of the bucket to determine the actual soil (and water) weight.
- 5.12 Pour the contents of the 5-gallon bucket into the top of the Gilson Porta-Screen. If the sample weight was greater than 60 lbs. only pour half of the soil into the shaker at a time. If the sample is split be sure to combine the total at the end. **Follow the instructions provided by Gilson when operating the shaker** (Attachment 2).
- 5.13 Transfer the contents of each tray into a separate pre-weighed dedicated grain size container. Weigh and record the weight on the field form making sure to subtract the container weight.
- 5.14 Sort through each container and pull out the chromium nodule. Place the chromium nodules in another pre-weighed container. Once all the chromium nodules are separated from the soil, weigh and record the weight of each chromium nodule container making sure to subtract the container weight. COPR nodules are typically round and 1/8 to 1/4 inch in size. Large particles and irregular shapes are possible. Suspect nodules can be scrapped or crushed for closer examination. Compare visual clues to sample COPR pellets.
- 5.15 Calculate percent weight of COPR by the following equation:
$$\text{Total weight of COPR pellets} / \text{Weight of soil tested (prior to wetting)} \times 100\%$$
- 5.16 Dispose of soil and chromium nodules in the soil stockpile for off-site disposal.

6.0 Quality Assurance / Quality Control

- 6.1 The field forms and field notes generated from this procedure will be reviewed by the sampling team leader, project manager, or designee.

7.0 Data and Records Management

- 7.1 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

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- 7.2** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

8.0 Personnel Qualifications and Training

8.1 Qualifications and training

- 8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
- 8.1.2** Each person who performs this procedure will be trained by someone familiar with the procedure such that the procedure is performed in a consistent manner throughout the duration of the project. No field staff will perform this procedure without one-on-one training from another field staff that is familiar with the procedure.

8.2 Responsibilities

- 8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

ASTM, 1993, Standard Practice for Wet Preparation of Soil Samples for Particle Analysis and Determination of Soil Constants D 2217-85

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

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Attachment 1

Soil Sieve Data Form

Date _____

Staff _____

Grid ID _____ Depth Interval _____

Does the sample contain MGP material or have a PID reading over 10 ppm Y/N **(if yes to either of these questions do not process and call the project manager)**

- a. 5-gal bucket weight without soil _____
- b. 5-gal bucket and soil weight _____
- c. Soil weight (b-a) _____
- d. 5-gal bucket and soil weight after soaking in water _____
- e. Wet soil weight (d-a) _____

f. Empty plastic container weight (Soil and COPR container)

2" material _____ 1" material _____ ½" material _____

1/4" material _____ No. 7 material _____ No. 200 material _____

g. Empty plastic container (COPR container)

2" material _____ 1" material _____ ½" material _____

1/4" material _____ No. 7 material _____ No. 200 material _____

h. Plastic container with soil and COPR

2" material _____ 1" material _____ ½" material _____

1/4" material _____ No. 7 material _____ No. 200 material _____

i. Soil and COPR weight (h-f)

2" material _____ 1" material _____ ½" material _____

1/4" material _____ No. 7 material _____ No. 200 material _____

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j. Plastic container with COPR weight

2" material _____ 1" material _____ ½" material _____
1/4" material _____ No. 7 material _____ No. 200 material _____

k. COPR weight (j-g)

2" material _____ 1" material _____ ½" material _____
1/4" material _____ No. 7 material _____ No. 200 material _____

l. Total COPR weight ($\sum k$) _____**m. Total COPR percent ($l/e*100$) _____****n. Grain size percentage (soil and COPR) ($i/e * 100$)**

2" material _____ 1" material _____ ½" material _____
1/4" material _____ No. 7 material _____ No. 200 material _____

o. COPR percentage by grain size ($k/l*100$)

2" material _____ 1" material _____ ½" material _____
1/4" material _____ No. 7 material _____ No. 200 material _____

Notes: _____

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Attachment 2

Gilson Porta-Screen Operating Manual



OPERATING MANUAL

Gilson Porta-Screen® PS-3 & PS-4



02/23/2010

SAFETY INSTRUCTIONS

GILSON PORTA-SCREEN®

WHETHER YOU ARE THE OWNER, EMPLOYER, OPERATOR, OR MAINTENANCE PERSON FOR THIS MACHINE, SAFETY IS YOUR RESPONSIBILITY. YOU ARE RESPONSIBLE FOR OPERATING AND MAINTAINING THIS EQUIPMENT IN COMPLIANCE WITH THESE INSTRUCTIONS AND FOR USING COMMON SENSE. YOU SHOULD ALWAYS REVIEW AND COMPLETELY UNDERSTAND THESE SAFETY AND OPERATING INSTRUCTIONS BEFORE USING THIS MACHINE.



DANGER: This machine operates on electrical current. Improper use could result in electric shock, electrocution, injury by explosion, or even death.

1. **ALWAYS** make sure the motor and electrical components are appropriate and properly configured for your intended use and available power source. Porta-Screens are normally wired for 115 volts 60Hz and come with a 1/4 hp non-explosion-proof motor.
2. **ALWAYS** check electrical wiring for loose connections and for pinched or frayed wiring.
3. **ALWAYS** ground the Porta-Screen®. Connect its three-pronged plug to a properly-wired, three-pronged, grounded receptacle with appropriate electrical current for the machine.
4. **ALWAYS** disconnect and lock out the power supply before performing maintenance or repairs on your machine.



DANGER: The 1/4 hp, 115-volt motor of the Porta-Screen® has internal thermal protection. Therefore, the motor will automatically shut off if overloaded. The motor will restart by itself after cooling unless disconnected from its power source during cool-down.



DANGER: Do not use the Porta-Screen® in an explosive or hazardous atmosphere. It is not explosion-proof.

Warning: Operate only in a properly-ventilated area.

Warning: Level the Porta-Screen® before operation.

Warning: Stop the Porta-Screen® if excessive vibration or machine movement occurs.

Warning: Always take care not to pinch your fingers between the clamp levers and the machine frame.

Warning: Do not operate without all guards and covers in place.

Warning: Keep all parts of your body away from moving parts of the machine while it is operating.

Warning: Do not wear loose clothing which might be caught in moving parts of the machine.

Warning: Wear safety glasses, protective clothing, and hearing protection. Wear approved NIOSH/MSHA respirator as required by the sample to prevent your inhaling any dust which may be considered hazardous.

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Gilson Porta-Screen®

The Gilson Porta-Screen® is a portable shaker for field control of construction aggregates and for quality control in asphalt and ready-mix plants. It is designed for best separation in the 2" (50.8mm) to No. 16 (1.18mm) range. Model PS-3 holds five screen trays and a pan; PS-4's capacity is seven trays and a pan.

1.0 Unpacking & Installation

The Porta-Screen®, packed for shipment, weighs between 225 and 255 lbs, depending on the model and the number of trays packed inside. Use equipment to adequately to handle this weight safely.

1. The Porta-Screen® is shipped in a cardboard carton. Before you accept the shipment, check the carton for visible damage. Note any damage on the freight bill, and proceed with inspection.
2. Place the carton on its side so that you can remove the staples from the bottom. Open the bottom flaps and set the machine upright again. Lift off the carton and set it aside until you are sure that the Porta-Screen® is in acceptable condition.
3. Check the machine for shipping damage. If you find concealed damage after you have signed for the Porta-Screen®, call the delivering carrier immediately for an inspection. Save all packing materials, and leave the Porta-Screen® as it is.
4. Check the tag on the electric motor of the Porta-Screen® to be sure that the machine is wired as ordered.
5. Release clamping pressure on the Porta-Screen® trays by rotating the clamp levers outward and upward 180°.
6. Remove trays by sliding them out the front of the machine.
7. Choose your operating site:
 - A. The Porta-Screen® requires a properly-wired, three-pronged, grounded receptacle with appropriate electrical current for the machine.
 - B. Choose a well-ventilated site.
 - C. Set the Porta-Screen® on a solid, stable floor, platform, or other surface.
8. When you have placed the Porta-Screen® in its operating location, and each time you move it, level the unit by adjusting the three leveling legs.

To extend a leg, place your foot on the edge of the pad, and lift up on the machine above the leg.

To contract a leg, depress the leg lock tab, which extends from the case above each footpad.

Use the bullseye level in the top frame crossbar as a guide.

After you have placed the Porta-Screen® into service, observe the distribution of sample material in the trays at the end of a test. If the material is not evenly distributed, re-level the machine.
9. Reinstall the trays in the Porta-Screen®. Leave them unclamped.
10. Do not plug in the Porta-Screen® until you are ready to use it.

2.0 Operation

WHETHER YOU ARE THE OWNER, EMPLOYER, OPERATOR, OR MAINTENANCE PERSON FOR THIS MACHINE, SAFETY IS YOUR RESPONSIBILITY. YOU ARE RESPONSIBLE FOR OPERATING AND MAINTAINING THIS EQUIPMENT IN COMPLIANCE WITH THESE INSTRUCTIONS AND FOR USING COMMON SENSE. YOU SHOULD ALWAYS REVIEW AND COMPLETELY UNDERSTAND THESE SAFETY AND OPERATING INSTRUCTIONS BEFORE USING THIS MACHINE.

Warning: Operate only in a properly ventilated area.

Warning: Level the Porta-Screen® before operation.

Warning: Stop the Porta-Screen® if excessive vibration or machine movement occurs.

Warning: Always take care not to pinch your fingers between the clamp levers and the machine frame.

Warning: Do not operate without all guards and covers in place.

Warning: Keep all parts of your body away from moving parts of the machine while it is operating.

Warning: Do not wear loose clothing which might be caught in moving parts of the machine.

Warning: Wear safety glasses, protective clothing, and hearing protection. Wear approved NIOSH/MSHA respirator as required by the sample to prevent your inhaling any dust which may be considered hazardous.

Procedure:

Read and be sure you understand all safety, operating, and timer instructions, as well as specifications and procedures for your test.

1. Check to see that the Porta-Screen® is level.
2. Select and load the appropriate trays.

Fill all the slots: five trays and pan for the PS-3
seven trays and pan for the PS-4

The Porta-Screen® will not clamp or operate properly unless fully loaded with trays. If your test requires fewer trays than the capacity of the Porta-Screen®, you may insert the required trays in the upper slots with the pan immediately below. Then fill the lower slots with extra trays.
3. Clamp the trays by rotating the clamp levers so that they point down.
4. Pour your sample into the top tray. Refer to the sample capacity information and be sure not to overload the Porta-Screen®.
5. Connect the three-pronged plug into a properly-wired, grounded receptacle with appropriate electrical current.
6. Set and activate the timer.
7. When the machine stops, unclamp the trays by rotating the clamp levers so they point up. Remove and empty the trays, following the directions in your test specifications.
8. When you have finished your test, unplug the machine. Do not reconnect power until you are ready to use the machine again.
9. Store clean, empty trays in the unit, leaving them unclamped.
10. Re-level the machine before the next use.

3.0 Sample Capacity

Capacity of the Porta-Screen® depends on the specifications of the test and the type and size of the material being tested. For any given sample, the Porta-Screen's maximum capacity is determined by the tray which has the largest load at the end of the test. This is the limiting tray.

Coarse Aggregates:

Minimum quantity of sample is usually established by the specifications of the test procedure. For example, ASTM C-136 "Specification for the Sieve or Screen Analysis of Fine and Coarse Aggregates" calls for the minimum weight of the test sample of coarse aggregates (density such as limestone or gravel) as follows:

Normal Maximum Size of Particle mm (in)	Minimum Sample Weight kg (lb)
9.5 (3/8)	1 (2)
12.5 (1/2)	2 (4)
19.0 (3/4)	5 (11)
25.0 (1)	10 (22)
37.5 (1-1/2)	15 (33)
50 (2)	20 (44)
63 (2-1/2)	35 (77)

These guidelines on minimum sample size quantities are for representative samples. Always take a much larger amount, perhaps from several spots in a storage bin or stockpile. Then combine and reduce them to the correct quantity by splitting.

With coarse series trays, (2" to No. 4), the limiting tray should have no more than one layer of particles over the wire cloth at the end of the test. Therefore, lightweight aggregates or coal must be tested in lower sample weights. High-density ores or pellets may be tested in larger amounts by weight. Many light materials are also soft, and test times should be limited to avoid degradation of the sample.

Most samples of up to 2" topsize can be handled in a single batch without difficulty. We do not recommend the use of trays with mesh sizes above 1-1/2", since larger particles become wedged in the mesh and make it difficult to remove the trays.

Fine Aggregates:

With fine series trays, (No. 8 to No. 200), the limiting tray should contain no more than approximately four grams per square inch of sieve surface at the end of a test. Assuming that the material is about the density of sand, there will be approximately 800 grams maximum on the limiting tray.

Since the Porta-Screen® is designed primarily for use in the 2" to No. 20 range, separations in finer sizes will not be as precise. If you are testing materials exclusively in the fine range, we recommend equipment specifically designed for this purpose, such as the Gilson Model SS-8R Sieve Shaker.

4.0 Maintenance & Disassembly

READ AND BE SURE YOU UNDERSTAND ALL SAFETY AND MAINTENANCE INSTRUCTIONS BEFORE PERFORMING MAINTENANCE ON YOUR PORTA-SCREEN®.

ALWAYS DISCONNECT AND LOCK OUT ELECTRIC POWER BEFORE PERFORMING MAINTENANCE.

Clamping System:

1. DISCONNECT AND LOCK OUT ELECTRIC POWER.
2. Load the Porta-Screen® with trays and pan, filling all the slots.
3. Rotate the clamp levers (#38) so that they point down.
4. Locate the clamp adjusting nuts (#9), which are on the lower ends of the four clamp tension rods (#7).
5. Tighten the nuts only enough to prevent the trays from rattling when the machine is operating.

Lubrication:

1. DISCONNECT AND LOCK OUT ELECTRIC POWER.
2. Remove and set aside trays and pan.
3. Remove upper case cover.
4. Connection Rod Bearing:
Lubricate the connecting rod bearing (#52) after every 80 to 100 hours of operation.
 - a. Rotate drive shaft (#20) slightly by hand until the grease fitting at the lower end of the connecting rod (#50) is accessible. (Grease fitting may be pointing either to the front or to the back of the Porta-Screen®).
 - b. Apply a small amount of any good-quality bearing grease.
 - c. Proceed to shaft bearing lubrication.
5. Shaft Bearings:
There are two bearings (#47), front and rear, on the drive shaft (#20), and two bearings (#41), front and rear, on each of the two counterweight shafts (#12, 13). Some Porta-Screens have sealed shaft bearings; others have shaft bearings with grease fittings. If the shaft bearings on your machine have grease fittings, lubricate the bearings after every 80 to 100 hours of operation.
 - a. WITH ELECTRIC POWER DISCONNECTED AND LOCKED OUT, and trays, pan, and upper case cover removed, remove lower front and rear case covers.
 - b. Apply a small amount of any good-quality bearing grease.
 - c. Reassemble in reverse order.
6. Motor Bearings: Lubricate annually.
 - a. Remove trays, pan, and upper case cover.
 - b. Remove lower front and rear case covers.
 - c. Find and remove the oil plugs at each end of the motor.
 - d. Insert a few drops of oil.
 - e. Replace plugs.
 - f. Reassemble in reverse order.
7. Idler Pulley Bearings:
These sealed bearings (#62) do not require lubrication.

Belts: The Drive Belt (#22) should fit snugly. If the belt is too tight, it will soon wear out, causing bearings to wear and resulting in noisy operation. A loose belt may cause the unit to run too slowly or to slip. Keep the drive pulley (#21) and motor pulley (#60) aligned so that the drive belt is straight.

The Timing Belt (#16) should fit tightly.

Access to Belts:

1. DISCONNECT AND LOCK OUT ELECTRIC POWER.
2. Remove and set aside trays and pan.
3. Remove all case covers.
4. Drive Belt:
Check tension by pressing on the span of the belt. If properly adjusted, the belt should be deflected 1/64th of the value of the distance between the pulleys. To adjust or remove, loosen the motor mounting bolts (#61); and the motor will slide up, loosening the belt tension.
 - a. To adjust, move the motor up or down until the belt tension is correct. Retighten the nuts.
 - b. Or remove the loosened belt if it is worn, and install a new one. Obtain the correct tension by moving the motor up or down. Retighten the nuts.
 - c. Continue or reassemble.
5. Timing Belt:
Check tension by pressing on the span of the belt. The belt should be tight. To adjust or remove the timing belt, loosen the two idler bracket mounting screws (#45). Loosen the nut on the adjusting screw (#46).
 - a. To tighten: Turn in the adjusting screw to pull the bracket (#17) down and increase tension on the belt. Retighten the nut to hold the bracket in position. Reassemble.
 - b. To replace: Loosen the adjusting screw to permit the idler bracket to move upward, loosening the tension on the timing belt so that you can remove it. Before reinstalling belt,

- (1) Rotate drive shaft (#20) until the connecting rod (#50) is at its highest position.
- (2) Rotate counterweight shafts (#12, #13) until counterweights are at their lowest position.
- (3) Fit the belt around the left counterweight shaft pulley, around the timing pulley (#49), above the right counterweight shaft pulley, and around the idler pulley (#19).
- (4) Tighten the idler bracket adjusting screw until the timing belt is tight, making certain that you do not change the position of the shafts. Lock the idler bracket in position with the nut. Tighten the bracket mounting screws.
- (5) Reassemble.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

Bearing Replacement:

1. Guide Bearing Assemblies:

The Porta-Screen® has three guide bearing assemblies: each has a housing and guide bushing. The two upper guide bearings (#34) are mounted to the top frame crossbar. The lower guide bearing (#59) is mounted to the underside of the vibrating unit.

If you notice side-to-side movement of the vibrating unit during operation, inspect the guide bearings and replace them if necessary. We recommend replacement of all three assemblies at the same time.

- a. DISCONNECTANDLOCKOUTELECTRICPOWER.
- b. Remove and set aside trays and pan.
- c. Remove top frame screws (#2), and lift off top frame crossbar (#1).
- d. Upper:
 - (1) Remove mounting screws (#35) to detach bearing housing (#34).
 - (2) Replace with new bearing housing assembly.
- e. Lower:
 - (1) Remove all case covers.
 - (2) Remove the connecting rod mounting bolt (#24).
 - (3) Lift the entire vibrating unit assembly up and out of the Porta-Screen® frame.
 - (4) Remove mounting screws (#56) to detach bearing housing unit (#59).
 - (5) Replace with new bearing housing assembly.
- f. Reassemble in reverse order.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

2. Connecting Rod & Drive Shaft Bearings:

The connecting rod (#50) can be replaced as an assembly, or you can press out and replace its bearing and bushing (#52).

The drive shaft (#20) has front and rear bearings (#47). We recommend replacement of both front and rear bearings as a set.

- a. DISCONNECTANDLOCKOUTELECTRICPOWER.
- b. Remove and set aside trays and pan.
- c. Remove top frame screws (#2).
- d. Lift off top frame crossbar (#1).
- e. Remove all case covers.
- f. Remove the connecting rod mounting bolt (#24).
- g. Lift the entire vibrating unit assembly up and out of the Porta-Screen® frame.
- h. Loosen the motor mounting bolts to release tension on the drive belt, and remove the drive belt from its pulleys.
- i. Loosen the setscrew in the drive pulley (#21), and slide the pulley off the drive shaft.
- j. Loosen the setscrew in the rear drive shaft bearing.
- k. Loosen the idler bracket mounting and adjusting screws (#45, 46) to release tension on the timing belt.
- l. Remove the timing belt (#16).
- m. Loosen the setscrew in the drive shaft pulley (#49), and slide the pulley off the drive shaft.
- n. Remove the mounting screws from the front drive shaft bearing (#47).
- o. Hold onto the top of the connecting rod (#50) while you pull the drive shaft out from the front of the machine with the front bearing attached.
- p. Remove the connecting rod (#50).
- q. Install new connecting rod assembly or press new bushing and bearing into existing connecting rod.
- r. Replace drive shaft bearings if needed.
- s. Continue or reassemble in reverse order. When replacing timing belt, refer to timing belt instructions and be sure that counterweights are aligned properly.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

3. Counterweight Shaft Bearings:

Each of the two counterweight shafts (#12, 13) has a front and a rear bearing (#41). We recommend replacement of both bearings on a shaft. If you have disassembled the Porta-Screen® to replace the connecting rod and/or drive shaft bearings, skip to step h. Otherwise, disassemble as follows:

- a. DISCONNECT AND LOCK OUT ELECTRIC POWER.
- b. Remove and set aside tray and pan.
- c. Remove top frame screws (#2).
- d. Lift off top frame crossbar (#1).
- e. Remove all case covers.
- f. Remove the connecting rod mounting bolt (#24).
- g. Lift the entire vibrating unit assembly up and out of the Porta-Screen® frame.
- h. Loosen the idler bracket mounting and adjusting (#45, 46) to release tension on the timing belt.
- i. Remove the timing belt (#16).
- j. Loosen the bolts on the rear counterweight clamp bracket (#43), and remove the counterweight from the shaft.
- k. Loosen the setscrew which holds the rear bearing to the counterweight shaft.
- l. Remove the mounting screws (#42) which hold the front counterweight shaft bearing (#41) to the main frame.
- m. Pull the counterweight shaft from the front of the machine with its front counterweight, pulley, and front bearing all attached.
- n. Reinstall parts as needed.
- o. Reassemble in reverse order. When replacing timing belt, refer to timing belt instructions and be sure that the counterweights are aligned properly.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

4. Wire Cloth:

Check condition of wire cloth both before and after operation. Test results can be only as accurate as the size of wire cloth openings. Always replace with testing grade wire cloth only.

Testing grade wire cloth is a precision-made material and should be treated with care. The ASTM E-11 specification permits only very slight variations in average opening and wire diameter. Abrasion due to normal use and/or improper cleaning and handling can cause the wire cloth to be out of specification to a considerable degree before it appears worn. Check it frequently to be sure that it conforms to your test specifications.

Wire cloth life can be extended by establishing proper procedures for handling, cleaning, and storage of trays. The Porta-Pan Accessory is helpful in the repetitive sequence of emptying trays, cleaning wire cloth, and weighing sample fractions.

Wire cloth may eventually sag, reducing its effective screening area. Wire sizes 2" to No. 14 are rigid and self-supporting. Trays for No. 16 through No. 80 wire cloth contain three wire cloth support strips. No. 100 and finer trays have supporting backup cloth to minimize wear and distortion. When you replace No. 16 and finer wire cloth, always use support strips or backup cloth as indicated.

5.0 Parts List

PARTS		NO. REQUIRED
<i>Outer Case & Frame Parts</i>		
1	Top frame cross bar	1
2	Top frame screw & lock washer	4
31	Bullseye level with cushion washer	1
36	Bullseye level adjusting screws	3
27	Leg lock tab	3
33	Leg lock tab spring	3
65,28	Leveling leg (65), with adjusting screw pad, nut & washer	3
29	Main frame	1
30	Vibrating unit assembly	
	Upper case cover	2
11A	Lower case cover, front	1
	Lower case cover, rear	1
<i>Upper Guide Bearing Assembly Parts</i>		
34	Upper guide bearing housing with guide bushing	2
35	Upper guide bearing mounting screw & lock washer	4
4	Upper guide bearing pin & set screw	2
<i>Clamping Assembly Parts, Right & Left</i>		
5A	Clamp lever with mounting bracket 6F left side	1
5B	Clamp lever with mounting bracket 6F right side	1
38	Clamp lever handle grip	2
6R	Rear clamp lever mounting bracket	2
39	Clamp lever mounting bracket screw & lock washer	8
7	Clamp tension rod	4
40	Clamp tension rod retainer clip, screw and lock washer	4
8	Clamp bar	1
9	Clamp adjusting nut and spacer	4
<i>Counterweight Assembly Parts</i>		
12	Left counterweight shaft (short)	1
13	Right counterweight shaft (long)	1
41	Counterweight shaft bearing	4
42	Counterweight shaft bearing mounting screw & lock washer	8
14	Counterweight	4
43	Counterweight clamp bracket	4
44	Counterweight clamp bracket bolt & lock washer	8
15	Counterweight shaft pulley & set screw	2
16	Timing belt	1
17	Idler bracket	1
45	Idler bracket mounting screw with lock & flat washers	2
46	Idler bracket adjusting screw with locking nut	1
18	Idler pulley mounting screw & lock washer	1
19/62	Idler pulley with bearing set	1
<i>Drive Shaft Assembly Parts</i>		
20	Drive shaft with eccentric, set screw, and roll pin	1
47	Drive shaft bearing	2
42	Drive shaft bearing mounting screw & lock washer	4
49	Timing pulley & set screw	1
21	Drive pulley with set screw	1
22	Drive belt	1

PARTS	NO. REQUIRED
<i>Connecting Rod Assembly Parts</i>	
50 Connecting rod with grease fitting	1
51 Connecting rod rubber bushing	1
52 Connecting rod bearing with inner race	1
— (Connecting rod assembly - Parts 50, 51, 52, assembled)	(1)
24 Connecting rod mounting bolt with lock nut	1
54 Connecting rod mounting bolt spacer	2
<i>Lower Guide Bearing Assembly Parts</i>	
59 Lower guide bearing housing with guide bushing	1
56 Lower guide bearing mounting screw & lock washer	2
26 Lower guide bearing pin	1
64 Lower guide bearing pin clamp bolt with lock nut	1
<i>Electric & Drive Parts</i>	
63 Motor, 1/4 hp, 115V, 60Hz, 1Ph, 1725 RPM	1
60 Motor Pulley & set screw	1
61 Motor mounting bolt with lock & flat washer	4
— Electric cord assembly, motor-to-timer	1
— Electric cord assembly, with ground plug	1
— Electric cord grip grommet	1
Timer, Digital (EDA)	1
Timer, Digital (Artisan)	1

Replacement Trays and Wire Cloth

Porta-Screen® Tray, complete with wire cloth

Model

PSA-300	2" to No. 4 inclusive
PSA-301	No. 5 to No. 14 inclusive
PSA-302	No. 16 to No. 80 inclusive with wire cloth supports
PSA-302	No. 100, with backup cloth
PSA-306	No. 200, with backup cloth
PSA-310	Dustpan tray

Replacement Wire Cloth, complete with metal shields & resilient gasket backing

Model

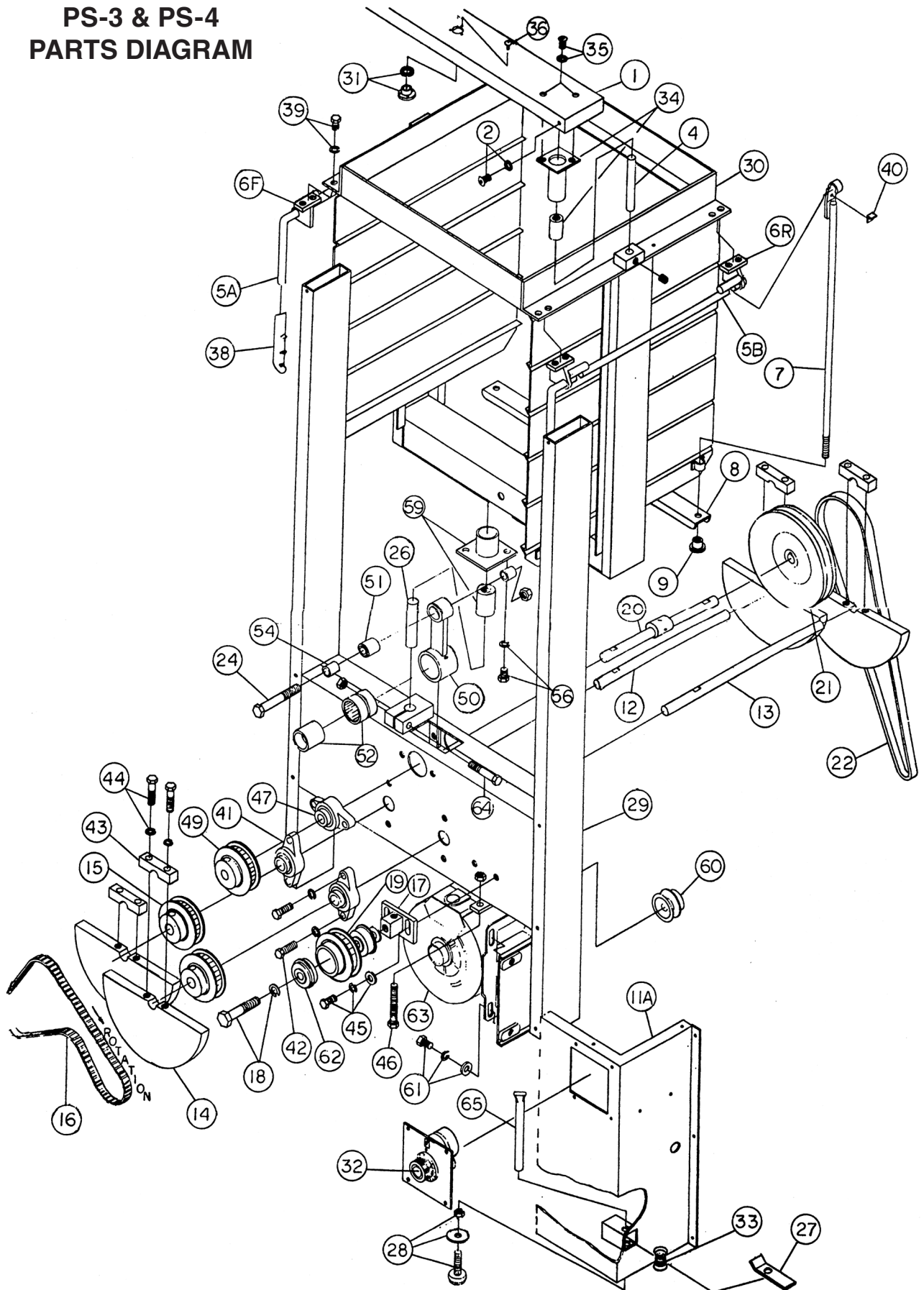
PSA-325	2" to No. 4 inclusive
PSA-326A	No. 5 to No. 14 inclusive
PSA-326B	No. 16 to No. 100 inclusive
PSA-327	No. 200
PSA-225	Backup cloth (use with No. 100 to No. 200)

Screen Tray Parts

Model

PSA-336	Tray, complete, but without wire cloth, supports, or backup cloth
	Tray side clamp (4 required per tray)
	Tray bolts & nuts (12 required per tray)
	Wire cloth support (3 required per tray)

PS-3 & PS-4 PARTS DIAGRAM



6.0 Accessories



Porta-Screen® has Foot-Tab leveling.



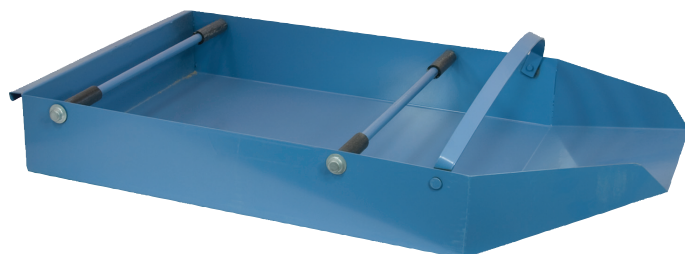
Porta-Screen® Tray cloth has metal shields to eliminate partial openings.

PSA-114 Porta Wheels may be attached for added mobility. Ball-bearing wheel assemblies with rubber tires are predrilled for quick attachment to frame of Porta-Screen®.



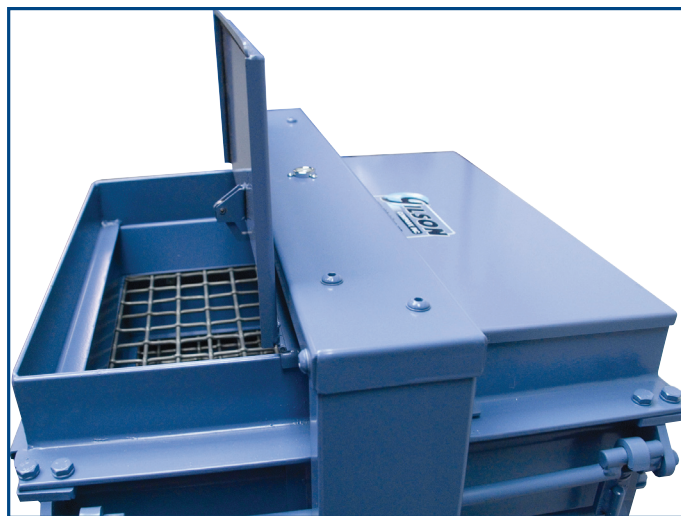
PSA-114

PSA-367 Porta-Pan is helpful in emptying and cleaning trays and in weighing operations. This 17x30x4in (432x762x102mm), WxLxD chute-end pan is sized to fit inverted trays and hold entire samples for cumulative weighing. Handling is easy with the top swing-away handle and end handle grip.



PSA-367

PSA-312 Porta Cover bolts to the top flange to enclose the sample chamber. It has a latch, and is hinged to open for introduction of samples.



PSA-312 on PS-3

Project Operating Procedure

Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

Procedure Number: PPG 017

Revision No.: 1

Revision Date: June 2010



POP Author: Henry Chow

Date: June 29, 2010



Program Manager: Frank R. Tringale

Date: June 29, 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Project Operating Procedure
**Operation of the TSI Model 8520
DustTrak™ Aerosol Monitor**

POP No.: PPG 017
Revision: 0
Date: June 2010
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Project Operating Procedure

Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

POP No.: PPG 017
Revision: 1
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1.0 Scope and Applicability

- 1.1** This Project Operating Procedure (POP) defines the procedures for monitoring particulate matter (PM) using a totally portable system.
- 1.2** This POP is to be utilized to conduct the work identified in the title of this POP. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

2.0 Health and Safety Considerations

- 2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, as well as personal protective equipment (PPE) requirements, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager Interferences.

3.0 Interfaces

- 3.1** The following may cause errors in data that could cause erroneous operation of this system:
- If the analyzers are in need of maintenance or repair;
 - If environmental conditions are beyond the limits specified in the instrument manual;
 - Excessive ambient moisture either because of high humidity or precipitation will interfere with the proper operation of either instrument; and
 - Operation of the system in portable mode without a fully charged battery can interfere with the proper measurement of PM data.

4.0 Equipment and Materials

- 4.1** The following equipment and materials are required for operation of the PAM station:
- Trimpot screw driver;
 - Flow meter with a measurement range of 0-3 LPM;
 - Zero particulate filter; and
 - Operator manuals for TSI model 8520 DustTrak™ aerosol monitor.

Project Operating Procedure

Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

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5.0 Procedures

5.1 ON/OFF key

Press the ON/OFF key to power the DustTrak monitor. The DustTrak monitor immediately begins an internal self-check, while illuminating the display digits and symbols. If a problem is detected, the display shows the message "SERVICE" along with a number indicating that the DustTrak monitor requires service. Refer to Chapter 5: "Troubleshooting," of the manual for information regarding service numbers. If the "SERVICE" message appears, the DustTrak monitor will pause until any key is pressed. (**NOTE:** when the cause of the service message is resolved, the message must be reset according to instructions specified in the user manual, if not, the message will re-appear again each time the DustTrak is powered on.)

5.2 Manually Setting the Real-Time Clock

To set the time and date with the keypad, you must press and hold the SAMPLE key while the DustTrak monitor displays the current time. Hold the SAMPLE key until the monitor "beeps". You will have an opportunity to view and/or change the year, month, and calendar day, hours, and minutes in sequence.

Use the up and down arrow keys (↓↑) to change a setting. Use the SAMPLE key to store each setting and advance to the next one. (**NOTE:** it is imperative to set the correct time and date when operating in the data logging mode.)

5.3 SAMPLE Key

Press the SAMPLE key to start/stop data sampling. The word "SAMPLE" appears in the upper right corner of the display while the DUSTTRAK monitor is in sample mode. When sampling is stopped, the DustTrak monitor automatically scrolls through statistics for the sampling period that just ended. (**NOTE:** Data sampling must be stopped in order to establish communication with TrakPro software to download logged data.)

5.4 TIME CONSTANT Key

Momentarily press and release the TIME CONSTANT key to view the current time-constant. To change the time-constant, press and hold the key down. The available time-constant choices will scroll on the display. When the desired value is displayed, immediately release the key. Select 10 seconds as the time constant for standard operation.

5.5 SAMPLING MODE Key

The SAMPLING MODE key allows you to select among the four (4) sampling modes: Survey, LOG 1, LOG 2, and LOG 3. Each time you press the SAMPLING MODE key, the DustTrak monitor sequences to the next mode. When the DustTrak monitor is in Survey mode, the current measurement will be shown on the display. When one of the LOG modes is selected,

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Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

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the LOG mode number, (i.e., LOG 1, LOG 2, or LOG 3) will be displayed along with the percentage of free memory available.

5.6 Survey Mode

When the DustTrak monitor is first turned on, it will always be in Survey mode. Survey mode allows you to make real-time measurements of aerosol concentrations, and to obtain statistics for that sample. The statistics include the average, minimum, and maximum values, as well as the elapsed time for that sample. Individual data points are not recorded in internal memory (this can be done in any of the LOG modes). Each new sample taken in Survey mode clears the previous sample data from memory. Data taken in Survey mode remains in memory until another sample is made, or until samples are taken in one of the LOG modes. Turning the DustTrak monitor off will **not** erase data.

Use the SAMPLE key to start and stop a sample

5.7 LOG Modes

There are three (3) LOG modes: LOG 1, LOG 2, and LOG 3. When one of these modes is selected using the SAMPLING MODE key, the LOG mode number will be listed at the top of the display. The LOG modes allow you to record aerosol concentration data points in the internal memory for later retrieval and analysis using the TrakPro software provided with the instrument. Use the SAMPLE key to start and stop recording. The word "RECORDING" appears at the top of the display when recording is in progress. The frequency that data is recorded can be set for LOG 1 mode with the LOGGING INTERVAL key. (**NOTE:** the logging interval is also the data averaging time used by the DustTrak and only block average can be generated.) Use TrakPro software for LOG 2 and LOG 3 modes. (**NOTE:** LOG2 and 3 are for timed or scheduled on/off sampling.)

Data recorded using one of the LOG modes can only be erased by using the CLEAR MEMORY key. Turning the DustTrak monitor off **will not** erase data. Recording another sample (by turning sampling off and on again) with one of the LOG modes without clearing memory first will cause new data to be added to the existing data in the memory and these new data will be identified with a new TEST number.

5.8 LOGGING INTERVAL key

This key sets the frequency and averaging period for LOG1 mode. Use SAMPLE MODE key to set the monitor to LOG1 mode, press and hold the LOGGING INTERVAL key, release this key when the desired interval is displayed. (**NOTE:** Only TrakPro software can be used to set interval for LOG 2 and 3.)

5.9 CLEAR MEMORY Key

Use the CLEAR MEMORY key to erase stored data. The CLEAR MEMORY key **will not** respond unless the DustTrak monitor is in one of the three LOG modes. (**NOTE:** before

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Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

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clearing the memory, you should first download the data to a computer through the TraKPro software.

There is only one block of memory in the DustTrak monitor. Clearing the memory for one LOG mode clears memory for all LOG modes.

To clear the memory, press and hold the CLEAR MEMORY key until the countdown reaches zero, then release quickly. This prevents the data from being accidentally erased. Releasing the key too soon or too late prevents memory from being cleared. (**NOTE:** the DustTrak monitor has memory capacity of 31,000 data points, if the data average interval is set to 15-minutes, it could store data up to a total of 322 days. After the memory is cleared 100% memory should be displayed.

5.10 The Arrow Keys



The two arrow keys are used to adjust the readings when calibrating the DustTrak monitor and for adjusting the time and date for the internal real-time clock.

5.11 CALIBRATE Key

Use the CALIBRATE key to put the DustTrak monitor into calibration mode. See Chapter 4, "Maintenance" and Step 5.1.12 below for details on how to perform zero calibration of the monitor.

5.12 Display/Keypad Lockout Switch

Recording data over extended time periods often requires leaving the DustTrak monitor unattended. To reduce the risk of having an unauthorized person either intentionally or inadvertently interrupt the measurements, you can lock the display and keypad. The lockout switch is on the backside of the DustTrak monitor between the data port and the external power socket. It is a small slide switch and is recessed so that a pointed device must be used to move it.

- With the switch in the right side position (nearest the power socket), the keypad and display functions will work normally.
- With the switch in the left side position (closest to the data port), the display and keypad will go into lockout mode.

There are two ways to use the lockout switch.

1. Lock the keypad after recording starts, or
2. Put the switch into the lockout position prior to when recording starts.

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The second method will enable you to operate each function normally *until* the SAMPLE key is pressed in one of the LOG modes. At that time the keypad automatically locks. When the display and keypad are locked, the display shows the words "RECORDING LOG X" where "X" is the current LOG mode number.

5.13 Zero Checking/Re-Zeroing/Calibration

To calibrate or perform a zero check on the DustTrak, use the following steps:

1. Put the DustTrak monitor in Survey mode;
2. Connect zero particulate filter (supplied by DustTrak manufacturer) on monitor sample inlet. (See Figure 4-1 of the manual for an illustration on how to make the connection);
3. Set the time-constant to 10 seconds, if necessary. Press and hold the TIME CONSTANT key until "10" is displayed, then release;
4. Wait 10–60 seconds for displayed values to settle to zero;
5. If the displayed value is between -0.001 and $+0.001$ mg/m^3 , the DustTrak monitor does not need adjustment. If the displayed value exceeds this limit, follow steps 6 to 8 below to re-zero the instrument;
6. Press and hold the CALIBRATE key and wait for the displayed countdown to reach 0, then immediately release the key. The message "CALIBRATE ZERO" is displayed. If it is not displayed, try again;
7. Press the SAMPLE key and wait for the 60-second countdown. When the countdown is completed, the current calibration constant will be displayed; and
8. Press the CALIBRATE key again to return to survey mode. The re-zeroing process is now completed.

5.14 Verification/Adjustment of sampling flow rate

The standard sampling flow rate for the DustTrak 8520 is 1.7 LPM and should be verified and adjusted initially and on a regular basis. The particle size cut-off is based on this flow rate for each size cut-off nozzles and cyclone.

Connect the flowmeter (supplied by manufacturer) to the monitor sample inlet, hold the flowmeter in a vertical position (as illustrated on Figure 4-4 of the manual) and verify the flowmeter ball height (middle of the ball) is at 1.7 LPM. If necessary, adjust the flow adjustment trimpot with a small screw driver until the flow rate is at 1.7 LPM. The flow adjustment trimpot is located at the back panel of the DustTrak monitor.

5.15 Maintenance

Project Operating Procedure

Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

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(See Chapter 4 of the Operation Manual for recommended maintenance schedule and detailed maintenance procedures)

5.16 Standard Startup Procedure for DustTrak 8520

Standard Startup procedure is as follows for the DustTrak:

5.16.1 Instrument set up

- Power up - press ON/OFF key
 - DustTrak should begin self-check sequence, and display all digits and symbols;
 - Verify no SERVICE messages; and
 - Verify adequate battery life remaining and no battery symbol is displayed.
- Verify internal clock - adjust clock if necessary either manually or through the use of TRAKPRO Software
- Verify flow rate @ 1.7 LPM – connect rotameter to inlet nozzle, check and verify ball high (mid-ball) at 1.7 LPM, adjust flow pot if necessary
- Verify time constant (recommended to use 10 seconds)
- Verify or Select/sampling particle size inlet. The selections are as follow:
 - 4.0 um: install BLACK nozzle and CYCLONE;
 - 10 um: install BLACK nozzle;
 - 2.5 um: install BLUE 2.5 um nozzle with impactor plate and O-ring; and
 - 1.0 um: install BLUE 1.0 um nozzle with impactor plate and O-ring.
- Zero checking/re-zeroing - perform this procedure:
 - Daily from cold start;
 - Ambient temperature change exceeds more than 8C;
 - Maintenance is performed; and
 - DustTrak is moved from high aerosol concentration to a low concentration location.
- Put DustTrak in SURVEY mode (press SAMPLE key if need to).
- Connect filter to inlet nozzle.
- Press and hold TIME CONSTANT key to verify display is in 10 sec (00:10:00).
- Wait 10-60 second sampling, readings should be approaching zero.
- If stable reading is between +/- 0.001 mg/m³, no zeroing will be needed.

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Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

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- If reading exceeds this limit, press and hold CALIBRATE key until count down to 0 and release key immediately, "CALIBRATE ZERO" message should be displayed, if not try again.
- Press SAMPLE key to initiate the 60 seconds countdown. Current calibration factor should be displayed after the countdown.
- Press CALIBRATE key to return DustTrak to survey mode and zeroing is completed.

5.16.2 Set DustTrak in one of the four SAMPLING MODES

- Survey mode – default mode after power up : to display real-time readings (no internal logging) – this mode is use mostly for analog output to connect to an external data logger.
- LOG 1 – sample and record average readings in internal memory
 - Press SAMPLE MODE until LOG1 is displayed;
 - Press LOGGING INTERVAL to verify averaging period (e.g., 15 minute);
 - Or press and hold key until the desired interval is displayed, release key immediately; and
 - Press SAMPLE key to start sampling. In addition to readings, **LOG1 Recording and Sample** message will also be displayed, this verifies that sampling is in progress and data averages will be stored in internal memory.

NOTE: each time when SAMPLE key is pressed to stop and start a new sampling event, a new test ID will be created for the current sampling event).

- LOG2 and LOG3 – user selectable auto start/stop operation and average readings recorded in internal memory.

5.16.3 Enable Alarm (only through the use of TraKPro software)

- Start up TraKPro.
 - Select Instrument Setup, select Parameters, Alarm Setpoint;
 - Check Alarm Enabled box;
 - Enter an alarm limit (e.g., 0.150 mg/m³);
 - Press send button to program the DustTrak;
 - When alarm is triggered, internal beeper will be on once/second and AL message will be flashing on display; and
 - Alarm will be turned off when reading falls below 5% of limit.

5.16.4 If LOG1 mode is used, verify and/or select the LOGGING INTERVAL. Verify adequate memory is available.

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5.16.5 Verify no battery warning is displayed. Press SAMPLE key to start the sampling session. (**NOTE:** SAMPLE should be displayed on the top right hand corner of the display panel).

5.17 Use of TraKPro Software

TraKPro is a companion software designed to assist in the operation of DustTrak 8520. TraKPro provides a number of operation features that cannot be initiated through the keypad.. These features include the following:

- Logging Interval for LOG2 and 3;
- Enable/disable data alarm and setting/modifying alarm threshold;
- Setting up analog output range;
- Downloading and exporting logged data; and
- Generating data reports.

5.17.1 Follow the procedure described in Chapter 2 "Setting up TraKPro Data Analysis Software" to connect the monitor to a Personal Computer (PC).

NOTE: Sampling must be stopped manually (press the SAMPLE key) in order to establish communications between the monitor and PC.

5.17.2 Follow the procedures described in Chapter 3 "Analog Output"; "Alarm Output Specifications and Programming the Alarm Set Point"; and "Programming Advanced Modes: LOG2 and LOG3" to configure the monitor as needed.

NOTE: DustTrak 8520 will alarm only on instantaneous readings.

5.17.3 Downloading and Exporting logged data

1. Open TraKPro Software.
2. Click on File in the TraKPro task bar.
3. Select Receive.
4. On the sub-menu "Logged data Test(s) to receive", sampling events stored in monitor (identify by Test ID number, Test date and time) will be listed on a menu. You either Select ALL or highlight the test ID to select the data you want to transfer from the DustTrak to the PC, and then click Receive...
5. After the data transfer is complete, a confirmed window "Logged Test(s)" will open with more detailed information on the selected test ID. By highlighting the Notes at the end of each test ID, the operator can add specific comments associated with each test ID (i.e., test location or site code before it is saved).

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6. Click File, select Save As, select a file destination, specify a file name, and click Save. The data will be saved with a TPK extension (the TrakPro native file).
7. To export data as text file that can be used with MS Excel, click File, select Export, and select Export Test Data. At this point a window will come up listing the test IDs, start date, and time.

NOTE: The default Data Delimiter is Comma.

Modify the selection as needed, highlight the monitoring event(s) to convert, click Export, specify a file destination, specify file name, and click Save. A text file with a .TXT extension will be created and saved.

NOTE: a standard file naming convention is recommended, at a minimum the name should contain information to identify the site location and date of sampling, an example is as follows:

NNNN mmddyy where:

NNNN = site code or location

mm = month

dd = day

yy = year

6.0 Quality assurance / quality control

- 6.1 Calibrations must always leave the analyzer operating within $\pm 5.0\%$ of the reference calibrator at each calibration input.
- 6.2 As soon as possible following calibration, the completed data form is to be submitted to the project manager or designee for review. Standards are reviewed for traceability and completeness. Data and strip chart readings (where applicable) are to be reviewed for agreement and completeness

7.0 Data and records management

- 7.1 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.2 Records associated with the activities described in this POP will be maintained according to the document management policy for the project.
 - 7.2.1 The field documentation (PAM Station Checklist) is included at the end of this POP.

Project Operating Procedure

Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

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- 7.3** Completed calibration data sheets are subject to senior review in accordance with AECOM senior review policy (SOP 1003, Senior Review). Calculations, standard conditions, correction factors, project identification, and other data will be reviewed for accuracy, completeness and conformance to the relevant AECOM operational SOP and the project QA Plan.

8.0 Personnel Qualifications and Training

8.1 Qualifications and training

- 8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

8.2 Responsibilities

- 8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2 The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

ENSR 1003, Senior Review.

ENSR SOP 1011, Preparation and Control of Standard Operating Procedures

TSI model 8520 DustTrak™ aerosol monitor

10.0 Revision History

Revision	Date	Changes
1	June 2010	Minor edits re typos



AECOM
2 Technology Park Drive
Westford, Massachusetts 01886

978.589.3000 tel
978.589.3100 fax

Routine Operations Check List

Portable Air Monitoring Stations

Week of (Monday date): _____

Site: _____

Activity	Technician's Results							Comments
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	
Daily Start-Up								
1. Time of Calibration								
2. Technician's Initials								
3. Perform <u>zero</u> check of RAE. Record results.								
4. Perform <u>span</u> check of RAE. Record results. (Re-span if > +/- 0.5 ppm)								
5. Perform <u>zero</u> check of DustTrak. Record initial results. (Re-zero if > +/- 1.0 ug/m ³)								
6. Perform flow check of DustTrak. Record initial results. (Acceptable flow 1.5 – 1.9 lpm)								
7. Record combined battery voltage (Target 12V, if less than 11.3V batteries must be changed).								
8. Record top battery voltage (Target 6.5V)								
9. Check water drop out jar and empty as necessary.								
Weekly								
1. Check DustTrak filter following rain events for moisture. If filter is wet, then replace with new filter.								
Monthly								
1. Replace sample line filters on RAE PID.								
2. Perform an upscale response check of DustTrak particulate monitor, using a smoke generator. Record upscale response and time of check.								
Comments:								



Standard Operating Procedure

Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS)

Procedure Number: PPG 018

Based on Procedure Number: 2000-226

Revision No.: 1

Revision Date: June 29, 2010

SOP Contributors: Tony Sacco

A handwritten signature in cursive script, appearing to read "Henry Chow", is positioned above a horizontal line.

Henry Chow, Technical Team Leader

Date: June 2010

A handwritten signature in cursive script, appearing to read "Frank R. Tringale", is positioned above a horizontal line.

Frank R. Tringale Project Manager

Date: June 2010

Standard Operating Procedure

Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS)

SOP No.: PPG 018

Revision: 0

Date: June 2010

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Standard Operating Procedure

Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS)

SOP No.: PPG 018

Revision: 0

Date: June 2010

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1.0 Scope and applicability

- 1.1 This Standard Operating Procedure (SOP) provides the guidance for the use of the MiniVol™ Tactical Air Sampler (TAS), to provide a standardized procedure for the collection of particulates or vapors.
- 1.2 This sampler may be used to collect particulate matter on various types of filter media or gases/vapors in Tedlar™bags. General sampler calibration procedures are given in ENSR SOP 2000-106.
- 1.3 This SOP is to be utilized to conduct the work identified in the title of this SOP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

2.0 Health and safety considerations

- 2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, as well as personal protective equipment (PPE) requirements, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- 3.1 Physical disturbance of the sample during collection can result in significant loss of sample. Care must be taken to minimize disturbance of samples during collection to ensure that intact discrete samples are obtained and that the samples are representative of the intended interval.
- 3.2 Communication with the laboratory in the project planning stages is critical to address the potential issues that may arise.

4.0 Equipment and materials

A standard MiniVol™ TAS comes packed in an all weather carrying case containing the following:

- 1 MiniVol™ TAS Pump Module
- 2 Filter Holder Assemblies
- 2 Size Selective Impactors
- 2 Battery Packs and a Battery Charger

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- 1 All Weather Carrying Case
- 1 Universal Mounting Bracket or Light Weight Tripod

During particulate matter sampling, the following consumables are needed for proper operation of the MiniVol™TAS:

- Impactor grease - Glisseal® Ht, Apiezon® M Grease, etc.
- 47 mm filters - pure quartz, pure Teflon®, Teflon®-coated glass, etc.
- Petrislides™ - for storage and transport of the filters.
- A microbalance accurate to one microgram is needed to weigh the filters.
- Operation Manual.
- ENSR SOP 2000-106 Ambient Monitoring Transfer Standard Calibration.

5.0 Procedures

5.1 Charging batteries

1. Connect the charging plug of the battery charger to the charging jack on the battery pack.
2. Plug the charger into an AC outlet.
3. The LED on the top of the battery charger will light indicating the status of the battery being charged.

When this light is green the battery is charged. A fully discharged battery requires about 5 hours to be completely recharged.

Battery Charger LED Status Modes

LED Status Battery Status

- Green Battery Fully Charged
- Red Battery Partially Charged
- Flashing Red Battery Fully Discharged

5.2 Turning the sampler On/Off

The ON/AUTO/OFF button on the Programmable Timer allows the operator to manually turn the sampler on or off (or to place it in the "Auto" mode in which it is controlled by programmed on/off sequences). As the ON/AUTO/OFF button is pressed, a bar at the lower edge of the LCD display moves horizontally over the words "On", "Auto" and "Off" which are printed on the timer case. With the battery pack inserted into the sampler, press the ON/AUTO/OFF button until the bar is above

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the "ON" legend. The red power indicator (to the right of the ON/AUTO/OFF button) should light and the pump motor should start. If the timer display does not respond, press the small black reset button located next to the red power led. While the sampler is running press the ON/AUTO/OFF button, until the bar indicator is over the "OFF" legend. The power indicator light will go off and the pump will stop running.

5.3 Programming the timer

The Programmable Timer can be set to run up to six on/off cycles within a 24 hour period, as well as to run for separate time periods on separate days within a 7-day period. To set the timer, first set the real-time clock to establish the correct time frame in which the cycles are to run. Next, enter the on/off times at which the programmed cycles are to begin and end. Finally, set the timer to "Auto" mode.

5.4 Setting the real-time clock

1. DAY SET: Hold down the CLOCK button and press the WEEK button until the correct day appears at the top of the display.
2. TIME SET (Hour): Hold down the CLOCK button and press the HOUR button until the display indicates the correct hour. You may have to cycle through the hours twice to obtain the proper AM or PM (on the left side of the display). Seconds will automatically reset to zero.
3. TIME SET (Minutes): Hold down the CLOCK button and press the MIN button until the display indicates the correct minutes. Seconds will automatically reset to zero.

5.5 Setting the On/Off times

1. Press the **PROG** button once. **1on** will appear near the lower left corner of the display indicating that the Power-on time for the first cycle is ready to be programmed.
2. Press the **HOUR** and **MIN** buttons to enter the power-on time for the first cycle.
3. Press the **WEEK** button to select the desired day. The days appear along the top of the display. Continuously pressing the **WEEK** button will sequentially display "Mo Tu We Th Fr Sa Su", "Mo", "Tu", "We", "Th", "Fr", "Sa", "Su", "Mo Tu We Th Fr", "Sa Su" and finally back to "Mo Tu We Th Fr Sa Su".

NOTE: When more than one day is displayed, these days will all have the same power-on time.

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4. After you have entered the power-on time and date for the first cycle, press the **PROG** button. **1off** now appears on the display to indicate that the power-off time for the first cycle is ready to be programmed. Repeat steps 2 and 3 to enter the desired power-off time.

NOTE: The power-off time does not have to occur on the same day as the on time. In this way, sampling may start on one day and end on the next day.

5. Press the **PROG** button again. **2on** appears on the display to indicate that the second power-on time is ready to be programmed. Repeat steps 2 through 4 to enter the remaining power-on/power-off times (up to 6 on/off times).
6. Press the **PROG** button to step through the times you entered to make sure they are correct. Press the **RST/RCL** button to disable (ReSeT) or reactivate (ReCaL) any time entries. When you disable a particular power-on/off entry, four dashes will appear instead of the time. When you reactivate an entry, it will return to the values that were set before you performed a reset.

NOTE: Be sure to clear or reset all unwanted time entries prior to sampling in the AUTO mode. Both ON and OFF entries need to be disabled for the unwanted programs to be inactive.

8. Press the **CLOCK** button to return to the real-time clock display.
9. Press the **ON/AUTO/OFF** button until the bar is positioned above the desired setting (see below).

5.5.1 Setting the time to "ON," "AUTO," and "OFF" modes

The **ON/AUTO/OFF** button is used to manually turn the sampler on or off, or to place it in the "Auto" mode. A bar on the lower edge of the LCD display moves from "Off" to "Auto" to "On" as the button is pressed. In the "Auto" mode the sampler is controlled by the programmed on/off sequences.

To manually turn the sampler ON, press the ON/AUTO/OFF button until the bar on the lower edge of the display is above the "ON" legend. The pump will start and the power indicator will light.

To manually turn the sampler OFF, press the ON/AUTO/OFF button until the bar is above the "OFF" legend.

To set the timer to "AUTO" mode, in which the sampler will be automatically controlled by programmed sequences, first turn the sampler OFF. Then press the ON/AUTO/OFF button until the bar is above the "AUTO" legend.

5.6 Checking for leaks

To check for leaks, remove the impactor/filter holder assembly from the inlet tube. Make sure that the inlet tube is fully extended and the compression fitting is tight. Cover the air inlet tube with the

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palm of the hand while the pump is running. The ball in the flowmeter should drop to zero and remain there without movement.

NOTE: If the “Low Flow” indicator LED activates and the sampler shuts down after 15-20 seconds, push the reset button twice to reactivate the sampler. If the ball does not drop to zero, a leak exists somewhere in the hoses and/or fittings between the inlet and the flowmeter.

Leaks on the inlet side of the pump are especially critical, since flow measurement will not accurately reflect the amount of air passing through the filter. The sampler will be measuring air passing through the filter, plus whatever air may be entering through the leak.

If there is a leak use the following procedures to isolate the leak. After each procedure check the sampler for leaks before moving to the next step:

- Verify that the inlet tube is extended and the compression fitting is tight.
- Remove the four faceplate thumbscrews and the sampler mount thumbscrew to access the sampler pump and plumbing.
- Verify that all push-on hose fittings are secure.
- Check for cracks in the flowmeter inlet and outlet.
- Check for cracks in the pulse dampener.
- Check and tighten all compression fittings.

5.7 Particulate matter sampling

Sampling procedures for TSP, PM₁₀, and PM_{2.5} are identical except for the configuration of the impactor/filter holder assembly.

5.7.1 Preparing the sampler

TSP - Remove the impactor from the filter holder assembly prior to sampling. Since the impactor will not be used, greasing and cleaning of the impactor's target disk need not be done.

PM₁₀ - Use a PM₁₀ impactor in the filter holder assembly. Greasing and cleaning of the impactor's target disk should be performed initially and after every fifth sample (or more often if heavy loading is observed).

PM_{2.5} - Use a PM_{2.5} impactor in the filter holder assembly and a PM₁₀ impactor in a multiple impactor adapter mounted on the filter holder assembly tube. Greasing and cleaning of the impactors' target disks should be performed initially and after every fifth sample (or more often if heavy loading is observed).

To remove impactor, use your thumb to simply push the impactor out of its tube from bottom to top. When correctly installed, the impactor's top is flush with the surrounding filter holder assembly tube or multiple impactor adapter tube.

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Before transporting the MiniVol™ TAS to the field, perform a laboratory check to determine if it is operational.

- Turn the sampler on and observe the motor performance.
- Perform a leak check. Investigate and correct any malfunctions before proceeding.
- Perform a single-point flow rate check using a calibrated orifice, soap-bubble meter or other flow measuring device of known accuracy and compare to the curve established during calibration. The flow should be within $\pm 10\%$ of 5 LPM at current conditions. If the unit fails to operate in this range, check the sampler for obvious leaks and malfunctions. The sampler must be repaired or recalibrated if the flow criteria are not met.

5.7.2 Flow rate

The particle size cut point of the impactor is a function of the velocity with which the air stream passes through the impactor and impacts on the target. The impactor is designed to have the correct cut point at an air flow rate of 5 LPM at ambient conditions. Since the density of air and the behavior of the flowmeter are functions of the ambient air temperature and atmospheric pressure, a flow rate set point must be calculated for each different sampling project.

The sampler air flow calibration curves that are supplied with each sampler contain the necessary information needed to determine the flowmeter set point for a particular ambient condition.

Flowmeter calibration

The sampler should be recalibrated once a year and/or if the flowmeter is replaced (see ENSR SOP 2000-106 Ambient Monitoring Transfer Standard Calibration).

5.7.3 Particulate matter sampling procedure

After the sampler has been assembled (refer to sections 4.7-4.14 of the MiniVol™ manual), adjusted, verified to be in proper working order, and a filter loaded in the Filter Assembly, the sampler is ready to collect air samples.

1. Carefully transport the sampler to the field site. Verify that the sampler, when finally installed will be positioned with the intake upward in an unobstructed area at least 30 cm from any obstacle to airflow.
2. Place the sampler on a firm level surface.
3. Loosen the inlet tube compression nut and extend the inlet tube to the maximum height and re-tighten the nut. Check for leaks.
4. Remove the clean Impactor/Filter Holder Assembly from the plastic transport bag or case. Attach the assembly to the top of the sampler inlet tube.
5. Record the following information on the PM Field Data Sheet: Site ID, number of the filter, the battery ID, sampler ID, ambient temperature and pressure, flowmeter

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reading, and elapsed time meter reading. (a copy of the data sheet may be downloaded from the Airmetrics website, www.airmetrics.com).

6. Open the sampler case and obtain the beginning flow rate, press the **ON/AUTO/OFF** button to start the pump. On the LCD display, the horizontal bar should move to "ON".
7. If the flowmeter, which should be in the vertical position, indicates zero or a very low reading, check for restrictions.
8. Using the Flow Rate Adjustment control, set the flowmeter within specifications for the project temperature and pressure conditions. Take the reading of the flowmeter from the center of the ball.
9. Press the **ON/AUTO/OFF** button twice to stop the pump.
10. Press the **ON/AUTO/OFF** button to set the timer to "Auto" mode.

NOTE: The Sampler MUST be in "Auto" mode before the operator leaves if the sampler is to run at a pre-programmed time.

11. Close the sampler case.

5.7.4 Particulate matter sample retrieval

As soon as possible after the end of the sampling period, the operator should return to the monitoring site to retrieve the exposed filter. There is a potential for filter damage or changes in sample mass due to particle loss, passive deposition, or volatilization increases if the filter is left in the sampler for extended periods of time after the sampling activity has ceased. On the previously referenced Field Data Sheet record the ambient temperature (Ta), barometric pressure (Pa), flowmeter reading and elapsed time.

NOTE: Ta and Pa readings may be estimated on site or may be obtained from a nearby US National Weather Service Forecast Office or airport weather station. Barometric pressure readings obtained from airports must be at station pressure (not corrected to sea level), and they may have to be corrected for differences between the elevation of the monitoring site and that of the airport. If Ta and Pa readings are not available, seasonal average temperature (T_{avg}) and barometric pressure (P_{avg}) may be substituted. Care must be taken that the actual conditions at the site can be reasonably represented by such averages. It is therefore recommended that seasonal values represent actual values within 20°C and 40 mmHg.

1. Open the sampler case and check the sampler for any error conditions. Repair as needed.
2. Verify correct time and day of week on time LCD.
3. Record elapsed time as shown on the Elapsed Time Totalizer.
4. Obtain ending flow rate:
 - Press the **ON/AUTO/OFF** button to start the pump.

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- With the flowmeter in a vertical position, record the flow rate to the nearest 0.25 LPM (read at center of ball).
 - Press the **ON/AUTO/OFF** button twice to stop the pump.
5. Exchange a new impactor/filter holder assembly for the exposed filter holder assembly. Perform a crosscheck of the exposed filter number with the filter number recorded on the Field Data Sheet for the run just completed. Also, check the filter number against the site number.
 6. Change the battery pack.
 7. Obtain beginning flow rate (see above, step 4).
 8. Make sure the timer is set for the desired period and in the **"AUTO"** mode.

5.7.5 Exposed filter

1. In the laboratory, unscrew the filter holder and remove the filter cassette.
2. Locate the Petrislide™ with the filter number which matches the number on the side of the filter holder assembly. This is the original Petrislide™ in which the filter came.
3. Use the cassette separator (P/N 600-007) to remove the top half of the filter cassette.
4. Using forceps carefully remove the exposed filter from the filter cassette and place it into its original Petrislide™ with the exposed side of the filter facing up, replacing the Petrislide™ lid when finished.

NOTE: Be sure to replace the filter support screen in the filter cassette assembly.

5. Remove the old ID tag from the filter holder assembly base and discard.

NOTE: Recheck this number to be sure it matches the number on the Petrislide™.

5.7.6 Maintenance

Ideally, records reflecting the history of maintenance (including all replacement parts, supplies, costs, expenditures) should be kept for each MiniVol™ TAS.

Check sheets should be used to record preventative and/or corrective maintenance activities and the subsequent sampler calibration curve.

The sampler is comprised of four basic components that require maintenance:

- impactor/filter holder assembly,
- flow control system,
- timer, and
- battery pack.

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Section 6 of the MiniVol™ TAS Operation Manual details the recommended maintenance procedures.

6.0 Quality assurance / quality control

6.1 Quality control requirements for the MiniVol™ TAS are dependent on project-specific objectives. The Quality Assurance Project Plan (QAPP) will provide requirements for sample preservation and holding times, container types, sample labeling, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, MS/MSDs, and field duplicate samples.

6.2 Siting Requirements

Siting recommendations in the operational manual conform to the U. S. Environmental Protection Agency requirements as stated in the U. S. Code of Federal Regulations (40 CFR part 58, Appendix E). When operating the sampler in locations under another jurisdiction, the operator should follow the appropriate guidelines.

The MiniVol™ TAS should be positioned with the intake upward and should be located in an unobstructed area at least 30 cm from any obstacle to air flow. Accessibility to the unit under all weather conditions, along with safety and security of the monitoring personnel and equipment, should be prime considerations.

Completed calibration data sheets are subject to senior review in accordance with AECOM's senior review policy. Calculations, standard conditions, correction factors, project identification, and other data will be reviewed for accuracy, completeness and conformance to the relevant AECOM operational SOP and the project QA Plan.

7.0 Data and records management

7.1 Forms must be completed and delivered to the project manager for review. A copy of these forms must be maintained on site. All columns on these forms must be completed or marked N/A if they do not apply.

7.2 All activities performed in shelter must be documented in the field station log including date, the time in and out, technician's initials and employee number, activities performed, time the instrument is taken off-line, time the instrument is put back on-line, calibration results as well as any other circumstances which may arise during the site visit.

7.3 Unanticipated changes to the procedures or materials described in this SOP (deviations) will be appropriately documented in the project records.

7.4 Records associated with the activities described in this SOP will be maintained according to the document management policy for the project.

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8.0 Personnel qualifications and training

8.1 Qualifications and training

- 8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.
- 8.1.2** Field technicians must have been trained to operate, maintain and calibrate this sampler and must be familiar with procedures for proper documentation of test data.

8.2 Responsibilities

- 8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.
- 8.2.2** The individual performing the work is responsible for implementing the procedures as described in this SOP and any project-specific work plans.
- 8.2.3** The Project Manager is responsible for determining the methods that are appropriate to achieve the project objectives, and for supplying the necessary resources to meet those objectives.
- 8.2.4** The field sampling team leader or task manager is responsible for ensuring that this procedure is followed in collecting the samples.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

AECOM Project Procedure PP-9-0, Senior Review Procedure.

AECOM SOP 1011, Preparation and Control of Standard Operating Procedures.

ENSR SOP 2000-106, Ambient Monitoring Transfer Standard Calibration.

ENSR SOP 1007, Chain of Custody Procedures.

Revision history

Revision	Date	Changes
0	June 2010	NA

Standard Operating Procedure

Sample Collection of Airborne Hexavalent Chromium using Airmetrics MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2

Procedure Number: PPG 019

Based on Procedure Number: 2000-126

Revision No.: 0

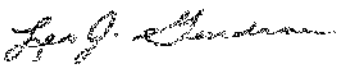
Revision Date: May 2010

SOP Contributors:



Henry Chow, SOP Team Leader

Date: 5/28/10



Leo Gendron, AM Dept. Manager

Date: 05/28/10

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

AECOM PROJECT

Standard Operating Procedure

Sample Collection of Airborne Hexavalent Chromium using Airmetrics MinVol Tactical Air Sampler and OSHA Method ID 215 Version 2

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1.0 Scope and applicability

This Standard Operating Procedure (SOP) defines the collection procedures of airborne hexavalent chromium in ambient air and/or work places using OSHA Method ID 215 Version 2 on a polyvinyl chloride (PVC) filter. Ambient air is drawn through a polystyrene cassette preloaded with a PVC filter and stainless steel back-up screen at a measured flow rate through the use of the Air Metric MiniVol Tactical Air Sampler (TAS). After sampling, the filters are extracted in an alkaline digestion solution and analyzed colorimetrically in the laboratory using the procedures described in OSHA Method ID-215 Version 2.

- 1.1** This SOP is to be utilized to conduct the field sampling tasks identified in the title of this SOP. In the event the Project Manager or Project Team Members determine that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

2.0 Health and safety considerations

- 2.1** The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- 3.1** The two known interferences in ambient sampling could be low humidity and low concentration that might affect the ability of PVC filter to retain hexavalent chromium (Cr (VI)).

4.0 Equipment and materials

- Air Metrics MiniVol TAS (Tactical Air Sampler or equivalent) with related apparatus and Manufacturer's instruction manual
- Air Metric (or equivalent) NIST traceable flow standard kit for calibrating the MiniVol TAS Sampler
- Cr(VI) Field Sampling Event Data Sheets

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- Chain-of-custody forms
 - Two-piece polystyrene filter cassettes with back-up screen
 - Cassettes shipping plastic mailer
 - 47 mm PVC filters
 - Teflon coated forceps
 - Small Shipping cooler
 - Blue Ice
 - Ziploc bag
 - Small Bubble wrap

5.0 Procedures

5.1 PVC Filter Cassette Assembly Preparation

- 5.1.1** Using the Teflon coated forceps, place a 47 mm PVC filter on the stainless steel screen in the outlet side of the two-piece cassettes
- 5.1.2** Replace the inlet side of the cassette and then compress the two pieces together to form the cassette assembly
- 5.1.3** Verify that the PVC filter is facing the inlet of the cassette assembly
- 5.1.4** Place the assembled filter cassette in a clean cassette holder (plastic mailer) to seal the filter cassette
- 5.1.5** Assembling of the filter cassette may be performed in the laboratory or the field.

5.2 Flow Calibration of the MiniVol TAS

The sample flow rate specified in OSHA Method ID 215 Version 2 is 2 liters per minute (LPM) and the total sample volume required is approximately 960 liters.

- 5.2.1** In order to simulate the pressure drop that will be encountered during actual sampling, the PVC filter cassette assembly prepared in section 5.1 should be used in the flow calibration. It is advisable to dedicate a "dummy" cassette assembly for the purpose of calibrations and flow checks.
- 5.2.2** Load the "dummy" cassette assembly in the MiniVol TAS filter holder. Remove the weather cap and insert the Air Metric flow calibration kit adaptor and connect the port of the adaptor to the digital manometer with suitable flexible tubing.

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- 5.2.3** The MiniVol TAS consists of an active constant flow device which compensates for changes in pressure drop across the sample train. The use of a dummy filter cassette assembly in-line during calibration and flow check serves as a verification that the pressure drop over the filter cassette assembly is not too great for the pump and is an exact duplication of conditions the pump will experience during sampling.
- 5.2.4** For the operating procedures of the MiniVol TAS and the Air Metric calibration kit, refer to the manufacturer instruction manual as well as its SOP
- 5.2.5** Turn ON the MiniVol TAS and digital manometer of the flow standard, and let it running and warm-up for at least 2-3 minutes, verify the ball height on the rotameter is at approximately 2 LPM, adjust the flow control circuit on the TAS until the ball height is at 2 LPM if necessary
- 5.2.6** Measure the approximate flow rate through the calibration system train. Adjust the flow on the MiniVol TAS until the desired flow rate close to 3.5 LPM is achieved. Ensure to allow 10 to 15 seconds after each adjustment for the flow control mechanism to respond before activating the flow standard to take any flow measurement. Record the digital manometer reading of the adapter and the equivalent rotameter reading (midpoint of the ball) on the calibration data sheet. Record the ambient temperature and pressure, the standard pressure and temperature
- 5.2.7** Repeat 5.2.7 for target flow rate of 3.0, 3.5, 4.0, 4.5 and 5.0 LPM
- 5.2.8** Calculate the actual flow from each manometer reading from the equation provided with the calibration kit (adaptor) for each ball height. Determine the relationship by linear regression or on a graph between the actual measured flow rates (on Y axis) and the square root of equivalent rotameter reading(on X axis) corrected to actual temperature and pressure
- 5.2.9** Determine the equivalent ball height (corrected to seasonal temperature and pressure) of the rotameter for the sampling flow of 2 LPM
- 5.2.10** When the calibration has been completed, remove the dummy filter cassette assembly and save it for future calibrations.
- 5.3** Calibrate each MiniVol TAS following step 5.2 of this SOP.
- 5.4** Record all calibration data on a Calibration Data Sheet including serial numbers as well as the calibrated flow rates, ball heights, temperature and pressure as well as flow rate vs. ball height relationship associated with each MiniVol TAS,
- 5.5** Determine and record the seasonal, operation ball height as in step 5.2.10 for each MiniVol TAS.
- 5.6** Install the MiniVol TAS consisting of a pre-loaded PVC filter cassette assembly at the sampling location. The height of the sample inlet should be approximately 2 meters from the ground. .
- 5.7** Record all initial pertinent data on the Cr (VI) Field Sampling Event Data Sheet including sample location name, date of sampling, filter and cassette ID #, MiniVol TAS serial #, seasonal rotameter ball height, and start time on the elapsed timer.

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- 5.8** At the start of the sampling event, turn the MiniVol TAS on and begin sampling. Record the initial reading on the elapsed timer. Verify the ball height on the rotameter has settled steadily on the pre-determined seasonal reading (from step 5.5)., adjust the ball height as necessary **Note:** The MiniVol TAS might take a few seconds to regulate the flow to the target value
- 5.9** If possible, check each MiniVol TAS at approximately one-hour intervals to assure proper operation.
- 5.10** After the sampling event is completed, record the final rotameter ball height, turn off the TAS then record the "End Time" on the elapsed timer on the Cr (VI) Field Sampling Event Data Sheet
- 5.11** Remove the exposed filter cassette from the MiniVol TAS inlet/filter holder and place it in a clean plastic cassette mailer. After all samples have been collected they will be transported to a "clean area" for transfer to the sample shipping container for overnight shipping and delivery to the analytical laboratory. **Note :** All Cr (VI) field samples with the chain-of-custody form will be shipped overnight to arrive at the analytical laboratory within 24 hours of sampling. All samples will be logged, with the accompanying information.
- 5.12** Once chain-of-custody documentation is completed and all entries verified, the samples will be prepared for overnight shipment. Sample cassette /plastic mailer assemblies should be placed in a clean Ziploc[®] bag and the bag should be packed with small bubble wrap snugly in a clean shipping container or cooler to prevent movement of the samples during shipment.
- 5.13** To preserve the samples during transit, Blue ices will be placed inside the shipping cooler as standard practice.
- 5.14** After packing, the container or cooler lid will be sealed along its entire length with wide tape.
- 5.15** **Field Blank** -One field blank per sampling day will also be submitted from the same lot number as the sample filters. Field blanks will be subjected to the exact handling as the samples, except that no air is drawn through the filter cassette assembly. The handling includes loading, sealing and transporting in the field and shipping to the laboratory.

6.0 Sample Analysis

- 6.1** All filter samples including blanks and quality control samples must be analyzed within 8 days of collection. Samples must be prepared using an alkaline digestion as described in OSHA Method ID-215. The digestate is then analyzed using OSHA Method ID-215. Results are reported as total ug Cr(VI)/filter.
- 6.2** Final results may be reported as $\mu\text{g}/\text{m}^3$ using the following equation:

$$\text{Cr(VI), } \mu\text{g/ m}^3 = \text{Cr (VI) on filter } \mu\text{g/ m}^3 \text{ air sampled}$$

Standard Operating Procedure

Sample Collection of Airborne Hexavalent Chromium using Airmetric MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2

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7.0 Quality assurance / quality control

- 7.1** Field Blanks: The purpose of field blanks is to facilitate the detection of contamination that may have occurred between the initial filter manufacturing process and field handling. To accomplish this a field blank is collected by dedicating a filter cassette through the entire process of filter loading, cassette sealing, labeling, transporting to the field site, set-up, and labeling/packaging/transporting to the lab, without passing any sample air through it. In general, at least one field blank from the same lot number as the samples should be collected and analyzed per day of sampling. Details of the blank collection procedure should be described in the sample collection records.
- 7.2** Chromic Acid cleaning solutions must not be used in any field or laboratory operations.

8.0 Data and records management

- 8.1** All data, notes, comments will be documented on the Cr(VI) Sampling Event Data Sheet and in the Site Log Book as described in this procedure. All laboratory data must be recorded in a bound notebook. All documentation must be reproducible. Use black ink whenever possible, and write legibly. All records shall be placed in the project/task file immediately following sample collection.
- 8.2** Unanticipated changes to the procedures or materials described in this SOP (deviations) will be appropriately documented in the project records.
- 8.3** Records associated with the activities described in this SOP will be maintained according to the document management policy for the project.

9.0 Personnel qualifications and training

- 9.1** Qualifications and training
- 9.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.
 - 9.1.2** The individual must have prior knowledge and training of operating the Air Metric Calibration kit flow standard and the Air Metrics MiniVol TAS.
- 9.2** Responsibilities
- 9.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.
 - 9.2.2** The individual performing the work is responsible for implementing the procedures as described in this SOP and any project-specific work plans.

Standard Operating Procedure

Sample Collection of Airborne Hexavalent Chromium using Airmetric MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2

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- 9.2.3** The on-site field technician or operator is responsible for the operation and documentation of the sample collection apparatus, as well as preparation of samples for shipment to the laboratory.

10.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

OSHA Method ID 215 Version 2 for Hexavalent Chromium Analysis. Revised April 2006. Method Development Team, Industrial Hygiene Chemistry Division, Sandy UT

AECOM SOP 1011, Preparation and Control of Standard Operating Procedures.

AECOM SOP 2000-226 Calibration/Operation/Maintenance of MiniVol TAS

11.0 Revision history

Revision	Date	Changes
0	May 2010	NA

Standard Operating Procedure

Sample Collection of Airborne Hexavalent Chromium using Airmetric MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2

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Cr(VI) Field Sampling Event Data Sheet

Network Name _____ Date _____ Operator _____

Site Temperature °C: begin _____ End _____ Atmospheric Pressure _____ mmHg

Seasonal Temperature °C = _____ Seasonal Pressure _____ mm Hg

Location (ID)	Filter ID	MiniVol TAS S/N	MiniVol Initial Flow Rate (LPM ₁)	MiniVol Post-Sampling flow Rate (LPM ₂)	Average sampling Flow Rate Ave(LPM)	Start Time (min)	End Time (min)	Elapsed Time (min)	Total Sampling Volume (Liters)

Note : Ave(LPM) = (LPM₁ + LPM₂)/2

Total Sampling Volume (Liters) = Ave(LPM) x Elapsed time (min)

Specs for Total Volume : between 912 - 1008 liters

Comments :

Example of a Sampling Event Data Sheet

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Operation and Calibration of a Portable Hydrogen Sulfide Monitor

Procedure Number: PPG 020

Revision No.: 0

Revision Date: May 2010



POP Author



Project Manager

Date: May 2010

Date: May 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____

Initials: _____ Date: _____

Project Operating Procedure
**Operation and Calibration of a Portable
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Operation and Calibration of a Portable Hydrogen Sulfide Monitor

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1.0 Project Scope and applicability

1.1 Purpose and Applicability

This document describes the procedures that will be followed by field staff for operation and calibration of a portable hydrogen sulfide (H_2S) monitor. The monitor is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of hydrogen sulfide in sampling environments.

The instrumentation routinely used by AECOM personnel is the Jerome 631-X Hydrogen Sulfide Analyzer manufactured by Arizona Instrument Company. Personnel responsible for using this monitor should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

The Jerome 631-X Hydrogen Sulfide Analyzer is designed for rapid detection of hydrogen sulfide vapor in ambient air. A thin gold film undergoes an increase in electrical resistance in the presence of hydrogen sulfide proportional to the mass of hydrogen sulfide present in the sample. When the SAMPLE button is pressed, an internal pump pulls ambient air over the gold film sensor for a measured period; the gold film absorbs the hydrogen sulfide and the increase in electrical resistance is converted to and displayed as parts per million (ppm) H_2S . During normal sampling the ambient air sample is diluted in the flow system at a ratio of 100:1. If low levels of hydrogen sulfide are expected, undiluted air samples can be drawn across the gold film sensor.

The instrument's microprocessor automatically re-zeroes the digital meter at the start of each sample cycle and freezes the meter reading until the next sample cycle is activated, thus eliminating drift between samples. During the sample mode cycle, the LCD display indicates the percentage of sensor saturation. Depending on concentration a series of 50 to 500 samples may be taken before the sensor reaches saturation. When the display indicates the sensor is near saturation a 10-minute heat cycle is required to remove the accumulated hydrogen sulfide from the sensor.

1.3 Specifications

Refer to the specific manufacturer's instructions for the technical specifications. This analyzer has a range of 0.003 ppm to 50 ppm H_2S . Response time is 12 – 52 seconds.

2.0 Health and safety considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

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This instrument is designed for vapor use only. The probe or instrument intake should not be exposed to any liquid, dust, or other foreign material.

3.0 Interferences

The instrument should be at the same temperature as its environment before sampling. A Zero Air Filter removes mercury vapor, mercaptans, and hydrogen sulfide from the air sample; when this filter is installed the readings should be at or near zero. Since air cooler than the instrument can cause low readings and warmer air can result in higher readings the Zero Air Filter should be used to equilibrate the instrument to ambient air temperature. Continuous sampling with clean air will not cause saturation of the gold filter but will allow the instrument to equilibrate more rapidly.

The Zero Air Filter can also be used to identify contamination within the instrument. If the readings do not reduce to near zero with the filter installed, contamination should be suspected.

The gold film sensors do not respond to the following compounds:

- Hydrocarbons
- CO, CO₂, and SO₂
- Water vapor (water vapor condensation on the gold film can cause irreparable harm to the sensor and must be avoided)

The following compounds *may* cause the gold film to respond:

- Chlorine
- Ammonia
- NO₂
- Most mercaptans (organic sulfur compounds or thiols)

4.0 Equipment and materials

- Jerome 631-X Hydrogen Sulfide Analyzer
- Probe
- Tubing Adapter
- Trimmer Tool
- Zero Air Filter
- Line Cord
- Functional Test Module
- Manufacturer's instructions

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- Field data sheets or logbook/pen

5.0 Procedures

5.1 Preliminary Steps

Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

5.2 Calibration

To ensure the input to the instrument contains no hydrogen sulfide or mercaptans, use a Zero Air Filter. This filter cleans the air sample and should produce sample readings of less than 0.003 ppm. With the Zero Air Filter in place, sample the air continuously until the readings stabilize.

Perform a sensor regeneration and re-zero the instrument prior to each day's use or after 30 days of storage or inactivity. Press the ON switch and the REGEN button. The instrument will begin a 10 minute regeneration cycle indicated by .H.H.H flashing on the display. **Do not interrupt this cycle.** When regeneration is complete wait 30 minutes to allow the instrument to cool then zero the sensor by pressing the ZERO button and turning the zero adjust screw under the instrument handle until the display reads 0.

The gold film sensor is inherently stable and does not require frequent calibration. It has been factory calibrated against NIST traceable permeation tubes. Calibration must be performed at the factory or an authorized calibration/repair facility. While the actual frequency depends upon the application and use, the recommended interval between calibrations is every 12 months. The Functional Test Module (FTM) provides a field check of the functionality of the instrument but does not calibrate the instrument. The FTM uses a permeation tube containing hydrogen sulfide; the flow rate and temperature of the release of hydrogen sulfide is factory calibrated to provide a specified concentration to the instrument. If the concentration falls within the expected range for the FTM being used the instrument is functioning properly; if the level is not within the expected range then the instrument must be returned for service. This calibration check is used as part of a routine maintenance routine.

5.3 Operation

Turn on the unit and allow it to warm up (minimum of 1 minute). The digital display should read 000. Recharge or replace the battery pack if the LO BAT indicator remains on.

Use the Zero Air Filter to equilibrate the instrument to ambient air temperature; sample continuously until the readings stabilize.

Perform sensor regeneration, wait a minimum of 30 minutes and then zero the instrument.

Press the SAMPLE button to begin sampling; during the sampling cycle the digital display will show bars to indicate the degree of sensor saturation. At the end of the sampling cycle the hydrogen sulfide

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concentration is displayed in ppm; record the value. This value will remain in the display until the next sample is taken; the digital meter automatically zeroes at the start of each sample.

When sampling is completed for the day, perform sensor regeneration. Under no circumstances should hydrogen sulfide be allowed to remain on the sensor overnight.

At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 5.2) except that no adjustment will be made to the instrument. Record the information in the field records.

When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

5.4 Routine Maintenance

Perform sensor regeneration daily. Do not allow hydrogen sulfide to remain on the gold film sensor overnight. This analyzer has a range of 0.003 ppm to 50 ppm H₂S. Periodically check Tygon[®] tubing within the instrument; kinks and crimps can restrict airflow during regeneration cycle and permanently damage the sensor.

All routine maintenance should be performed in a non-hazardous environment.

5.5 Troubleshooting Tips

A display of .8.8.8 indicates the sensor is saturated and must be regenerated.

Changes in temperature may cause the display to show .L.L.L when taking the initial sample. Refer to the operating manual for directions on zero adjustment.

The display shows H at conclusion of sensor regeneration when zero is pressed. Check tubing for crimps and repeat regeneration cycle. If the problem is not resolved the fritware filter, intake filter disk, scrubber filters and Tygon[®] tubing.

High or erratic results may indicate that the internal filters are clogged. This can happen when sampling in dusty or humid areas.

A low response or erratic readings, particularly after an extended period of non-use may indicate the need for a second regeneration cycle. Wait 30 minutes before performing the second regeneration cycle.

6.0 Quality assurance / quality control

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

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Calibration of the H₂S monitor will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The FTM will be used as part of a routine maintenance program to verify instrument functionality. Readings which are outside the stated acceptance range for the FTM used will require that the monitor be returned to the factory for calibration.

Checks of the instrument response (Section 5.2) should be conducted periodically and documented in the field records.

7.0 Data and records management

Safety and survey monitoring with the hydrogen sulfide monitor will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number.
- Instrument manufacturer, model, and identification number.
- Operator's signature.
- Date and time of operation.
- Calibration check at beginning and end of day (meter readings before adjustment).
- Span setting after calibration adjustment.
- Meter readings (monitoring data obtained).
- Instances of erratic or questionable meter readings and corrective actions taken.
- Instrument checks and response verifications.

8.0 Personnel qualifications and training

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

The field operator is responsible for verifying that the hydrogen sulfide monitor is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this POP and the project plan.

Project Operating Procedure

**Operation and Calibration of a Portable
Hydrogen Sulfide Monitor**

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9.0 References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SEDS, Enforcement and Investigations Branch, Athens, GA. November 2001.

10.0 Revision History

Revision	Date	Changes
0	May 2010	Original POP

Field and Laboratory Measurement of pH

Manager's Signature: 

SOP #: 7121

Effective Date: 12/29/2009

Revision #: 2

Method Reference: 2550 B

1.0 SCOPE AND APPLICATION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) provides basic instructions for routine calibration and operation of the Oakton pH/CON 300 meter. This SOP is designed specifically for the measurement of pH in accordance with Standard Method 4500-H B which address electrometric pH measurements of drinking, surface, and saline waters, domestic and industrial wastes, and acid rain.

1.2 Quality Assurance Planning Considerations

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the laboratory Quality Assurance Quality Control (QA/QC) Manual and may include duplicate or replicate measurements or confirmatory analyses.

2.0 RESPONSIBILITIES

2.1 The analyst is responsible for verifying that the pH meter is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this SOP and the project plan.

2.2 The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project plan.

3.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Oakton Portable Waterproof pH/Conductivity/temperature meter (with Auto temperature correction) (model 300)
- Oakton pH/CON 300 instruction manual

- Deionized water
- Clean glass or plastic beakers or cups
- 4.0, 7.0, and 10.0 buffer solutions
- Magnetic stirrer and Teflon-coated stirring bar
- Lint-free tissues
- Mild detergent and/or 10% hydrochloric acid (for use if samples contain oily material or particulate matter)
- Calibration sheets
- Laboratory/field data sheets or logbook.

4.0 SUMMARY OF METHOD

The pH of a sample is determined electrometrically using either a glass electrode and a reference potential or a combination electrode.

5.0 SAMPLE HANDLING, PRESERVATION, AND GENERAL MEASUREMENT PROCEDURES

5.1.1 To achieve accurate pH measurements, samples shall be analyzed within 15 minutes of collection. Sample should be collected in plastic or glass containers.

5.1.2 After measuring a sample containing oily material or particulate matter, the electrode must be cleaned by carefully wiping with a lint-free cloth, or washing gently in a mild detergent, followed by a deionized water rinse. If this does not suffice, an additional rinse with 10% hydrochloric acid (followed by de-ionized water) may be needed.

5.1.3 As temperature can affect the pH measurements obtained, both the pH and the temperature of the sample must be recorded.

5.1.4 Calibration must include a three point calibration that bracket the expected pH of the samples to be measured.

5.1.5 Primary standard buffer salts available from NIST can be purchased and are necessary for situations where extreme accuracy is required. Secondary standard buffers may be purchased as a solution from commercial vendors and are recommended for routine use. Buffers should not be used after their expiration dates as provided by the manufacturer. If the manufacturer does not supply an expiration date or if the buffers are prepared from pH powder pillows, etc., an expiration date of one year from purchase or preparation should be used. All standards must be labeled with manufacturer, lot number, receipt date, opened date, and expiration date.

5.1.6 When the meter is being used in the field, move the probe in a way that creates sufficient sample movement across the sensor; this insures homogeneity of the sample and suspension of solids. If sufficient

movement has occurred, the readings will not drift (<0.1 pH units). Rinse the electrode with deionized water between samples and wipe gently with a lint-free tissue.

5.1.7 Fluctuating readings may indicate more frequent instrument calibrations are necessary.

5.2 Calibration and Measurement Procedures

5.2.1 The pH meter must be calibrated daily before any analyses are performed. The instrument serial # should be noted in the log book. The meter should be checked every 3 hours against one of the buffers, and the value recorded. If the measurement is off by more than 0.2, the instrument needs to be re-calibrated.

5.2.2 A duplicate pH reading must be made for every twenty (20) samples measured in the field for any given parameter. The duplicate results must be reported with its corresponding sample results. Duplicate results must be within 0.10 standard units of the original analysis result.

5.2.3 Connect the electrode to the meter. Choose either 7.0 and 10.0 (high range) or 4.0 and 7.0 (low range) buffers, whichever will bracket the expected sample range. Place the buffer in a clean beaker. If the pH is being measured in a laboratory, place the beaker on the magnetic stirrer and place the stirring bar in the beaker. Measure and record the temperatures of the buffers using a calibrated thermometer or automatic temperature compensation (ATC).

5.2.4 Place the electrode into the 10.0 buffer or into the 7.0 buffer. (The calibration procedure described here begins with the buffer of the highest pH selected. The instrument manufacturer's calibration instructions may suggest starting with the buffer of the lowest pH selected).

5.2.5 Adjust the instrument calibration according to the Oakton instruction manual. Discard the buffer and rinse the beaker and stirring bar thoroughly with de-ionized water.

5.2.6 Refill the beaker with the 7.0 buffer or the 4.0 buffer. Rinse the electrode, gently wipe it with a lint-free tissue, and place it in the selected buffer solution. If the pH is being measured in a laboratory, place the beaker on the magnetic stirrer and place the stirring bar in the beaker. Continue adjusting the instrument calibration according to the manufacturer's instructions. Record the electrode slope (if provided by the instrument) on the calibration sheet (an acceptable slope is between 92 and 102 percent). Measure and record the temperature of the buffer using a calibrated thermometer or ATC. Discard the buffer and rinse the beaker and stirring bar thoroughly with deionized water.

5.2.7 After calibration, the instrument shall be checked against the calibration buffers. Calibration is valid if buffers read within 0.10 standard units of their certified values.

5.2.8 An additional check may be performed, if required by the project plan, by placing the electrode into an additional buffer solution. This buffer should be from a different source than the buffers used for the initial calibration. This buffer should read within $+0.2$ pH units of the buffer's true pH value if after three hours of use.

5.2.9 Verify the calibration every 20 samples and after the last sample of the day with a buffer solution prepared from a different source than that used for initial calibration. Recalibrate the instrument if the check value varies more than 0.2 pH units from the true value.

5.2.10 The electrode will be rinsed with deionized water and wiped gently with a lint-free tissue between sample analysis.

5.2.11 Recalibrate the instrument if the buffers do not bracket the pH of the samples.

5.2.12 The meter must be re-calibrated following any maintenance activities and prior to the next use.

5.3 Troubleshooting Information

If there are any performance problems with the pH meter which result in inability to achieve the acceptance criteria presented in Section 5.0, consult the appropriate section of the meter instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

5.4 Maintenance

5.4.1 Instrument maintenance should be performed according to the procedures and frequencies required by the manufacturer.

5.4.2 The electrode must be stored and maintained according to the manufacturer's instructions.

5.4.3 If an instrument with ATC is being used, the device should be checked on a quarterly basis for accuracy with an NIST thermometer.

6.0 QUALITY CONTROL

6.1 Duplicate measurements of a single sample will be performed of at least 1 per every 20 samples. Duplicate measurements should agree within ± 0.1 pH units.

6.2 The temperature readout of the meter will be checked quarterly against an NIST-traceable thermometer. If the difference is greater than 0.2°C , the instrument manufacturer will be consulted for instructions. Temperature measurements will be compensated for any difference with the reference thermometer.

7.0 REPORTING

7.1 All pH meter calibration, temperature check, and maintenance information will be recorded on a daily calibration sheet. pH data may be recorded on the appropriate laboratory or field data sheets or logbooks.

7.2 Calibration documentation must be maintained in a thorough and consistent manner. At a minimum, the following information must be recorded:

- Date and time of calibration

- Signature or initials of person performing the measurement
- Instrument identification number/model
- Expiration dates and batch numbers for all buffer solutions
- Reading for pH 7.0 buffer before and after meter adjustment
- Reading for pH 4.0 or 10.0 buffer before and after meter adjustment
- Readings for all continuing calibration checks
- Temperature of buffers (corrected for any difference with reference thermometer), including units
- Slope reading (if provided by instrument)
- Comments

7.3 Documentation for recorded data must include a minimum of the following:

- Date and time of analysis
- Signature or initials of person performing the measurement
- Instrument identification number/model
- Sample identification/station location
- Temperature (corrected for any difference with reference thermometer) and pH of sample (including units and duplicate measurements)
- Comments
- All calibration records (logs) must be retained for five years.

8.0 TRAINING/QUALIFICATIONS

To properly perform pH measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOP. The analyst must also be experienced in the operation of the meter.

Certain state certification programs require that pH measurements in the field be taken by, or in the presence of, personnel that are qualified under the certification program.

9.0 REFERENCES

APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater, 20th Edition. 1999.



Project Operating Procedure

Field and Laboratory Measurement of Dissolved Oxygen

Procedure Number: PPG 022

Reference SOP #: 7124 Revision No.: 3

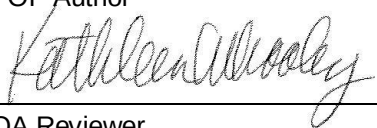
Method Reference: 2550 B

Revision Date: June 2010



POP Author

Date: 6/21/2010



QA Reviewer

Date: 6/21/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Project Operating Procedure

Decontamination of Field Equipment

POP No.: PPG 022
Revision: 0
Date: June 2010
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Project Operating Procedure

Decontamination of Field Equipment

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1.0 Purpose and applicability

This Standard Operating Procedure (SOP) provides basic instructions for routine measurement of Dissolved Oxygen (DO) using Oakton Portable Waterproof Dissolved Oxygen Meter (Model 35641). It is noted that this instrument is a combination DO/temperature meter.

This SOP, which has been prepared pursuant to the requirement of NJAC7:18-8, addresses DO measurement only.

This SOP applies when performing “analyze immediately” DO measurements on regulatory samples, in accordance with Standard Method SM 4500 O G, for DO measurement in drinking, surface and saline waters, and domestic and industrial wastewaters.

2.0 Summary of method

Dissolved oxygen levels in natural and waste waters depend on the physical, chemical, and biochemical activities in the water body.

This meter uses a galvanic probe. It consists of a cell that contains electrolyte and that is enclosed by a selective membranes, and two metallic electrodes. The membrane is practically impermeable to water and ionic dissolved matter, but is permeable to oxygen and a few other gasses.

The cathode consumes the oxygen passed through the membrane, and produces an electric current in the probe; this current is proportional to the partial pressure of oxygen in the sample.

3.0 Responsibilities

The analyst is responsible for verifying that the DO meter is in proper operating condition prior to use, and for operating the meter in accordance with manufacturers' instructions. The analyst is also responsible for implementing and documenting the calibration and measurement procedures in accordance with the manufacturers' instructions, this SOP and the project plan.

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources and guidance necessary to perform the measurements in accordance with this SOP and the project plan.

4.0 Required materials

The following materials are necessary for this procedure:

- Oakton Portable Waterproof DO meter (Model 35641)
- Oakton instruction manual
- Deionized Water

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Decontamination of Field Equipment

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- Field logbook
- Lint free cloth

5.0 Sample handling and general measurement procedures

To achieve accurate temperature measurements, samples must be analyzed within 15 minutes of collection. Samples should be collected in glass or plastic containers.

Since the cathode consumes the oxygen in the sample, it is essential that the fluid flow past the sensor to maintain accurate readings. Therefore, when the meter is being used in the field, if necessary, move the probe in a way that creates sufficient sample movement across the sensor. This insures homogeneity of the sample. If sufficient movement has occurred, the readings will not drift. Rinse the electrode with deionized water between samples and wipe gently with a lint free cloth.

The solubility of oxygen in water varies with barometric pressure and temperatures, and decreases as salinity increases. For the most accurate DO readings, you need to compensate for these factors. This meter automatically compensates for temperature readings. It also allows you to enter a salinity correction factor and the barometric pressure to correct this variability. A pressure vs. altitude table is included in the equipment instruction booklet. Consult manufacturer's instructions if it becomes necessary to adjust the instrument from factory default settings for salinity and/or barometric pressure.

After measuring a sample containing oily material or particulate matter, the electrode may need to be cleaned using a deionized water rinse and/or by carefully wiping with a damp lint-free cloth.

6.0 Calibration and measurement procedures

The DO meter must be calibrated daily before any analyses are performed. The meter shall be calibrated in accordance with the manufacturer's instructions. The instrument serial number should be noted in the field book.

A duplicate DO reading must be made for every twenty samples measured in the field. The duplicate result must be reported with its corresponding sample result. Duplicate results must be within 10% of the original analysis result and recorded in the field book.

The electrode will be rinsed with deionized water and wiped gently with a lint-free tissue between sample analyses.

The meter must be re-calibrated following any maintenance activities and prior to the next daily use.

The built-in temperature sensor included in the probe is factory calibrated. Calibrate your sensor only if you suspect drift that may have occurred over a long period of time or if you have a replacement probe. Calibration is performed using a NIST traceable thermometer, in accordance with manufacturer's instruction.

The instrument will be calibrated for DO measurement precision weekly when in use using the Winkler Method.

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7.0 Troubleshooting information

If there are any performance problems with the DO meter which result in inability to achieve the acceptance criteria presented in Section 6 (+/- 10%), consult the appropriate section of the meter instruction manual for the troubleshooting procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

8.0 Probe care

The probe is a galvanic measuring element which produces an output proportional to the oxygen present in the medium in which it is placed. The galvanic probe design lets you take measurements immediately- without the typical 15 minute wait of other dissolved probes.

The probe consists two parts:

- An upper part consisting of an anode, a cathode, and cable; and
- A lower part consisting of a membrane cap, membrane, and electrolyte.

Under typical operating control conditions, the probe should last for several years. Proper care and maintenance will help you receive the maximum probe life and ensure more accurate readings. Since any deposits on the membrane surface act as a barrier to oxygen diffusing through the membrane, the membrane must be cleaned at regular intervals to assure maximum reliability. After using the probe, rinse the probe in clean water and wipe it with a soft cloth or paper to avoid any hardening of deposits. If growth develops on the probe, use a disinfecting chemical to clean.

NOTE: Although the membrane is strong and not easily damaged, wipe it gently while cleaning it. If the membrane is damaged or torn, the probe will no longer function. There are no special probe storage requirements.

9.0 Quality control

A duplicate measurement of a single sample will be performed of at least 1 per every 20 samples. Duplicate DO measurements should agree within +/- 10%. Duplicate temperature measurements should agree within 1.0 degree Fahrenheit.

The instrument will be calibrated quarterly when in use using the Winkler method. The temperature probe will be calibrated against an NIST traceable thermometer. Calibration records will be maintained by AECOM's Laboratory Manager. Records will be kept on the file for at least 5 years.

10.0 Reporting

All daily DO meter calibration and maintenance information, as well as DO data, will be recorded on the appropriate laboratory or field data sheets or field logbook.

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At a minimum, the following information must be recorded:

- Date and time of calibration
- Instrument identification number/model
- Signature or initials of person performing the measurement

Documentation for recorded data must include a minimum of the following:

- Data and time of analysis
- Signature or initials of person performing the measurement
- Instrument identification number/model
- Sample identification/ station location
- Temperature and DO readings
- Comments

11.0 Training/qualifications

To properly perform temperature measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOP. The analyst must also be experienced in the operation of the meter.

Certain state certification programs require that temperature measurements in the field be taken by, or in the presence of, personnel that are qualified under the certification program.

12.0 References

APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater, 20th Edition. 1999.

Operating Instructions – Oakton DO Meter – 300 Series.

13.0 Revision History

Revision	Date	Changes
3	June 2010	Revised POP

Field and Laboratory Measurement of Temperature

Manager's Signature: 

SOP #: 7123

Effective Date: 12/29/2009

Revision #: 2

Method Reference: 2550 B

1.0 SCOPE AND APPLICATION

1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) provides basic instructions for routine measurement of temperature using the Oakton pH/CON 300 meter. It is noted that this instrument is a combination pH/temperature meter. This SOP addresses temperature measurement only (other capabilities are outlined in the appropriate SOP). This SOP is designed specifically for the measurement of temperature in accordance with Standard Method 2550 B which address thermometric temperature measurement of drinking, surface, and saline waters, and domestic and industrial wastes.

1.2 Quality Assurance Planning Considerations

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the laboratory Quality Assurance Quality Control (QA/QC) Manual and may include duplicate or replicate measurements or confirmatory analyses.

2.0 RESPONSIBILITIES

2.1 The analyst is responsible for verifying that the Oakton pH/CON 300 meter is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this SOP and the project plan.

2.2 The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project plan.

3.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Oakton Portable Waterproof pH/Conductivity/Temperature meter (model 300)
- Oakton pH/CON 300 meter instruction manual
- National Institute of Standards and Technology (NIST)-traceable thermometer
- Laboratory or field data sheets or logbooks
- Clear glass or plastic containers

4.0 SUMMARY OF METHOD

The temperature of a sample is determined electrometrically using a temperature sensor. The Oakton pH/CON 300 meter displays temperature in the range of -10.0 to 110 °C simultaneously with sample results. The meter can display measurement values to tenths (0.0), hundredths (0.00) or thousandths (0.000). The default is hundredths. The meter can display temperature in °C or °F.

5.0 SAMPLE HANDLING, PRESERVATION, AND GENERAL MEASUREMENT PROCEDURES

To achieve accurate temperature measurements, samples shall be analyzed within 15 minutes of collection. Samples should be collected in glass or plastic containers.

5.1 Calibration and Measurement Procedures

- 5.1.1 The Oakton pH/CON 300 meter will, at a minimum, be checked quarterly as described in Section 5.0. The device will be checked against an NIST-traceable thermometer and the necessary compensation made for the difference in temperature 0.5 °C or greater
- 5.1.2 Immerse the Oakton pH/CON 300 meter into the sample.
- 5.1.3 Swirl and take a reading when the value stabilizes.
- 5.1.4 Record the temperature reading to the nearest 0.1°.
- 5.1.5 The Oakton pH/CON 300 meter will be deployed in accordance with the manufacturer's instruction manual. For water-column profiling operations (if applicable) the sensor readings will be recorded manually in a designated field logbook or continuously through the use of a computer. An internal data-logger will be used for recording sensor measurements during moored deployment of a sensor. The frequency of data recording will be specified in the project plan. The location, date, and time of sensor deployment, along with depth (of measurement or mooring) will be recorded in

conjunction with the temperature sensor data. Additional documentation requirements are listed in Section 6.2.

- 5.1.6** Temperature data may be post-calibrated using any of a variety of calibration data including, but not limited to, field calibration points, manufacturer calibration data, and analytical results from samples collected during field deployment of the sensors. The decision criteria for post calibration, and the technique used, will be specified in the project plan, and will be consistent with the manufacturer's recommendations.

5.2 Troubleshooting Information

If there are any performance problems with the Oakton pH/CON 300 meter, consult the appropriate section of the meter instruction manual for the checkout and self-test procedures. If the problem persists, consult the Oakton customer service department immediately for further instructions. If performance problems exist with the probe, repair or replace the temperature sensor.

5.3 Maintenance

Instrument maintenance for meter-type temperature measuring devices should be performed according to the procedures and frequencies specified by Oakton.

6.0 QUALITY CONTROL

- 6.1** The Oakton pH/CON 300 meter will, at a minimum, be checked against an NIST-traceable thermometer at the frequency stated in section 5.1.1 (quarterly). This verification procedure will be performed as follows:

- Immerse the temperature sensor and the NIST-traceable thermometer into a sample.
- Allow the readings to stabilize.
- Record the readings and document the difference.
- Label the temperature sensor with the correction value/adjustment and the date the accuracy check was performed. A correction factor is required only when the difference between the NIST thermometer and the probe equals or exceeds 0.5 °C.
- Compensate for the difference when sample measurements are taken.
- Record the thermometer IDs, the temperature from the NIST-traceable thermometer, the temperature from the thermometer being verified, the time, date and the initials of the analyst, and any required correction factor.

6.2 A duplicate measurement must be made for every twenty (20) samples measured in the field for temperature measurements. It is noted that duplicate measurements should agree within $\pm 0.5^{\circ}\text{C}$ or approximately $\pm 1.0^{\circ}\text{F}$.

7.0 REPORTING

7.1 Records for checking the accuracy of the Oakton pH/CON 300 meter (where applicable) will include:

- Date
- Temperature probe checked
- Reference thermometer number
- Readings for reference thermometer and temperature probe being checked
- Adjustment made for difference in readings
- Initials of analyst

7.2 Documentation for recorded data must include a minimum of the following:

- Date and time of analysis
- Signature or initials of person performing the measurement
- Thermometer ID number or instrument identification number/model
- Sample identification/station location
- Temperature of sample (including units and duplicate measurements) compensated for any difference with the reference thermometer if applicable
- Comments
- Records will be kept on file for at least 5-years.

8.0 TRAINING/QUALIFICATIONS

To properly perform temperature measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOP. The analyst must also be experienced in the operation of the meter.

Certain state certification programs require that temperature measurements in the field be taken by, or in the presence of, personnel that are qualified under the certification program.

9.0 REFERENCES

APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater, 20th Edition. 1999.



STANDARD OPERATING PROCEDURE

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CALIBRATION AND OPERATION OF THE LAMOTTE 2020 TURBIDIMETER

Prepared by: _____
Andrew J. Mosuly // Supervisor/Technical Director

Date: _____

Reviewed by: _____
Erin Murphy Govern // Quality Assurance Officer

Date: _____

Approved by: _____
Anne M. Salazar // Manager

Date: _____



CALIBRATION AND OPERATION OF THE LAMOTTE 2020
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1.0 Scope and Application

This procedure is applicable to the field measurement of turbidity in groundwater, drinking water, or surface water using the LaMotte 2020 turbidimeter. Turbidity is an expression of the optical property that causes light to be scattered or absorbed rather than transmitted in straight lines through a sample (the higher the intensity of scattered light, the higher the turbidity). Turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic material, and microscopic organisms. Turbidity should not be confused with color, since a darkly colored water can still be clear and not turbid.

2.0 Summary of Method

The LaMotte 2020 turbidimeter is a portable, microprocessor controlled Nephelometer. The LaMotte 2020 turbidimeter measures scattered light in the sample at 90 degrees from the light source. A reference beam passes through the sample and is measured at 180 degrees from the light source. The ratio of these two readings is electronically converted to a turbidity measurement in nephelometric turbidity units (NTU). The light source for the LaMotte 2020 turbidimeter is a tungsten incandescent light bulb operated at 2,800 degrees Kelvin, and the light is detected by two silicon photo diodes (one at 90 degrees from the light source and one at 180 degrees from the light source). The multi-detector optical configuration assures long term stability and minimizes stray light and color interferences. All readings are determined by the process of signal averaging over a five second period, minimizing fluctuations in readings attributed to large particles and enabling rapid, repeatable measurements. A picture of the LaMotte 2020 turbidimeter is presented as Figure 2-1. A diagram illustrating how the LaMotte 2020 turbidimeter measures turbidity is presented as Figure 2-2.

The LaMotte 2020 turbidimeter is pre-calibrated by the manufacturer to a range of 0 to 1,100 NTU with AMCO™ primary standards. Recalibration of the LaMotte 2020 is not required by the user. However, a procedure to standardize the calibration is performed to obtain the most accurate readings over a narrow range using two AMCO™ standards of 1.00 NTU and 10.0 NTU, which are supplied with the LaMotte 2020.

For operation of the LaMotte 2020 turbidimeter, a sample is collected into the LaMotte 2020 turbidity vial. The vial is placed into the LaMotte 2020 sample chamber, the sample chamber is closed, and the READ button is pressed. A walking dash “—” is displayed while the LaMotte 2020 turbidimeter analyzes the sample. After five seconds, the turbidity in NTU is displayed.

3.0 Health and Safety Warnings

- 3.1 Refer to the site-specific health and safety plan for cautions and health and safety procedures associated with the samples to be analyzed.
- 3.2 Caution should be taken when working with all chemicals. Refer to the Material Safety Data Sheets (MSDSs) for the chemicals to be used. The MSDSs are located in the site-specific health and safety plan.

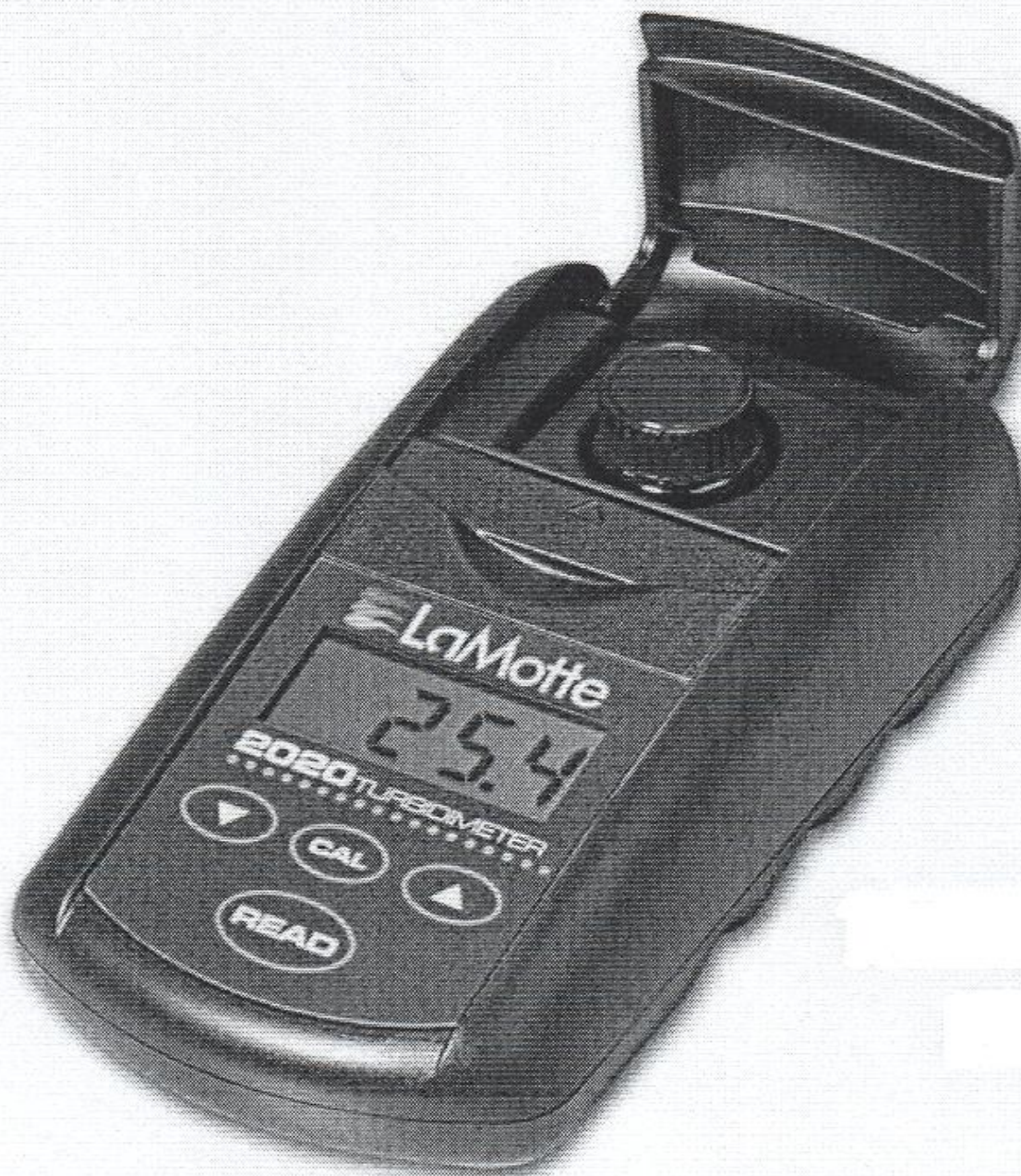


Figure 2-1. The LaMotte 2020 Turbidimeter

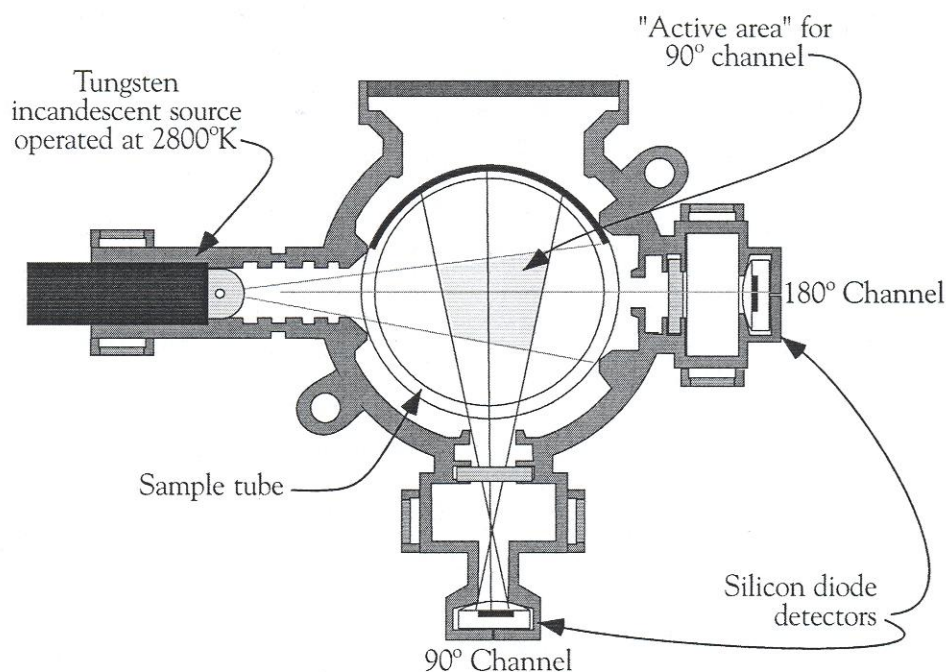


Figure 2-2. How the LaMotte 2020 measures turbidity

- 3.3 The LaMotte 2020 turbidimeter should not be stored or used in a wet or corrosive environment. Care should be taken to prevent water from wet turbidity tubes from entering the turbidimeter light chamber. NEVER PUT WET TURBIDITY TUBES IN THE TURBIDIMETER.
- 3.4 If operating the LaMotte 2020 turbidimeter in an environment where the temperature is less than or equal to 0° C, be sure to remove the turbidity standards from the LaMotte 2020 turbidimeter case, as the standards will freeze and crack the turbidity vials if exposed to temperatures less than or equal to 0° C.
- 4.0 Interferences**
- 4.1 The presence of floating debris, coarse sediments, or air bubbles will cause high readings.
- 4.2 The presence of light absorbing materials (such as activated carbon) will cause low readings.
- 4.3 Excessive color in a sample will absorb light and cause high readings. If the turbidity readings appear to be biased high due to excessive color in the sample, use professional judgment when interpreting the turbidity results. This should be noted on the monitoring well worksheet or the field logbook.

- 4.4 Extreme care should be taken when handling the turbidity standards or the turbidity vial, as surface scratches or finger smudges will cause analytical errors. Handle these items by the top only.
- 4.5 Do not shake or freeze samples or turbidity standards.
- 4.6 Do not operate the LaMotte 2020 turbidimeter near electric motors. The electric field created by electric motors can affect turbidity readings on the LaMotte 2020 turbidimeter.
- 4.7 The LaMotte 2020 turbidimeter should be placed on a surface free from vibration. Vibrations can cause high turbidity readings on the LaMotte 2020 turbidimeter.

5.0 Personnel Qualifications

All field samplers are required to take the 40-hour OSHA Hazardous Waste Operations training course and annual 8-hour refresher training prior to engaging in any field collection activities. Prior to the implementation of this SOP, all field samplers will be instructed by a person experienced with the LaMotte 2020 turbidimeter and this SOP. All field samplers must demonstrate to the field team leader and/or Project Chemist the proper procedures for calibration and operation of the LaMotte 2020 turbidimeter prior to sample analysis.

6.0 Equipment and Supplies

- Copy of the Health and Safety Plan and Sampling and Analysis Plan
- LaMotte 2020 turbidimeter
- LaMotte 2020 turbidimeter turbidity tubes
- AMCO™ 1.00 NTU and 10.0 NTU turbidity standards
- Kimwipes® Absorbent Wipes
- Backup 9-volt battery
- Deionized, ultra-filtered (DIUF) water
- Turbidity free water
- ¾" circular stickers
- thermometer

7.0 Procedure

7.1 Setting the Operating Mode

The LaMotte 2020 turbidity meter has two operating modes: standard operating mode and EPA mode. The standard operating mode displays the measured turbidity to the full resolution of the instrument. The EPA mode displays the measured turbidity rounded to the reporting requirements of the EPA and Standard Methods compliance monitoring programs. Operating in EPA mode eliminates the need for the user to manually round off turbidity results according to EPA specifications. The EPA requires these reporting requirements because it recognizes the inherent accuracy limitations of turbidity measurements within the specified ranges.

The LaMotte 2020 turbidity meter can only be switched from one mode to the other while turning the instrument on from the off state. The LaMotte 2020 turbidity meter will remain in which ever mode it was last used, even if the meter has been turned off. To switch from one mode to the other, perform the following procedure:

- 7.1.1 Turn off the LaMotte 2020 turbidimeter if it is on.
- 7.1.2 Press the **CAL** button and hold it down while pressing the **READ** button to turn the LaMotte 2020 turbidimeter on.
- 7.1.3 The LaMotte 2020 turbidimeter will come on in the opposite mode than it was in previously. If the LaMotte 2020 is in EPA mode, an up arrow (▲) will be visible in the upper left hand corner of the instrument display.

7.2 Calibration of the Turbidity Tubes

If the LaMotte 2020 is supplied by a rental agency (e.g. U.S. Environmental, Pine Environmental), calibration of the turbidity tubes is usually not needed, as this procedure is performed by the rental agency and the turbidity tube with the lowest reading is usually supplied with the turbidimeter. If the LaMotte 2020 turbidimeter is purchased, or if this step was not performed by the rental agency and more than one turbidity vial is provided with the LaMotte 2020, perform the following procedure.

- 7.2.1 Record the ambient temperature.
- 7.2.2 Allow the calibration standards to equilibrate to ambient temperature.
- 7.2.3 Fill each turbidity tube with DIUF water.
- 7.2.4 Analyze and record the turbidity reading for each turbidity tube according to the procedures presented in Section 7.4.
- 7.2.5 Mark the tube with the lowest turbidity reading by placing a 3/4" circular sticker on the top of the lid of the tube and writing an "R" on the sticker for reference tube.
- 7.2.6 Follow the calibration procedures presented in Section 7.3, using the reference turbidity tube and the 1.00 NTU or 10.0 NTU AMCO™ standard.
- 7.2.7 Fill the remaining turbidity tubes with the same AMCO™ standard as in the reference turbidity tube.
- 7.2.8 Analyze and record the turbidity reading for each tube according to the procedures presented in Section 7.3.
- 7.2.9 The difference between the true value of the AMCO™ standard (1.00 NTU or 10.0 NTU) and the value produced when the turbidity tube with the AMCO™ standard is analyzed is the correction

factor for that tube. Place a $\frac{3}{4}$ " circular sticker on the top of the lid of the turbidity tube and write the correction factor on the sticker. This correction factor should be used when comparing results from different tubes.

In most cases, comparison of results from different tubes is not necessary, and only steps 7.2.1 through 7.2.3 need to be performed in order to determine which turbidity tube produces the lowest reading.

7.3 Calibration of the LaMotte 2020 Turbidimeter

- 7.3.1 Record the ambient temperature.
- 7.3.2 Allow the calibration standards to equilibrate to ambient temperature.
- 7.3.3 Select the AMCO™ standards (1.00 NTU or 10.0 NTU) in the range of the samples to be tested. In most cases this will be the 10.0 NTU standard.
- 7.3.4 Fill the reference turbidity tube (see section 7.2) with the standard, cap the reference turbidity tube, and wipe the reference turbidity tube with a Kimwipe®. **NOTE:** If the LaMotte 2020 Turbidimeter is provided by a rental agency, the rental agency will most likely supply the two AMCO™ standards in capped turbidity tubes that are dedicated to each standard. Therefore, pouring of the AMCO™ standard into the reference turbidity tube is not necessary.
- 7.3.5 Open the lid on the LaMotte 2020 turbidimeter. Align the indexing arrow on the turbidity tube with the indexing arrow just below the sample chamber on the LaMotte 2020 turbidimeter (see Figure 7-1), and insert the turbidity tube into the sample chamber.

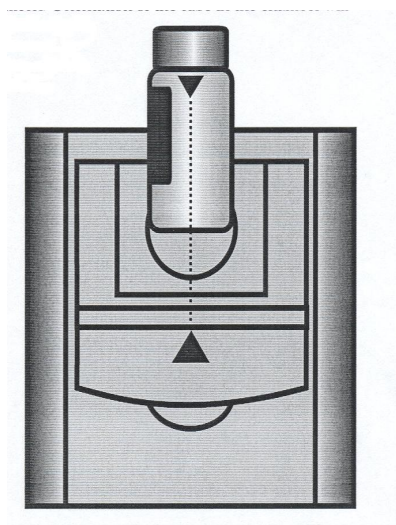


Figure 7-1 Aligning the Index Arrows on the Turbidity Tube and the LaMotte 2020 Turbidimeter

- 7.3.6 Close the lid on the LaMotte 2020 turbidimeter and press the **READ** button. The turbidity in NTU will be displayed in five seconds. If the displayed value is within $\pm 5\%$ of the true value of the AMCO™ standard, record the reading on the turbidity calibration log sheet, and indicate in the comments column of the turbidity calibration log sheet that the reading was obtained through a calibration check, and the LaMotte 2020 turbidimeter did not require calibration. If the displayed value is not within $\pm 5\%$ of the true value of the AMCO™ standard, continue with the calibration procedure.
- 7.3.7 Push the **CAL** button for five seconds until **CAL** is displayed on the LaMotte 2020 turbidimeter, and release the **CAL** button. The display will flash the reading obtained in step 7.3.6.
- 7.3.8 Adjust the display with the **▲** or **▼** buttons until the true value of the AMCO™ standard is displayed on the LaMotte 2020 turbidimeter.
- 7.3.9 Push the **CAL** button again to memorize the calibration. The LaMotte 2020 turbidimeter display will stop flashing, indicating that calibration is complete. Press the **READ** button again to verify that the calibration is acceptable. If the reading is not within $\pm 5\%$ of the true value of the AMCO™ standard, the LaMotte 2020 turbidimeter must be recalibrated by repeating steps 7.3.1 through 7.3.9.
- 7.3.10 Once an acceptable calibration check has been performed, record the reading on the turbidity calibration log sheet, and indicate in the comments column of the turbidity calibration log sheet that the reading was a calibration check obtained following calibration.
- 7.3.11 Repeat the calibration check using a second standard to bracket the expected values. For low-flow groundwater sampling, deionized ultra-filtered water (0.00 NTU) should be used unless elevated turbidity is expected. Repeat steps 7.3.4 and 7.3.6. The value should be within ± 0.10 NTU. If criteria are not met, check the cleanliness of the tube, check the standard for air bubbles, and repeat the check. If the error cannot be corrected, recalibrate, or use another meter.

7.4 Sample Analysis

- 7.4.1 Rinse an empty turbidity tube with a portion of the sample, and shake out the excess sample water.
- 7.4.2 Fill the reference turbidity tube to the neck. The turbidity tube should be filled in a manner such that the sample water is entering the turbidity tube down the side of the turbidity tube to avoid creating bubbles.
- 7.4.4 Cap the turbidity tube and wipe the turbidity tube dry with a clean Kimwipe®.
- 7.4.5 Gently mix the sample by inverting the turbidity tube. Be careful not to introduce any bubbles into the turbidity vial.

- 7.4.6 Open the lid on the LaMotte 2020 turbidimeter. Align the indexing arrow on the turbidity tube with the indexing arrow just below the sample chamber on the LaMotte 2020 turbidimeter (see Figure 7-1), and insert the turbidity tube into the sample chamber.
- 7.4.7 Close the lid on the LaMotte 2020 turbidimeter and press the **READ** button. The turbidity in NTU will be displayed in five seconds.
- 7.4.8 Use a graduated cylinder and turbidity free water to dilute any sample that is over 1,100 NTU, such that the reading falls within the LaMotte 2020 turbidimeter's calibrated range (0 to 1,100 NTU). Calculate final turbidity according to the following formula:

$$\text{Turbidity (NTU)} = \text{sample\_reading} \times \text{dilution\_factor}$$

Record the results on the monitoring well worksheet or the field logbook.

- 7.4.9 The LaMotte 2020 turbidimeter will turn off automatically two minutes after the last button push. To turn the LaMotte 2020 turbidimeter off manually, press and hold the **READ** button for at least one second. Release the **READ** button when "OFF" is displayed.

8.0 Data and Records Management

All calibration/calibration check information must be documented on the turbidity calibration log sheet. An example turbidity calibration log sheet is presented in Attachment A. All sample data and relevant information (e.g. sample collection method used) must be documented on field data sheets (e.g. groundwater monitoring worksheets, surface water sampling worksheets) or within site log books with permanent ink. Data recorded will include the following:

- Instrument make, model, and serial number
- Date, time, and results of instrument calibration and calibration checks
- Deviations from the procedure as written
- Readings obtained, including any dilutions

9.0 Quality Control and Quality Assurance

- 9.1 The LaMotte 2020 turbidimeter will be calibrated at the start of each day of sample analysis according to the procedures described in Section 7.3. If a parameter is measured that lies outside of the range bracketed by the instrument calibration standards, the instrument must either be recalibrated using standards that bracket the value or a calibration check using a standard that brackets the value must be performed. If the standards are not available to bracket the result, the data must be qualified.
- 9.2 Readings measured by instruments that are subsequently found to be outside of criteria during the calibration check shall be documented on the sampling worksheet used to document the sample collection.

- 9.3 If the LaMotte 2020 turbidimeter is being used in fieldwork (e.g. groundwater sampling or surface water sampling), the calibration will be checked each day prior to calibration, immediately after calibration (if calibration is required as described in Section 7.3), and at the end of each day using the same AMCO™ standard as was used for calibration. The reading must be within +/- 5% of the true value (± 0.10 NTU for the zero standard). If this criteria is not met, the source of the problem must be identified and corrected, or another turbidimeter must be used.
- 9.4 If the LaMotte 2020 turbidimeter is being used in a field laboratory setting (e.g. pilot groundwater treatability study), the calibration will be checked each day prior to calibration, immediately after calibration (if calibration is required as described in Section 7.3), at the midpoint of each day, and at the end of each day using the same AMCO™ standard as was used for calibration. The reading must be within +/- 5% of the true value. If this criteria is not met, the source of the problem must be identified and corrected, or another turbidimeter must be used.

10.0 Troubleshooting and Maintenance

The LaMotte 2020 turbidimeter is not designed for field service with the exception of battery replacement. See the Instructions Manual presented in Attachment B for detailed descriptions of troubleshooting and maintenance procedures. Some common troubleshooting and maintenance procedures are presented below.

- 10.1 "BAT" is displayed – The battery is low and needs to be changed.
- 10.1.1 Open the battery compartment lid on the bottom of the LaMotte 2020 turbidimeter
 - 10.1.2 Remove the 9-volt battery from the battery compartment, disconnect and remove the 9-volt battery from the polarized plug
 - 10.1.3 Carefully connect a new 9-volt battery to the polarized plug and insert it into the battery compartment.
 - 10.1.4 Close the battery compartment lid.
- 10.2 "ER1" is displayed – The battery is very low and needs to be changed immediately. **Operating the LaMotte 2020 turbidimeter with a very low battery could result in permanent erasure of the factory calibration. Change the battery according to the procedures outlined in steps 10.1.1 through 10.1.4 immediately.**
- 10.3 "ER2" is displayed – The sample result is above the calibration range ($>1,100$ NTU). Dilute the sample with turbidity free water and reanalyze.
- 10.4 "ER3" is displayed – The tungsten incandescent light bulb is misaligned or burnt out. Call LaMotte for procedures on returning the instrument to the manufacturer.



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11.0 References

LaMotte Company, 2004. *LaMotte 2020 Turbidimeter Instruction Manual*, August.

U.S. Environmental Protection Agency Region I (U.S. EPA-NE). 2010. *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductivity, oxidation/reduction potential [ORP], and turbidity)*, Revision Number 2. January 19.



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REVISION: 02
ISSUED: April 15, 2010
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STANDARD OPERATING PROCEDURE

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CALIBRATION AND OPERATION OF YSI 6-SERIES WATER
QUALITY METER FOR TEMPERATURE, PH, DISSOLVED OXYGEN,
CONDUCTIVITY AND OXIDATION REDUCTION POTENTIAL

Prepared by: _____
Andrew J. Mosuly // Supervisor/Technical Director

Date: _____

Reviewed by: _____
Erin Murphy Govern // Quality Assurance Officer

Date: _____

Approved by: _____
Anne M. Salazar // Manager

Date: _____



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FIELD CALIBRATION OF THE YSI WATER QUALITY METER

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FIELD CALIBRATION OF THE YSI WATER QUALITY METER

1.0 Scope and Application

The purpose of this standard operating procedure (SOP) is provide a framework for calibrating sondes used to measure water quality parameters for ground water and surface water. Water quality parameters include temperature, pH, dissolved oxygen, conductivity/specific conductance, and oxidation reduction potential. Turbidity must not be measured using the portable water quality meters since the method used by the YSI and other models for turbidity measurement may not be approved for use by EPA, and because the flow-through cell acts as a sediment trap. A separate meter which uses EPA Method 180.1 or Standard Method 3130 B to measure turbidity must be used.

This SOP is written specifically for the YSI model 6-Series Sondes (which include the 600R, 600XL, 600XLM, 6820, 6920 and 6600 models), and the YSI 650 MDS (Multi parameter Display System) display/logger. Note that the YSI 6820 is the equipment model typically used. The general calibration processes discussed herein are applicable to other manufactures sondes and displays/loggers. Consult the manufacturer's instruction manuals for specific procedures.

2.0 Summary of Method

This SOP describes the process for calibration using YSI Model 6-Series Sondes for water quality field measurements.

3.0 Health and Safety Warnings

- 3.1 All proper personal protection clothing and equipment is to be worn.
- 3.2 The standard solutions for calibrating conductivity contain iodine, potassium chloride and propanol. When using the standards, avoid inhalation, skin contact, eye contact or ingestion. If skin contact occurs, remove contaminated clothing immediately. Wash the affected areas thoroughly with large amounts of water. If inhalation, eye contact or ingestion occurs, consult the Material Data Safety Sheets (MSDS) for prompt action, and in all cases seek medical attention immediately.
- 3.3 All standard solutions for calibration pH contain the following chemicals:
- pH 4 Solutions: potassium hydrogen phthalate, formaldehyde, water
 - pH 7 Solutions: sodium phosphate (dibasic), potassium phosphate (monobasic), water
 - pH 10 Solutions: potassium borate (tetra), potassium carbonate, potassium hydroxide, sodium diethylenediamine tetraacetate, water

Avoid inhalation, skin contact, eye contact and ingestion. If skin contact occurs remove contaminated clothing immediately. Wash the affected areas thoroughly with large amounts of water. If inhalation, eye contact or ingestion occurs, consult the MSDS for prompt action, and in all cases seek medical attention immediately.

- 3.4 Standard solutions for calibration of oxidation reduction potential (ORP) contain the following chemicals:
- potassium ferrocyanide trihydrate

- potassium ferrocyanide
- potassium chloride

Avoid inhalation, skin contact, eye contact, and ingestion. Avoid combining with the pH buffers and with any acids since cyanide may be released. Isolate the ORP solution. Do not dispose with other calibration solutions. If skin contact occurs, wash affected areas thoroughly with large amounts of water. Consult the Health and Safety Plan, and the MSDSs therein.

- 3.5 Standard solutions for calibration of dissolved oxygen contain sodium sulfite, cobalt chloride, manganese sulfate, alkali-iodide-azide, sulfuric acid, starch solution and sodium thiosulfate. Avoid inhalation, skin contact, eye contact, and ingestion. If skin contact occurs, wash affected areas thoroughly with large amounts of water. Consult the Health and Safety Plan, and the MSDSs therein.

4.0 Interferences

- 4.1 Each of the parameters measured with this procedure is subject to various interferences including cross-contamination, turbidity, aeration, and temperature fluctuations. Care must be taken to ensure that the instrument remains in a stable, controlled environment throughout the calibration and monitoring process; and that the conditions under which the samples are analyzed are the same as those under which calibration is conducted.

- 4.2 There must be no air bubbles lodged between the probe and probe guard.

- 4.3 All standards should be stored according to manufacturers' instructions.

5.0 Personnel Qualifications

- 5.1 All field samplers are required to take the 40-hour OSHA health and safety training course and annual 8-hour refresher courses prior to engaging in any field collection activities.
- 5.2 Prior to implementation of this procedure, the field sampler will be instructed by a person experienced with these procedures and will demonstrate to the field team leader the proper set-up, calibration, operation, and routine maintenance of the hand-held equipment, as well as an understanding of this procedure.

6.0 Equipment and Supplies

- Copy of the instrument manual and instrument specifications
- Copy of the project Health and Safety Plan and Sampling and Analysis Plan
- Thermometer (with NIST trace)
- pH Buffers of 4, 7, and 10
- Conductivity standards (concentration dependent upon expected field conditions)
- Zobell ORP calibration standard
- Zero Dissolved Oxygen Solution
- Deionized Ultra-Filtered (DIUF) Water

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- YSI Sonde with attached pH, Conductivity, Dissolved Oxygen, and ORP probes with clear flow-through cell
- YSI 650 MDS Multiparameter Display System
- Sonde communications cable
- Winkler DO Kit
- Ring stand or similar capable of holding the sonde and flow-through cell upright during low-flow groundwater sampling
- Kimwipes or equivalent
- Gallon-size plastic freezer bags (e.g. Ziploc) to protect the MDS and the top of the Sonde from rain

7.0 Procedure

All instrument probes must be calibrated before they are used to measure environmental samples, and the calibration should be checked at the end of the sampling day or if any anomalous readings are obtained. All results should be recorded on the YSI Water Quality Calibration Log Sheet, presented in Attachment 1.

7.1 Set-up

- 7.1.1 Before performing any calibration procedure the sonde and display/logger must warm-up for at least 15 minutes.
- 7.1.2 During the warm-up period, set the sonde up on a ring stand.
- 7.1.3 Prior to calibration, all instrument probes on the sonde must be cleaned according to the manufacturer's instructions. Failure to perform this step can lead to erratic measurements. The probes must also be cleaned by rinsing with deionized water before and after immersing the probe in a calibration solution.
- 7.1.4 Check the calibration solutions for expiration dates and do not use expired standards.
- 7.1.5 The temperature of the standards should be as close to the temperature of the samples to be measured as is practical.
- 7.1.6 For each of the calibration solutions, provide enough volume so that the probe and the temperature sensor are sufficiently covered. Specific detail on the volume required for each sonde and calibration solution is provided on pages 2-29 and 2-30 of the YSI 6-Series Instrument Manual.
- 7.1.7 Check the display/logger to determine the battery level in the display/logger to see if new batteries are necessary.
- 7.1.8 Set up instrument display so that the following items are displayed:
 - DO (%)
 - ORP (mV)

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- DO (mg/L)
- Cond. ($\mu\text{S}/\text{cm}$)
- Sp. Cond. ($\mu\text{S}/\text{cm}$)
- pH (Standard Units [S.U.])
- Temperature ($^{\circ}\text{C}$)

7.2 Temperature

For instrument probes that rely on the temperature sensor (pH, dissolved oxygen/specific conductance, and ORP), the sonde temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). This accuracy check should be performed at least quarterly, and the date and results of the check kept with the instrument. Temperature checks will be checked by the rental company for rented units, and by the M&E equipment manager for M&E-owned units. Prior to mobilizing, obtain the date and results of the check from the equipment room manager or check the outside of the case for rental units. If the check has not been performed within the past three months, do not use the instrument. Document the date, results, and company that performed the check on the calibration log sheet or in the field logbook. In the event that verification is required, the procedure is presented below:

- 7.2.1 Fill a container with water and adjust the water temperature to a temperature below the temperature of the samples to be measured.
- 7.2.2 Place a thermometer that is traceable to the NIST into the water and wait for both temperature readings to stabilize.
- 7.2.3 Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer within the accuracy of the sensor ($\pm 0.2^{\circ}\text{C}$). If the measurements do not agree, the instrument may not be working correctly and the manufacturer should be contacted.
- 7.2.4 Repeat the procedure using a container of water that has a temperature above that anticipated for the samples to be measured.

7.3 Dissolved Oxygen

Dissolved oxygen (DO) content in water is measured using a membrane electrode. The DO probe's membrane and electrolyte solution should be inspected for any damage or air bubbles prior to calibration. If air bubbles, nicks, or damage are present, replace the membrane according to manufacturer's suggestions. After changing the membrane, it is preferable to wait 12 hours before use to allow the membrane to equilibrate. If this is not possible, note this in the calibration log. YSI 6-Series DO probe must be calibrated using the calibration cup provided with the sonde. Calibration of the DO probe requires inputting the current barometric pressure. The YSI 650 display/logger has a barometer within the unit and automatically provides this during the calibration procedure. The barometric pressure for all units onsite should be checked for agreement between units, or checked using the onsite barometer. Other display/loggers do not supply the barometric pressure, and this must be obtained from an onsite barometer. Do not use barometric pressure obtained from meteorology reports as these are usually corrected to mean sea level.

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Calibration is performed using 100% saturated air, and checked immediately after with a solution with zero dissolved oxygen. The calibration check at the end of the day uses both 100% saturated air and the zero dissolved oxygen solution. In addition, on a weekly basis when the meter is in use, compare DO concentrations measured by the probe to those measured using the Winkler method.

7.3.1 DO Calibration

- 7.3.1.1 Gently dry the temperature sensor and remove any water droplets from the DO probe's sensor membrane according to the manufacturer's instructions. Note that the evaporation of moisture on the temperature sensor or DO probe may influence the readings during calibration.
- 7.3.1.2 Place a small amount of water ($<1/8"$) in the bottom of the calibration cup. Engage only one thread of the calibration cap onto the sonde so that the DO probe is readily vented to the atmosphere. Take care to avoid touching the oxygen membrane with the calibration cups and flow-cell. The DO probe and thermistor must not be in contact with the water. Keep the instrument in run mode and wait approximately 15 minutes for the air in the calibration cup to become water-saturated (100% humidity at atmospheric pressure) and the temperature to equilibrate. Set up the remaining instruments and solutions in the meantime.
- 7.3.1.3 When the temperature has stabilized, go to Calibrate mode - **Calibrate DO%**
- 7.3.1.4 Record the temperature on the calibration log. Check the barometric pressure reading on the YSI versus the barometer and other YSIs present. Enter the barometric pressure if correction is necessary. Record the barometric pressure on the calibration log. (Note: barometric pressures presented in meteorological reports are generally corrected to mean sea level. These are not useful for calibrating the sonde, which requires uncorrected barometric pressure).
- 7.3.1.5 When the DO% and temperature readings have stabilized for at least one minute, press **enter**. Record the number that appears on the screen. Record also the DO mg/L value.
- 7.3.1.6 Check the oxygen solubility at that pressure and temperature on Table 1 and record under "Std temp/pressure correction." The instrument DO reading should be comparable with the value on the table (within ± 0.2 mg/L). If not, recalibrate, or replace DO membrane.
- 7.3.1.7 Make up the zero DO solution by filling the calibration cap with DI water, adding approximately 1 gram of sodium sulfite to supersaturate the solution. Add a few crystals of the cobalt chloride (purple salt) and stir. There should be solids on the bottom of the cap. Screw the cap tightly onto the YSI. Water should leak out to indicate that there is no air around the probes. An open disposable sample cup may be used in place of the

calibration cap, however if check criteria are not met, the procedure must be repeated using the calibration cap as described.

7.3.1.8 Immediately after calibration, if the DO is ≤ 0.50 mg/L and ≥ 0.00 mg/L, record the value on the calibration log. If the number stabilizes at a value > 0.50 mg/L, or reads negative, and an open cup was used, repeat the procedure with the closed calibration cup. If an open cup was not used, change the DO membrane and repeat the calibration and check.

7.3.1.9 Remove the cap, and rinse the probes well with DI water. Blot the probes dry, carefully avoiding the DO membrane.

7.3.2 DO End-of-Day Check

7.3.2.1 Perform the calibration check using the 100% saturated standard.

7.3.2.1.1.1 Follow Steps 7.3.1.1 and 7.3.1.2.

7.3.2.1.1.2 Allow the DO% and temperature readings to stabilize for at least one minute. Record the number that appears on the screen. Record also the DO mg/L value.

7.3.2.1.1.3 Check the oxygen solubility at that pressure and temperature on the attached table and record under "Std temp/pressure correction." The instrument DO reading should be comparable with the value on the table (within ± 0.5 mg/L).

7.3.2.2 Perform the calibration check using the zero dissolved oxygen standard.

7.3.2.2.1.1 Follow Step 7.3.1.7.

7.3.2.2.1.2 The DO should be ≤ 0.5 mg/L, but not negative. If the DO is above criteria, make up a new zero DO standard and use a closed calibration cap if an open cup was used. Repeat the calibration check. If criteria are still not met, note the failed criteria and the readings that are impacted.

7.3.3 Winkler Method

7.3.3.1 Fill a 300-mL glass stoppered BOD bottle with sample water. Remember no bubbles.

7.3.3.2 Immediately add 2mL of manganese sulfate to the collection bottle by inserting the calibrated pipette just below the surface of the liquid. (If the reagent is added above the sample surface, you will introduce oxygen into the sample.) Squeeze the pipette slowly so no bubbles are introduced via the pipette.

7.3.3.3 Add 2 mL of alkali-iodide-azide reagent in the same manner.

7.3.3.4 Stopper the bottle with care to be sure no air is introduced. Mix the sample by inverting several times. Check for air bubbles; discard the sample and start over if any are seen. If oxygen is present, a brownish-orange cloud of precipitate or floc will appear. When this floc has settled to the bottom, mix the sample by turning it upside down several times and let it settle again.

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- 7.3.3.5 Add 2 mL of concentrated sulfuric acid via a pipette held just above the surface of the sample. Carefully stopper and invert several times to dissolve the floc. At this point, the sample is "fixed" and can be stored for up to 8 hours if kept in a cool, dark place. As an added precaution, squirt distilled water along the stopper, and cap the bottle with aluminum foil and a rubber band during the storage period.
- 7.3.3.6 In a glass flask, titrate 201 mL of the sample with sodium thiosulfate to a pale straw color. Titrate by slowly dropping titrant solution from a calibrated pipette into the flask and continually stirring or swirling the sample water.
- 7.3.3.7 Add 2 mL of starch solution so a blue color forms.
- 7.3.3.8 Continue slowly titrating until the sample turns clear. As this experiment reaches the endpoint, it will take only one drop of the titrant to eliminate the blue color. Be especially careful that each drop is fully mixed into the sample before adding the next. It is sometimes helpful to hold the flask up to a white sheet of paper to check for absence of the blue color.
- 7.3.3.9 The concentration of dissolved oxygen in the sample is equivalent to the number of milliliters of titrant used. Each milliliter of sodium thiosulfate added in steps 6 and 8 equals 1 mg/L dissolved oxygen.

7.4 pH

The pH of a sample is determined electrometrically using a glass electrode. Choose the appropriate standards that will bracket the expected values at the sampling locations. A two or three-point calibration can be performed. Typically, a three-point calibration using standards pH 4, pH 7, and pH 10 will be required. A calibration check is performed immediately after calibration using the pH 7 standard and a criterion of ± 0.05 S.U. A calibration check is also performed at the end of the day using the pH 7 standard and a criteria of 0.2 S.U..

7.4.1 pH Calibration

- 7.4.1.1 Allow the buffered samples to equilibrate to the ambient temperature.
- 7.4.1.2 Remove the calibration cap and clean all of the probes on the sonde with deionized water. Begin with pH 7. Wipe with Kimwipe and immerse all the probes except the DO probe in the 7 pH solution. Place enough pH 7 solution in the calibration cup to immerse the pH probe, reference junction, and thermistor. Return to **calibration mode**.
- 7.4.1.3 Scroll to pH on the calibration menu. Select **3-pt calibration**.
- 7.4.1.4 Enter the pH value based on the solution temperature when prompted for the first value, and press **enter**. The pH value adjusted for temperature is presented on the label of the buffer solution.
- 7.4.1.5 When value is stable for approximately 30 seconds, press **enter**, and record the number that appears on the screen. The display will indicate that the calibration has been accepted and will prompt the analyst to enter a second pH value.

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7.4.1.6 Remove probes from solution. Rinse with DI water, wipe carefully, and put all probes in solution pH 4. Make sure that there is enough pH 4 buffer to immerse the pH probe, reference junction, and thermistor.

7.4.1.7 Enter the pH value based on the solution temperature when prompted for the second pH solution, press **enter**.

7.4.1.8 Allow at least one minute for temperature equilibration. When value is stable for at least 30 seconds, press **enter**, and record the number that appears on the screen.

7.4.1.9 Repeat steps 5, 6, and 7 for the pH 10 solution.

7.4.1.10 Press **enter** or **esc** to go to calibration menu.

7.4.1.11 Go to the run mode to perform a calibration check of the pH 7 solution. Rinse the probe and immerse in pH 7 solution. The reading should be within ± 0.05 pH units of the pH value adjusted for temperature. If not, recalibrate. Record the reading.

7.4.2 pH End-of-Day Check

7.4.2.1 Go to the run mode to perform a calibration check of the pH 7 solution.

7.4.2.2 Rinse the probe and immerse in pH 7 solution. Record the reading. The reading should be within ± 0.2 pH units of the pH value adjusted for temperature.

7.4.2.3 If not, record on the measurements impacted that the pH calibration check criterion was not met.

7.5 Conductivity

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C. Note that the pH buffers are highly conductive and will adversely impact calibration of conductivity. Thoroughly rinse the probes after performing pH calibration, and then pre-rinse the probe with the conductivity solution to be used.

EPA recommends that conductivity be calibrated using standards that bracket the range of concentrations expected. Conductivities in groundwater frequently range below 1,000 $\mu\text{S}/\text{cm}$; however YSI does not recommend calibration with standards below 1,000 $\mu\text{S}/\text{cm}$ because interference with the instrument from outside electrical noise (RF) may be a factor. Since the calibration for conductivity is a 1-point calibration, and expected conductivities will generally be less than 1,000 $\mu\text{S}/\text{cm}$, calibrate with the 1,000 $\mu\text{S}/\text{cm}$ standard, and perform a check with a lower conductivity solution to bracket the range (e.g. 100 $\mu\text{S}/\text{cm}$). If an alternative check concentration is required to bracket the expected concentrations of site samples, the alternative concentration will be specified in the site-specific QAPP.

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7.5.1 Conductivity Calibration

7.5.1.1 Allow the calibration standards to equilibrate to the ambient temperature.

7.5.1.2 Carefully rinse the probes in DIUF, then in the first conductivity solution to be used.

7.5.1.3 Immerse all probes except the DO probe completely in the conductivity calibration solution. Make sure that the thermistor is immersed, and the conductivity cell is immersed past the vent hole. Gently tap the side of the calibration cup to dislodge any air bubbles trapped inside the cell.

7.5.1.4 Scroll to **conductivity** on the screen, then select **specific conductance**. Select calibrate to **µS/cm**. Enter the conductivity value for the standard at 25°C in µS/cm, which is the same as the specific conductance for the standard

7.5.1.5 Press **enter** and wait for the readings to stabilize. Press **enter**. Record the readings for specific conductivity in the calibration log. Do not exit conductivity.

7.5.1.6 **Do not** indicate “accept” when the calibration indicates “Out of Range.” Possible causes are incorrect entry, low level of solution, bubbles, or a bad probe. Attempt to recalibrate. If the problem persists, use another instrument. Return the instrument to the vendor or equipment room.

7.5.1.7 Perform a check of the calibration. Remove the probes from the solution. Rinse with the next conductivity solution. Immerse all probes except DO in the conductivity calibration solution. Allow the number to stabilize and record the values for specific conductivity in the calibration log. If the specific conductivity result is not within 5% of the value on the bottle, recalibrate. Remove probes from solution and rinse with DI water. Wipe dry.

7.5.2 Conductivity End-of-Day Check

7.5.2.1 Rinse the probes with the conductivity solution. Immerse all the probes except the DO probes in the conductivity calibration solution.

7.5.2.2 Allow the number to stabilize and record the values for conductivity and specific conductivity in the calibration log. If the specific conductivity result is not within 5% of the value on the bottle, note on the measurements obtained that the conductivity calibration check criteria were not met.

7.5.2.3 Remove the probes from solution and rinse with DI water. Wipe dry.

7.6 Oxidation Reduction Potential

ORP will be checked for accuracy, and will only be field calibrated if the calibration check fails criteria.

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7.6.1 ORP Calibration

7.6.1.1 Switch to **run mode**. Gently mix the ORP solution and open the packet. Put all but the DO probe in the ORP solution. Allow to stabilize and record reading. If reading is not within $\pm 10\text{mV}$ of the actual value corrected for temperature (see Table 2), proceed to 7.6.1.2.

7.6.1.2 Go to Calibration mode. Scroll to ORP and press **enter**. Enter ORP value (**corrected for temperature** - see above) and press **enter**. When the number is stable for 20 seconds, press **enter** and record the number. If instrument says "Out of Range," do not accept the value: Use a different instrument. If a different instrument is not available, record the number and note that it is not within limits.

7.6.2 ORP End-of-Day Check

7.6.2.1 Switch to **run mode**.

7.6.2.2 Gently mix the ORP solution and open the packet. Put all but the DO probe in the ORP solution.

7.6.2.3 Allow to stabilize and record reading. If reading is not within $\pm 10\text{mV}$ of the actual value corrected for temperature (see table below), note on the measurements affected that the criterion for ORP check was not met.

7.7 Close up Instrument (After calibration and prior to mobilizing to the sampling location)

7.7.1 Replace clean cap over probes.

7.7.2 Select MDS Menu mode. Reset the parameters to the field sampling parameters:

- Time (24hr) – correct as needed
- pH (S.U.)
- specific conductivity ($\mu\text{S}/\text{cm}$)
- ORP (mV)
- Temperature ($^{\circ}\text{C}$)
- DO (mg/L)

7.7.3 Shut off computer, and return to case

8.0 Data and Records Management

8.1 Calibration logsheets shall be used to document the details of instrument calibration and calibration checks.

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- 8.2 The site logbook should be used to note when instrument calibration and instrument calibration checks were conducted, and should reference the calibration logsheets for details.

9.0 Quality Control and Quality Assurance

- 9.1 Quality Control Criteria are summarized in Table 2.

9.1.1 If a parameter is measured that lies outside of the range bracketed by the instrument calibration standards, the instrument must either be recalibrated using standards that bracket the value or a calibration check using a standard that brackets the value must be performed. If the standards are not available to bracket the result, the data must be qualified.

9.1.2 Readings measured by instruments that are subsequently found to be outside of criteria during the calibration check shall be documented on the sampling worksheet used to document the sample collection.

- 9.2 Pollution Prevention

9.2.1 Containers used to calibrate the probes shall be sized to use the smallest amount of standard possible but still accommodate all probes which need to be in the calibration solution such that they are adequately covered.

9.2.2 Conductivity and pH calibration solutions may be reused at the end of the day with caution if properly stored. However, a calibration check that reuses standard but does not meet criteria should be re-checked with fresh standard, and calibration should be conducted with fresh standards.

- 9.3 Waste Management

Unused calibration standards should be returned to the equipment room manager for proper disposal. Do not combine ORP standards with other standards since cyanide could be released.

10.0 References

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Table 1: Oxygen Solubility at Indicated Pressure (Source: 2010 EPA SOP for Calibration of Field Instruments)



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Table 2: ORP Check Standard Readings (Source: YSI 3682 Zobell Solution Instructions)

Temperature, °C	231 mV Standard Solution
-5	270.0
0	263.5
1	262.2
2	260.9
3	259.6
4	258.3
5	257.0
6	255.7
7	254.4
8	253.1
9	251.8
10	250.5
11	249.2
12	247.99
13	246.6
14	245.3
15	244.0
16	242.7
17	242.4
18	240.1
19	238.8
20	237.5
21	236.2
22	234.9
23	233.6
24	232.3
25	231.0
30	224.5

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**Table 3: pH Values Adjusted for Temperature
For Use Only with
pH4 -- Fisher #SB-101-500
pH7 -- Fisher #SB-107-500
pH10 -- Fisher #SB-115-500**

(Source: Fisher Scientific Standard Labels)

Temperature (° C)	pH 4 (S.U.)	pH 7 (S.U.)	pH 10 (S.U.)
0	4.01	7.13	10.34
5	3.99	7.10	10.26
10	4.00	7.07	10.19
15	3.99	7.05	10.12
20	4.00	7.02	10.06
25	4.00	7.00	10.00
30	4.01	6.99	9.94
35	4.02	6.98	9.90

Table 4: Quality Control Criteria

	Beginning of Activities				End-of-Day			
	Calibration		Calibration Check		Calibration Check			
Parameter	Standard	Criteria	Standard	Criteria	1 st Standard	Criteria	2 nd Standard	Criteria
Temperature	NIST Thermometer	± 0.2 °C	NA	NA	NA	NA	NA	NA
Dissolved Oxygen	100 % Saturated	± 0.2 mg/L	0.0 mg/L	≤ 0.5 mg/L, but ≥ 0.0	100% Sat	± 0.5 mg/L	0.0 mg/L	≤ 0.5 mg/L, but ≥ 0.0
pH	Bracket anticipated (pH 7, 4, 10)	NA	pH 7 Temp. adjusted value	± 0.05 pH	pH 7 Temp. adjusted value	± 0.2 pH	NA	NA
Specific Conductance	Bracket anticipated (≤ 1,000 µS/cm)	NA	Bracket anticipated	± 5%	Same as for calibration	± 5%	NA	NA
Oxidation-Reduction Potential	Only if check fails: 231 mV Zobell solution	NA	231 mV Zobell solution	± 10mV	231 mV Zobell solution	± 10mV	NA	NA



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NUMBER: 004

REVISION: 05

ISSUED: April 15, 2010

PAGE: Attachment

Attachment: YSI Water Quality Calibration Log

Operation/ Field Calibration of the Baseline BTX Model 1030A GC

Date: October 2004
Revision Number: 01
Author: Tony Sacco
Discipline: Air Toxics Monitoring

1.0 PURPOSE AND SCOPE

The purpose of this SOP is to provide a method for field personnel to operate and calibrate/ adjust the span response setting of the Baseline model 1030A gas chromatograph (GC) that is configured to speciate the BTX compounds benzene, toluene and the m, o, p-xylenes (defined as Xylene).

This operation and calibration procedure assumes that the Model 1030A GC is installed in a real-time network where the analog output from each of the GC channels is sent to a Odessa Model 3260 data logger. The data logger converts the signals (0-10VDC) to engineering units. The engineering units are communicated to a desktop central computer by means of a telemetry system such as a spread spectrum or other wireless system

This SOP is intended for the use of individuals who have been trained in the task of calibration in general and in the calibration of this specific instrument, in particular.

2.0 RESPONSIBILITIES

- 2.1** It is the responsibility of the project manager to make the proper training available to the qualified project field personnel.
- 2.2** It is the responsibility of the project engineer to provide the training and guidance to field personnel prior to any field activity where this SOP is to be employed.
- 2.3** It is the responsibility of the affected field personnel to read and understand this SOP and to also, read and understand the manufacturer's operation manual for the **Baseline, Model 1030A BTX Gas Chromatograph (GC)**.

3.0 REQUIRED MATERIALS

- Single pen strip chart recorder (0-10 VDC range) with the capability of a chart speed of 2 cm/min.
- Calibration gas mixture of benzene (approx. 1ppm), toluene (approx. 5 ppm), xylene (approx. 5 ppm).
- Electronic Calculator.
- Calibration form(s) (NJNG Calibration of Baseline GC).
- 10" adjustable wrench, 6" adjustable wrench.

- Laptop computer or data terminal (Optional).
- The manufacturer's operation manual for the Baseline, Model 1030A BTX Gas Chromatograph.

4.0 INSTRUMENT SPECIFICATIONS

- Dynamic Range: Benzene (0-2.00 ppm), Toluene (0-10.00 ppm), Xylene (0-10.00 ppm)
- Detection limits: 0.001 ppm, Benzene, Toluene, Xylene.
- Precision: 1% or 0.02 ppm
- Accuracy: +/- 1% of full scale
- Calibration: See section **6.0**
- Detector: PID 10.6 eV lamp
- Columns: packed
- Power: 115 VAC @ 60 Hz and 300 watts
- Operating conditions: 40-95 °F (4-40 °C); humidity, 10-85%, non-condensing.
- Carrier Gas: Helium containing <1ppm total hydrocarbons

5.0 CALIBRATION FREQUENCY

- 5.1** A daily automatic span check is conducted for benzene, toluene and xylene. The span check is initiated through the data logger at each monitoring site and takes place during a time when there are no site activities.
- 5.2** The site technician will conduct the following corrective actions on the basis of the nightly span checks results:
- **Routine QC Adjustment** (section **6.0**)– if the span check error on any BTX channel is less than +/- 25% of full scale
 - **QC Adjustment with Dynamic Calibration Verification** (section **7.0**) - if the span check error on any BTX channel is equal or greater than +/-25% of full scale

6.0 ROUTINE QC ADJUSTMENT

- 6.1** Prior to going to the monitoring station that requires adjustment; fill out the top portion of the calibration data sheet "**Calibration of Baseline GC**". In order to determine the percent of Full Scale (**%FS**) that is expected for each of the compounds, use the following equation:

$$\%FS = \frac{cyl. ppm}{Span - ppm} (100)$$

Where:

%FS = the expected % of full scale that is expected for the compound

Cyl. ppm = the concentration of the compound in the calibration gas cylinder (ppm). (**Note:** This information should be noted on a paper tag or a label directly on the cylinder bottle installed in the monitoring station.)

Span-ppm = the full-scale range of the GC for the compound (ppm). (See list below)

The Span-ppm for the BTX compounds are:

Benzene = 2 ppm,

Toluene = 10 ppm

Xylene = 10 ppm.

- 6.2 Locate the monitoring station, verify that the Monitor System Unit # matches the station (site) # on the calibration data sheet or on the daily span check report.
- 6.3 Verify the GC is in **Standby** mode, switch the display to the BTX channel required adjustment
- 6.4 Un-lock the corresponding BTX channel potentiometer (pot), turn the pot clockwise or counter-clockwise until the display is equal to the corresponding expected value in % full scale (**D**) as indicated on the calibration data sheet. Go to Step 6.5. But if the pot has run out of adjustment, a coarse adjustment should be performed as follow:
 - 6.4.1 Adjust the pot to mid-scale (5.00), and then remove the cover of the GC chassis
 - 6.4.2 Locate the integrated control/output PCB inside the chassis, this PCB is mounted on the panel in the middle left hand side of the chassis and on the same side as the sample pump.
 - 6.4.3 Locate the 8 position DIP switches on the PCB. Record the current setting on calibration data sheet
 - 6.4.4 Turn on the next combination of switches to increase the effective gain (refer to page 20 of the operation manual for the effective gain setting) (ie. Switch 4 on = effective gain X5, switches 5&6 on = effective gain X8.33, etc.)

- 6.4.5** Repeat step **6.4** to fine tune the adjustment to the expected %of full scale.
- 6.5** Lock the pot when the adjustment is complete and record the **After Cal** pot setting on the calibration data sheet
- 6.6** Repeat step **6.4** and **6.5** for other BTX channels as necessary
- 6.7** At the Main site, perform the following steps to activate the GC into speciation mode for analyzing the ambient sample and to reset the BTX integrated outputs to ambient condition.
 - 6.7.1** At the conclusion of a polling cycle press the **ESC** key of the computer terminal of the desktop PC (when the screen flashes several times) and the screen will display the **Main Menu** list.
 - 6.7.2** Select “**Communicate with DAU (SCADA)**” by using the arrow keys and move the cursor to appropriate box , Key in **X** and then press the **F1** key. Select the DAU # corresponding to the number on the shelter door of the GC that is to be calibrated (1-9) and press the **F1** key and then **F1** key again, the data logger responds with the specific DAU # indicating that it is in data collection mode and is logged in
 - 6.7.3** In data collection mode, key-in **A**; the data logger will respond with a sub-menu consisting of a listing of action items; enter a **1** (start seq), when data logger prompts again; enter a **3** to activate sequence 3 of the data logger set up. (note: sequence 3 was designed to accomplish step **6.7** to reset the BTX integrated outputs to ambient conditions)
- 6.8** Press **ESC** and **ESC** again to bring the desktop PC back to displaying the data screen.
- 6.9** Press **Alt M** for a Marco screen , select “ **Change Display to BTX and PM10**” Verify that when sequence **3** is complete, all BTX outputs are near ambient concentration levels.
- 6.10** Press **Alt M** again for the Macro screen; select “**Change Display to TVOC and PM10** “ to return monitor to the normal data display screen.

7.0 QC ADJUSTMENT WITH DYNAMIC CALIBRATION VERIFICATION

- 7.1** Repeat steps **6.1** through **6.6**
- 7.2** At the Main site, perform the following steps to activate the daily calibration sequence for the GC to verify the field QC adjustment.
- 7.3** At the conclusion of a polling cycle on the desktop PC (when the screen flashes several times) and from data display screen, press the **ESC** key at the computer terminal and the screen will display the **Main Menu** list.

- 7.4 Select "**Communicate with DAU (SCADA)**" by using the arrow keys and move the cursor to related the appropriate box , Key in **X** and then press the **F1** key. Select the DAU # corresponding to the number on the shelter door of the of the GC is to be calibrated (1-9) and press the **F1** key and then the **F1** key again, the data logger responds with the specific DAU # indicating that it is in data collection mode and is login
- 7.5 In data collection mode, Key-in **A**, data logger will respond with a sub-menu, enter a **1** (start seq), when data logger prompts again, enter a **1** to activate sequence 1 of the data logger set up. (note: sequence 1 was designed for the daily calibration of the GC)
- 7.6 Press **ESC** and **ESC** again to bring the desktop PC back to displaying data screen.
- 7.7 When daily calibration sequence **1** is complete (the calibration sequence should be completed within 25 minutes), press **ESC** to return to the **Main Menu**,
- 7.8 Select "**Generate Quick Look Report**" on **Main Menu** then **F1**, select the specific DAU #, and then **F1**
- 7.9 Verify the date of the daily calibration report to be generated and then select a **Single Day** report.
- 7.10 Key-in **X** on "**Calibration Report to a Printer**".
- 7.11 Check and verify the start time on the report is correct
- 7.12 scale. The QC adjustment is complete.
- 7.13 Verify that the calibration result of all BTX channels is within +/- 20 % of the full If the result is more than +/- 20 % of full scale on any BTX channel, the GC should be removed for services and replaced with a backup unit.

8.0 DYNAMIC CALIBRATION AFTER MAINTENANCE SERVICE

This calibration procedure should be performed after trouble-shooting or maintenance service (e,g cleaning and/or replacing the UV lamp or PID detector. Refer to page 16 of the Operation Manual for detailed maintenance procedure) and is recommended to be conducted in a temperature controlled environment such as inside the trailer located at the Main site. The 1030A GC should be removed from the monitoring location and set up inside the trailer.

- 8.1 After the performing any maintenance services, re-connect the Helium carrier gas and the calibration gas cylinder to the GC
- 8.2 Turn GC power on, verify the carrier gas is on and that the analyzer is in **standby** mode. Allow the GC to warm up at minimum of 1-2 hours or until the temperature reaches its set point.
- 8.3 install a strip chart recorder and connect the chart recorder input leads to Pin 2(+) and Pin 10(-) on connector 1 at the rear panel of the GC.(**Note:** polarity of

the leads should be observed). Plug the recorder power cord into a power outlet. Confirm the recorder is getting power and the pen and chart advance is operating. The chart will move slowly at 2 centimeters per hour (one inch per hour). Set recorder signal input span to 0-10Vdc

- 8.4** Repeat step **6.1** described above, determine the % full scale (D) for each BTX compound and fill out data sheet with required information
- 8.4** Locate and press the **Auto** button on the GC followed by the **Clear** button on the lower right front panel of the Baseline GC.
- 8.5** Put the 1030A GC **CAL** switch in the **ON** (up) position and confirm the recorder is attached and operating (responding to the GC). The display panel above the GC keypad will begin scrolling through the timing program similar to the program as indicated on Page 5 of the Model 1030A Analyzer Operation Manual. Observe that the RED **Stand-by** lamp (located to the left of the display screen) goes out and that the GREEN **Analyze** lamp (located below the stand-by lamp) comes on.
- 7.6** Adjust the chart speed of the recorder to obtain a smooth chromatogram showing good separation of the BTX compounds. Allow the GC to complete at least 3 cycles or until the peak heights from two consecutive cycles for each of the BTX compounds have stabilized. The heights should be approximately the same when observing the strip chart.
- 8.6** After the peak heights have stabilized, record the %FS data from the GC display screen on the calibration data sheet.
- 8.7** Release **AUTO** and depress **CLEAR** to stop the analysis
- 8.8** Adjust the calibration potentiometer (pots), which are located below the display screen, to the expected % full scale for each of the BTX compounds (benzene is **CH1**, toluene is **CH2**, and xylene is **CH3**).
Note: The selector switch below the display screen must be set to the appropriate channel before it can be adjusted
- 8.9** Record **yes** in the column marked **Cal. Adj** on the calibration data form
- 8.10** At the conclusion of the calibration record the final potentiometer settings in the spaces marked **After cal.** on the calibration data form. Be sure to lock the pot(s) at the conclusion of the calibration
- 8.11** Place the **CAL** switch on the GC to the middle position, depress **AUTO** and then **CLEAR** to switch into speciation and allow the GC to go through two cycles without span gas to re-set the integrated output to ambient concentration.
- 8.12** The GC is ready for monitoring service

9.0 DOCUMENTATION

Make certain to document all calibrations along with comments in the field station log. Return all equipment and tools to the proper locations.

10.0 QUALITY ASSURANCE

All calibration documentation will be reviewed by the project engineer. Quarterly audits of the GCs will be conducted by the project quality assurance officer.



CALIBRATION OF BASELINE GC

Site # _____ Monitor System Unit # _____ GC S/N _____ Date of Cal. _____
 Tech Name _____ Time of Calibration _____

Span Pot Settings: Before Cal: CH1 _____ CH2 _____ CH3 _____ Coarse Setting _____
 After Cal: CH1 _____ CH2 _____ CH3 _____ Coarse Setting _____

Cal. Gas Concentration : Benzene* _____ ppm Toluene** _____ ppm Xylene*** _____ ppm
 Expected %FS _____ (D) % FS _____ (D) %FS _____ (D)

Down Channel Before Cal.: Yes / No Time: _____ Up Channel After Cal. Yes / No Time: _____
 (circle response Yes or No)

DATA

	Benzene (O) %FS	Δ% FS	Toluene (O) %FS	Δ% FS	Xylene (O) %FS	Δ% FS	Cal. Adj. (Yes or No)

Δ% FS = 0 – D

(LIMIT FOR QC Adjustment with Dynamic Span Check Verification: +/- 20 % FS)

Output Voltage-ppm equivalent:

*Benzene: 0-10VDC = 0-2.0 ppm

**Toluene: 0-10VDC = 0-10 ppm

*** Xylene: 0-10VDC = 0-10 ppm

Comments

Standard Operating Procedure

Changing the BTX Span Value(s) for an Air Monitoring System

Procedure Number: 2000-119

Revision No.: 0

Revision Date: May 2008

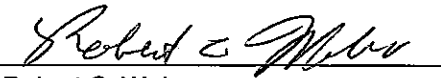
SOP Contributors: Larry Nigro


Tony Sacco, SOP Team Leader

Date: June 4, 2008


Joseph Curreri,
Stakeholder/Service Line Leader

Date: 6/4/08


Robert C. Weber,
President and Chief Executive Officer

Date: June 4, 2008

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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Standard Operating Procedure

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1.0 Scope and applicability

- 1.1 This Standard Operating Procedure (SOP) defines methods by which technicians may change the values for the benzene, toluene and xylenes (BTX) span values for the gas chromatograph/photoionization detector (GC/PID) instruments installed at a fenceline air monitoring site.
- 1.2 This SOP applies to those situations when a new cylinder of BTX is being installed at a monitor location. The method in this SOP is used to change the database so that the designated values for the BTX calibration reflect new span concentrations.
- 1.3 This SOP is to be utilized to conduct the work identified in the title of this SOP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

2.0 Health and safety considerations

- 2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

3.0 Interferences

- Employing calibration gases that have not been properly certified may cause data to be rejected.
- Calibration gases used outside of the operating range of the monitoring system may cause data to be rejected.
- Leaks in the GC/PID pneumatics may lead to erroneous data.

4.0 Equipment and materials

- BTX calibration cylinder.
- Calibration gas in the appropriate range for the monitoring program under test.
- A tool kit that includes several adjustable wrenches.

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5.0 Procedures

5.1 As soon as the pressure in any BTX calibration cylinder declines below 500 psig the field technician should inform the project engineer so that new calibration gas can be ordered. The cylinder pressure may be observed on the cylinder regulator pressure gage which is the gage that is closer to the cylinder. In order to read the pressure, the cylinder supply valve must be turned on.

5.1.1 The BTX calibration cylinder should be replaced when the gas pressure falls below 100 psig.

5.1.2 The procedure below should be followed in order to replace a BTX calibration cylinder.

1. Shut off the cylinder supply valve.
2. Shut off the regulator supply valve.
3. Use a 6" adjustable wrench to remove the fitting that connects the Teflon line to the GC.
4. Slowly bleed any pressure that may remain in the regulator by opening the regulator supply valve. Be sure to shut the valve after the regulator has been bled.
5. Use a 10" adjustable wrench to remove the regulator from the cylinder.

NOTE: THE THREAD ON THE FITTING IS LEFTHAND. IN ORDER TO REMOVE IT THE FITTING MUST BE TURNED CLOCKWISE.

6. Connect the regulator to the new BTX cylinder using a 10" adjustable wrench. The fitting must be turned **counterclockwise**.
7. Reconnect the fitting for the Teflon® line to the regulator. Make sure that the regulator output valve is shut.
8. Turn on the cylinder supply valve. The cylinder pressure gage should register approximately 2000 psig. If the gage registers less than 1500 psig, inform the project engineer. You may still use the cylinder.
9. Use Snoop liquid to identify whether there are any leaks at any of the thread connections. This will be obvious by the appearance of bubbles where the Snoop has been applied.
10. Turn on the regulator supply valve and set the pressure to approximately 20 psig.

5.2 Once the new cylinder has been installed and leak checked, the new span values for the BTX compounds should be input to the computer at the main site.

5.2.1 From the dual data screen key in **ESC**.

5.2.2 Scroll down to the line that reads "Perform Operator Functions" and key in **F1**.

5.2.3 Select the option that indicates "Change Expected Calibration Factors" and key in **F1**.

5.2.4 Select the monitor number where the BTX calibration values are to be changed and key in **F1**.

5.3 Select the parameter (benzene, toluene or xylene), key in **F1** and enter the new expected span value (the expected span values for each BTX compound is printed on the certification tag on the calibration cylinder).

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- 5.4 Key in **ESC** and repeat steps 5.2.2 - 5.2.5.
- 5.5 When all the required span values have been modified, key in **ESC, ESC** to return to the dual data screen.

6.0 Quality assurance / quality control

- 6.1 Calibrations should always leave the analyzer operating within $\pm 5.0\%$ of the reference calibrator at all calibration inputs.
- 6.2 As soon as possible following calibration, the completed data form is to be submitted to the project manager or designee for review in accordance with ENSR's [Senior Review Policy PP-9-0](#). Standards are reviewed for traceability and completeness. DAS and strip chart readings are to be reviewed for agreement and completeness. Calculations, standard conditions, correction factors, project identification, and other data should be reviewed for accuracy, completeness and conformance to the relevant ENSR operational SOP and the project QA Plan.

7.0 Data and records management

- 7.1 Unanticipated changes to the procedures or materials described in this SOP (deviations) will be appropriately documented in the project records.
- 7.2 Records associated with the activities described in this SOP will be maintained according to the document management policy for the project.

8.0 Personnel qualifications and training

- 8.1 Qualifications and training
 - 8.1.1 The individual executing these procedures should have read, and be familiar with, the requirements of this SOP.
 - 8.1.2 Technicians attempting the tasks in this SOP must be thoroughly trained to operate and calibrate the GC/PID being used.
- 8.2 Responsibilities
 - 8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.
 - 8.2.2 It is the responsibility of the project manager and project engineer to make this SOP available to field personnel and to ensure that the method described in this SOP is directly applicable to the task.
 - 8.2.3 It is the responsibility of the field technicians to read and follow this SOP at any time when a new BTX span cylinder is to be installed.

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9.0 References

ENSR SOP 1011, Preparation and Control of Standard Operating Procedures.

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

10.0 Revision history

Revision	Date	Changes
0	May 2008	NA



Project Operating Procedure

Standard Operating Procedure for the Niton XL3t 600 XRF

Procedure Number: PPG 028

Revision No.: 0

Revision Date: June 2010

POP Author

Date: June 2010

Project Manager

Date: June 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

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Standard Operating Procedure for the Niton XL3t 600 XRF

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Project Operating Procedure

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1.0 Scope and Applicability

- 1.1 This Project Operating Procedure (POP) provides the proper techniques for safely operating the Niton XL 3t 600 X-Ray fluorescence (XRF) analyzer for field screening of metals, primarily chromium, in soil. The procedure will permit in-situ analysis of soil samples for field decision making and will be used for delineation purposes during the remedial investigation. This procedure is not intended for submission of data to regulatory agencies; confirmatory analysis must be performed by a certified laboratory using EPA total metals methods.
- 1.2 This procedure is to be used in conjunction with the site specific Field Sampling Plan. This procedure is intended to provide the necessary information for setting up and analyzing soil samples with the XRF analyzer and performing associated quality control procedures.
- 1.3 This procedure is to be used in conjunction with the Niton XL 3t 600 XRF User's Guide. This procedure will provide the basic information for set up of the instrument and analysis of soil samples. However, certain custom functions are not covered in this procedure and must be referenced from the instruction manual.
- 1.4 The method sensitivity or lower limit of detection depends on a number of factors including physical and chemical matrix effects and interelement spectral interferences; in-situ analysis and testing of bagged samples are considered field screening procedures. More accurate measurements using XRF are highly dependent on sample homogeneity; samples must be prepared by sieving and potentially grinding to a uniform particle size in order to achieve the most accurate results.
- 1.5 In-situ XRF results alone are not acceptable for determining that a sample is below cleanup levels. In these cases XRF must be performed on a prepared (homogenized) sample and confirmed using a certified laboratory.

2.0 Health and Safety Considerations

- 2.1 The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.
- 2.2 Due to the dust generation anticipated from this procedure, field personnel will be required to don Level C personal protective equipment (PPE) for this procedure. Refer to the job safety analysis (JSA) for this activity in the site-specific HASP for more detail.
- 2.3 The XRF analyzer contains an x-ray tube; when the x-ray tube is turned on by the user and the shutter is open, as during a measurement, the analyzer emits a directed radiation beam. The instrument should never be pointed at anyone or at any body part. **Never** point the analyzer into the air and perform a test. **Never** hold a sample in your hand and perform a test.

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- 2.4 Each field analyst must undergo training in safe use of the instrumentation by a manufacturer's representative prior to use of the XRF equipment. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. All maintenance other than that specifically listed in the operating manual must be performed by the manufacturer.
- 2.5 Those operating XRF equipment must be aware of, and comply with, state-specific licensing requirements for the use of XRF analyzers (N.J.A.C 7:28-54.1). A copy of the license should be present with the instrument at all times and available upon request in an audit.
- 2.6 A copy of the United States Department of Transportation (US DOT) compliance statement has been provided with each Niton instrument; this document should be kept in the analyzer case at all times.
- 2.7 The analyst must comply with all safety requirements listed in the instrument specific operating manual.

3.0 Interferences

- 3.1 Physical matrix effects can result from variations in the physical character of the sample. This includes variations in particle size, uniformity, homogeneity and surface condition. As a minimum every effort should be made to thoroughly mix and homogenize samples before analysis. The most accurate data will be obtained if samples are sieved and ground to a uniform particle size prior to testing.
- 3.2 Moisture content of soils and sediments can impact analytical accuracy particularly if the sample is water saturated; moisture levels of 5-20% generally have a minimal impact on accuracy. If field data are to be compared with laboratory generated results, samples should be dried using a convection or toaster oven; a microwave should not be used due to the potential for arcing if metal fragments are present in the sample. Studies have also shown poor agreement between laboratory confirmatory analysis and field XRF data when microwave drying is used.
- 3.3 Inconsistent positioning of the sample in front of the probe window can produce errors since the x-ray signal decreases as the distance from the radioactive source increases. The best results are obtained when the sample has a flat, smooth surface and the probe window is in direct contact with the surface.
- 3.4 Chemical matrix effects can occur in soils contaminated with metals and result from spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Peak overlaps occur when certain x-ray lines from different elements are close in energy; the degree to which these peaks can be resolved is dependent upon the instrument detector. Elevated levels of vanadium have been documented as a potential interference for chromium. Absorption occurs when one element tends to absorb the x-rays of a second element reducing the detector's measurement of the intensity of the second element. Less common

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are interferences resulting from K/L, K/M, and L/M line overlaps; this interference can cause difficulty in detection of arsenic in the presence of high levels of lead.

- 3.5** Ambient temperature changes can result in instrument drift. The analyst should review the instrument instructions for the optimal operating range of the instrument and assess the accuracy of instrument response through periodic analysis of blanks and QC check samples.

4.0 Equipment and Materials

- 4.1** The following equipment and materials are required for sample analysis using this technique:

- Niton XL 3t 600 XRF
- Niton XL 3t 600 XRF User's Guide, Version 6.5
- U.S. DOT Compliance Statement and any state required licenses
- Battery charger and spare battery
- National Institute of Standards and Testing (NIST) certified standard reference material(s) (SRMs) or similar standards from the U.S. Geological Survey (USGS) or commercial sources.
- Reference standards and samples provided by the instrument manufacturer
- Blank sample of clean quartz, Teflon, or silicon dioxide
- Trowel for smoothing soil surface or collecting sample
- Plastic bags for collection and homogenization of soil samples.
- Field logbook and pen
- Level C PPE
- Camera (optional)

5.0 Procedures

5.1 Initial Setup

- 5.1.1** Don the Level C PPE as instructed in the site-specific HASP.
- 5.1.2** To turn on the analyzer depress the on/off/escape button on the control panel for 10 seconds; the start screen will appear and begin a 10 second countdown. When the log on screen appears, press anywhere on the screen to continue. Acknowledge the radiation warning by pressing "Yes" and enter the security code for the device.

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- 5.1.3** Confirm that the date/time display is correct. Refer to the Niton XL3t 600 User's Guide for specific instructions on navigation through the menu. If the instrument has been turned off for more than 30 minutes allow a 10 minute warm-up period before calibration. Select Calibrate and Test and press Clear/Enter to begin the self calibration; when the instrument beeps the calibration is complete and the instrument is ready for use.
- 5.1.4** For the purposes of in-situ measurements, the instrument will be operated in the Standard Soil Mode. Select Standard Soil Mode from the Bulk Analysis Menu. Calibrate the instrument using the soil standards supplied by Niton immediately after the instrument completes self-calibration. The standards should be tested every 1- 2 hours during the analysis day and at the conclusion of testing for the day to ensure that no drift has occurred. All calibration procedures and the results of standard check samples must be recorded in the XRF logbook. Until control limits specific to the XRF unit being used are established control limits of $\pm 20\%$ of the true value should be used.
- 5.1.5** The Niton XL3T 600 offers six modes of operation for soil samples. It is expected that the Easy Trigger method will be used for in-situ measurements. Using this technique the measurement window is placed against the sample and the trigger is pulled once to initiate the analysis. The instrument constantly checks the backscatter measurements to determine if a sample is against the measurement window and will shut off any radiation directed through the window if it determines there is no sample present.
- 5.1.6** The analyzer will display the results screen throughout the duration of the reading; once the reading is complete, the screen will display the final results of the measurement.
- 5.2** Sample screening may be performed by holding the probe directly on the soil or on a bagged sample. Clean the measurement window between samples using a cotton swab.

 - 5.2.1** Remove any obviously non-representative materials such as leaves, vegetation, roots, or concrete from the sample; use caution that COPR related materials are not removed from the sample. Finer and more homogeneous material will yield more accurate results. Increased accuracy can be gained by loosening the soil and letting it dry in the sun prior to testing. The soil sample should not be saturated with water; the XRF technique will generally not produce reliable results if ponded water exists on the surface.
 - 5.2.2** Use a trowel to level the surface of the soil. Hold the XRF in one hand and place the instrument window flush against the surface of the sample to be tested. The four LED lights on the screen will flash to indicate the initiating preconditions have been met (see page 1-45 of the User's Guide); however as a safety precaution the x-ray tube will not turn on immediately and no reading will begin for approximately 0.5 seconds. Watch the display screen to determine when the test is complete; a typical test will take 30-60 seconds. To end the test simply release the trigger mechanism.

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- 5.2.3** If direct measurement of the sample is not possible, samples may be placed in plastic bags and analyzed without preparation. However, since the measurement is made through a plastic bag, test results can be 5-10% lower than those obtained by direct measurement. Place 50-100g of soil in a clean zipper locking bag (approximately 1-mil thick polyethylene bag is recommended) removing any obviously non-representative material. Mix the sample thoroughly by kneading the bag and flatten the bag of soil to form uniform layer of approximately 0.5 inch thickness. Place the XRF flat against the bag and take a measurement as described in Section 5.2.2. ***Do not hold the bag in your hand during testing.***
- 5.3** Download the stored data and spectra to a computer or directly to a database; erase the stored data from the XRF once you have confirmed that all results have been successfully downloaded. ***Do not attempt to take measurements while downloading readings, this will generate an error requiring a system reset and may corrupt stored readings.***
- 5.4** Routine maintenance procedures include cleaning and replacement of the measurement window.
- 5.4.1** Keep the transparent measurement window covering the analysis window clean. Clean the measurement window gently with a cotton swab. Clean the body of the analyzer with a soft cloth. The touch screen may be cleaned using a lens cleaning solution with a soft cloth; water should not be used. Never use detergents or solvents on any portion of the analyzer or immerse the analyzer in water.
- 5.4.2** If the measurement window becomes frayed, ripped, or contaminated with metal particulates, replace it with a new window. The User's Guide provides part numbers and instructions for replacement of the windows.
- 5.4.3** All other maintenance must be performed by an authorized Niton service center. The instrument must be transported and stored in its padded carrying case when not in use.

6.0 Quality Assurance / Quality Control

- 6.1** An energy calibration check should be run at the start of each day of sampling. This check confirms that the characteristic x-ray lines are stable and instrument drift is not occurring. This also provides a gain check if the ambient temperature fluctuates significantly. This test must be run at the start of each day, when the batteries are changed, when the instrument is shut down, and at the end of each day. This procedure should also be run any time the operator believes that drift is occurring during analysis.
- 6.2** A blank consisting of silicon dioxide or a Teflon or quartz block must be run at the beginning and end of each day of analysis and after every 20 samples or every hour of operation during the day or at any time the analyst suspects contamination in the analytical system.
- 6.3** An independent standard must be used to verify the accuracy of the instrument and confirm its stability and consistency for the analyte of interest. NIST, USGS or commercial standards

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may be used. The standard check must be performed at the beginning and end of each analysis day and after every 20 samples or hour of operation during the day. If the measured value falls outside the acceptance range the check sample must be reanalyzed; if it is still outside the acceptance range the instrument must be recalibrated and any samples analyzed since the previous acceptable calibration check must be reanalyzed.

- 6.4 At least one sample in each set of 20 must be analyzed in duplicate to assess measurement precision. Relative percent difference for duplicates should be $\leq 30\%$.
- 6.5 The field forms and field notes generated from this procedure will be reviewed by the sampling team leader, project manager, or designee. All quality control results must be downloaded to project computer files along with sample data. Any deviations from this SOP, problems encountered during the analysis and corrective actions taken must be documented in the field records.

7.0 Data and Records Management

- 7.1 Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.
- 7.2 All data and spectral files must be backed up onto a computer on a regular basis. Any deviations from this POP or problems encountered during the analysis must be documented in a field log book which is dedicated to the XRF analyzer.
- 7.3 Records associated with the activities described in this POP will be maintained according to the specific document management policy for the project.

8.0 Personnel Qualifications and Training

- 8.1 Qualifications and training
 - 8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.
 - 8.1.2 Sampling personnel must be health and safety certified as specified by Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(e)(3)(i) to work on sites where hazardous materials may be present.
 - 8.1.3 Each person who performs this procedure will undergo training offered by the manufacturer such that the procedure is performed in a consistent manner and all safety procedures are followed.
 - 8.1.4 Individual states and countries have specific regulations and guidelines for the use of X-ray tube devices that produce ionizing radiation. For New Jersey site work, the licensing requirements outlined in N.J.A.C. 7:28-54.1 must be met prior to the start of site work.

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8.2 Responsibilities

- 8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.
- 8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

United States Environmental Protection Agency. 2007. Method 6200, Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Revision 0. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Washington, D.C. January 2008.

New Jersey Department of Environmental Protection Site Remediation Program. 1994. Field Manual. Trenton, NJ. July 1994.

Thermo Scientific, Niton XL3t 600 Analyzer User's Guide, Version 6.5. Billerica, MA 2009

10.0 Revision History

Revision	Date	Changes
0	June 2010	Original POP

Field Sampling Plan / Quality Assurance Project Plan

Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

Section: Appendix C
Revision: 1
Date: June 2010

Appendix C

Required Preservation, Container and Maximum Holding Times

Field Sampling Plan / Quality Assurance Project Plan

Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

Section: Appendix C
Revision: 1
Date: June 2010

Appendix C-1: Required Preservation, Container, and Maximum Holding Times for Solid and Aqueous Samples

Table 2.2 Required Preservation, Container, and Maximum Holding Times for Drinking Water Samples, Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Total Coliform Finished Drinking Water	Cool 4°C, 0.008% sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$)	P or G	30 hours
Heterotrophic Plate Count Finished Drinking Water	Cool 4°C, 0.008% $\text{Na}_2\text{S}_2\text{O}_3$	P or G	8 hours
Total Coliform Source Water	Cool 4°C, 0.008% $\text{Na}_2\text{S}_2\text{O}_3$	P or G	8 hours
Fecal Coliform Source Water	Cool 4°C, 0.008% $\text{Na}_2\text{S}_2\text{O}_3$	P or G	8 hours
Cryptosporidium	Cool 0-8°C, No Freezing	LPDE Cubitainer	Elution must begin within 96hrs of sampling ¹⁴
Giardi cysts	Cool 0-8°C, No Freezing	LPDE Cubitainer	Elution must begin within 96hrs of sampling ¹⁴
Alkalinity	Cool 4°C	P or G	14 days
Antimony	Conc. HNO_3 to pH < 2	P or G	6 months
Arsenic	Conc. HNO_3 to pH < 2	P or G	6 months
Asbestos	Cool 4°C	P or G	Filter within 48 hours
Barium	Conc. HNO_3 to pH < 2	P or G	6 months
Beryllium	Conc. HNO_3 to pH < 2	P or G	6 months
Bromate	50 mg/L Ethylenediamine (EDA) solution	P or G	28 days
Bromide	None	P or G	28 days
Cadmium	Conc. HNO_3 to pH < 2	P or G	6 months
Calcium	Conc. HNO_3 to pH < 2	P or G	6 months
Chlorate	50 mg/L Ethylenediamine (EDA) solution	P or G	28 days
Chloride	None	P or G	28 days
Chlorite	50 mg/L Ethylenediamine (EDA) solution Cool 4°C	P or G	14 days
Chlorinated Hydrocarbons	Refrigerate at 4°C. After collection, Ascorbic acid	Glass with foil or Teflon [®] -lined cap	14 days until extraction; 40 days after extraction

Table 2.2 (continued) Required Preservation, Container, and Maximum Holding Times for Drinking Water Samples, Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Chlorinated Pesticides	80mg/L $\text{Na}_2\text{S}_2\text{O}_3$ if residual chlorine (Cl_2) is present, Cool 4°C	Glass with Teflon®-lined septum	7 days until extraction; 14 days after extraction
Chlorinated Phenoxy Acids	80mg/L $\text{Na}_2\text{S}_2\text{O}_3$ if residual chlorine (Cl_2) is present, Cool 4°C	Glass with Teflon®-lined septum	14 days until extraction; 28 days after extraction
Chlorine Dioxide	None	P or G	Analyze Immediately
Chlorinated Acids	Refrigerate at 4°C after collection, Ascorbic acid	Glass with foil or Teflon®-lined cap	7 days until extraction; 30 days after extraction
Chromium	Conc. HNO_3 to pH < 2	P or G	6 months
Copper	Conc. HNO_3 to pH < 2	P or G	6 months
Cyanide	NaOH to pH > 12, Cool 4°C, 0.6 g Ascorbic acid	P or G	14 days
EDB/DBCP/1,2,3-TCP	Cool 4°C, 0.08% $\text{Na}_2\text{S}_2\text{O}_3$	Glass with Teflon®-lined septum	extract: 14 days; 24 hours to analysis
Fluoride	None	Polyethylene only	28 days
Free Chlorine Residual	None	P or G	Analyze Immediately
Lead	Conc. HNO_3 to pH < 2	P or G	6 months
Mercury	Conc. HNO_3 to pH < 2	P or G	28 days
N-Methyl-Carbamoyloximes N-Methyl-Carbamates	Monochloroacetic acid to pH 3, 80mg/L $\text{Na}_2\text{S}_2\text{O}_3$, Cool 4°C until storage, Store at -10°C	Glass with Teflon®-lined septum	28 days at -10°C
Nickel	Conc. HNO_3 to pH < 2	P or G	6 months
Nitrate-Nitrate	Conc. H_2SO_4 to pH < 2; Cool 4°C	P or G	28 days
Nitrate-N	Cool 4°C	P or G	48 hours
Nitrite-N	Cool 4°C	P or G	48 hours
Nitrogen- and Phosphorus-Containing Pesticides	80mg/L $\text{Na}_2\text{S}_2\text{O}_3$ (if residual Cl_2) Cool 4°C	Glass (dark) with Teflon®-lined septum	14 days until extraction; 14 days after extraction
o-Phosphate	Cool 4°C	P or G	48 hours
Perchlorates	None Required	P or G	28 days

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Table 2.2 (continued) Required Preservation, Container, and Maximum Holding Times for Drinking Water Samples, Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Odor	Cool 4°C	P or G	24 hours
Organic Compounds	If residual Cl_2 40-50 mg sodium arsenite or sodium thiosulfate; if unchlorinated, 6 N HCl to pH < 2	Glass with Teflon®-lined septum	7 days until extraction; 30 days after extraction
Organohalide Pesticides and Commercial PCB Products (Aroclors)	3mg $\text{Na}_2\text{S}_2\text{O}_3$ or 7uL $\text{Na}_2\text{S}_2\text{O}_3$ (0.04g/mL), Cool 4°C until analyzed	Glass with Teflon®-lined septum	If Heptachlor, 7 days until extraction; 40 days after extraction. If no extraction, analysis within 14 days
Ozone	None	G	Analyze Immediately
pH	None	P or G	Analyze Immediately
Selenium	Conc. HNO_3 to pH < 2	P or G	6 months
Silver	Conc. HNO_3 to pH < 2	P or G	6 months
Sodium	Conc. HNO_3 to pH < 2	P or G	6 months
Sulfate	Cool 4°C	P or G	28 days
Temperature	None	P or G	Analyze Immediately
Thallium	Conc. HNO_3 to pH < 2	P or G	6 months
TTHMs	$\text{Na}_2\text{S}_2\text{O}_3$ if residual Cl_2 and 6N HCl	Glass with Teflon®-lined septum	14 days
Total Dissolved Solids	Cool 4°C	P or G	7 days
Turbidity	Cool 4°C	P or G	48 hours
Volatile Aromatic and Unsaturated Organic Compounds	1:1 HCl to pH < 2 Cool, 4°C until analysis, Ascorbic acid	Glass with Teflon®-lined septum	14 days
Volatile Halogenated Organic Compounds	1:1 HCl to pH < 2 Cool, 4°C until analysis, Ascorbic acid	Glass with Teflon®-lined septum	14 days
Volatile Organic Compounds	1:1 HCl to pH < 2 Cool, 4°C until analysis, Ascorbic acid	Glass with Teflon®-lined septum	14 days

Table 2.3 Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Bacterial Tests			
Coliform (fecal)	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	P, G	6 hours
Coliform (total)	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	P, G Cool	6 hours
Fecal streptococci	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	P, G	6 hours
Enterococci	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	P, G (sterile)	6 hours
Escherichia coli	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	P, G (sterile)	6 hours
Heterotrophic Plate Count	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	P, G (sterile)	8 hours
Salmonella sp. Bacteria	Cool 4°C	P, G (sterile)	24 hours
Helminth Ova	Cool 4°C	P, G (sterile)	24 hours
Enteric Viruses ¹³	Cool 4°C	P, G (sterile)	8 hours
Toxicity Test			
Acute or Chronic Toxicity	Cool 4°C	P, G	36 hours ¹²
Inorganic Tests			
Acidity, as CaCO ₃	Cool 4°C	P, G	14 days
Alkalinity as CaCO ₃	Cool 4°C	P, G	14 days
Aluminum-total ³	HNO ₃ to pH < 2	P, G	6 months
Ammonia (as N)	Cool 4°C H ₂ SO ₄ to pH < 2	P, G	28 days
Antimony-total ³	HNO ₃ to pH < 2	P, G	6 months
Arsenic-total ³	HNO ₃ to pH < 2	P, G	6 months
Barium-total ³	HNO ₃ to pH < 2	P, G	6 months
Beryllium-total ³	HNO ₃ to pH < 2	P, G	6 months
Biochemical Oxygen Demand	Cool 4°C	P, G	48 hours
Boron-total ³	HNO ₃ to pH < 2	P, G	6 months
Bromide ³	None required	P, G	28 days
Cadmium-total ³	HNO ₃ to pH < 2	P, G	6 months
Calcium-total ³	HNO ₃ to pH < 2	P, G	6 months
Carbonaceous Biochemical Oxygen Demand	Cool 4°C	P, G	48 Hours

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Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Chemical Oxygen Demand (COD)	Cool 4°C H ₂ SO ₄ to pH < 2	P, G	28 days
Chloride	None required	P, G	28 days
Chlorine total residual (TRC)	None required	P, G	Analyze Immediately
Chromium VI (dissolved)	Cool 4°C	P, G	24 hours
Chromium-total ³	HNO ₃ to pH < 2	P, G	6 months
Cobalt-total ³	HNO ₃ to pH < 2	P, G	6 months
Color	Cool 4°C	P, G	48 hours
Copper-total ³	HNO ₃ to pH < 2	P, G	6 months
Cyanide-total ³	Cool 4°C, NaOH to pH > 12, 0.6g ascorbic acid	P, G	14 days (24 hours when sulfide is present) ²
Cyanide amenable to chlorination ³	Cool 4°C, NaOH to pH > 12, 0.6g ascorbic acid	P, G	14 days (24 hours when sulfide is present) ²
Fluoride	None required	Polyethylene only	28 days
Gold-total ³	HNO ₃ to pH < 2	P, G	6 months
Hardness-total as CaCO ₃	HNO ₃ to pH < 2 H ₂ SO ₄ to pH < 2,	P, G	6 months
Hydrogen ion (pH)	None required	P, G	Analyze Immediately
Iridium-total ³	HNO ₃ to pH < 2	P, G	6 months
Iron-total ³	HNO ₃ to pH < 2	P, G	6 months
Kjeldahl & Organic Nitrogen	Cool 4°C, H ₂ SO ₄ to pH < 2	P, G	28 days
Lead-total ³	HNO ₃ to pH < 2	P, G	6 months
Magnesium-total ³	HNO ₃ to pH < 2	P, G	6 months
Mercury-dissolved ¹¹ (does not include methyl mercury)	5mL/L of 12 N HCl or 5mL/L of 12 N BrCl Cool 4°C	Fluoropolymer with fluoropolymer or fluoropolymer lined cap	28 days
Mercury-dissolved ¹¹ (includes methyl mercury)	5mL/L of 12 N HCl Cool 4°C	Fluoropolymer with fluoropolymer or fluoropolymer lined cap	28 days
Mercury-total ³	HNO ₃ to pH < 2	P, G	28 days
Mercury-total ¹¹ (does not include methylmercury)	5mL/L of 12 N HCl or 5 mL/L of 12 N BrCl	Fluoropolymer with fluoropolymer or	28 days

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
	Cool 4°C	fluoropolymer lined cap	
Mercury-total ¹¹ (includes methylmercury)	5mL/L of 12 N HCl Cool 4°C	Fluoropolymer with fluoropolymer or fluoropolymer lined cap	28 days
Molybdenum-total ³	HNO ₃ to pH < 2	P, G	6 months
Nickel-total ³	HNO ₃ to pH < 2	P, G	6 months
Nitrate (as N)	Cool 4°C	P, G	48 hours
Nitrate-Nitrite(as N)	Cool 4°C, H ₂ SO ₄ to pH < 2	P, G	28 days
Nitrite (as N)	Cool 4°C	P, G	48 hours
Oil and grease	Cool 4°C HCl or H ₂ SO ₄ to pH < 2	G	28 days
Organic carbon-total (TOC)	Cool 4°C, HCl or H ₂ SO ₄ to pH < 2 or phosphoric acid	P, G	28 days
Orthophosphate (as P)	Filter Immediately, Cool 4°C	P, G	48 hours
Osmium-total ³	HNO ₃ to pH < 2	P, G	6 months
Oxygen dissolved (probe)	None Required	Glass bottle and top	Analyze Immediately
Oxygen dissolved (Winkler)	Fix on site and store in dark	Glass bottle and top	8 hours
Palladium-total ³	HNO ₃ to pH < 2	P, G	6 months
Petroleum Hydrocarbons	HCl to pH 2	G	7 days
Phenols	Cool 4°C, H ₂ SO ₄ to pH < 2	G only	28 days
Phosphorus (elemental)	Cool 4°C	G	48 hours
Phosphorus-total	Cool 4°C, H ₂ SO ₄ to pH < 2	P, G	28 days
Platinum-total ³	HNO ₃ to pH < 2	P, G	6 months
Potassium-total ³	HNO ₃ to pH < 2	P, G	6 months
Residue-total	Cool 4°C	P, G	7 days
Residue-filterable (TDS)	Cool 4°C	P, G	7 days
Residue-nonfilterable (TSS)	Cool 4°C	P, G	7 days
Residue-settleable	Cool 4°C	P, G	48 hours
Residue-volatile	Cool to 4°C	P, G	7 days
Rhodium-total ³	HNO ₃ to pH < 2	P, G	6 months
Ruthenium-total ³	HNO ₃ to pH < 2	P, G	6 months

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Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Salinity	Cool 4°C	G	28 days
Selenium-total ³	HNO ₃ to pH < 2	P, G	6 months
Silica-dissolved	Cool 4°C	P	28 days
Silver-total ³	HNO ₃ to pH < 2	P, G	6 months
Sodium-total ³	HNO ₃ to pH < 2	P, G	6 months
Specific conductance	Cool 4°C	P, G	28 days
Sulfate	Cool 4°C	P, G	28 days
Sulfide	Cool 4°C, add zinc acetate & NaOH to pH > 9	P, G	7 days
Sulfite	None required	P, G	Analyze Immediately
Surfactants	Cool 4°C	P, G	48 hours
Temperature	None required	P, G	Analyze Immediately
Thallium-total ³	HNO ₃ to pH < 2	P, G	6 months
Tin-total ³	HNO ₃ to pH < 2	P, G	6 months
Titanium-total ³	HNO ₃ to pH < 2	P, G	6 months
Turbidity	Cool 4°C	P, G	48 hours
Vanadium-total ³	HNO ₃ to pH < 2	P, G	6 months
Zinc-total ³	HNO ₃ to pH < 2	P, G	6 months
Organic Tests⁴			
Acenaphthene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ Store in dark	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Acenaphthylene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃	Glass, Teflon®-lined cap Store in dark	7 days until extraction; 40 days after extraction
Acrolein	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ Adjust pH to 4-5 ⁶	Glass, Teflon®-lined septum	14 days
Acrylonitrile	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ Adjust pH to 4-5 ⁶	Glass, Teflon®-lined septum	14 days ⁶
Anthracene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Benzene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ HCl to pH 2	Glass, Teflon®-lined septum	14 days
Benzidine ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃	Glass, Teflon®-lined cap	7 days until extraction ⁸

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Benzo(a) anthracene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Benzo(a)pyrene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Benzo(b) fluoranthene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Benzo(g,h,i) perylene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Benzo(k) fluoranthene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Benzyl chloride	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon®-lined septum	14 days
Benzyl butyl phthalate ⁷	Cool 4°C	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Bis(2-chloroethoxy) methane ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Bis(2-chloroethyl) ether ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Bis(2-ethylhexyl) phthalate ⁷	Cool 4°C	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Bromodichloro-methane	Cool 4°C 0.008% Na ₂ S ₂ O ₃ ¹ , HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
Bromoform	Cool 4°C 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
Bromomethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
Carbon tetrachloride	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
4-Chloro-3-methylphenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon®-lined cap	7 days until extraction; 40 days after extraction
Chlorobenzene	Cool 4°C 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
Chloroethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
2-Chloroethylvinyl ether	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days
Chloroform	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon®-lined septum	14 days

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Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Chloromethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
2-Chloronaphthalene ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2-Chlorophenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
4-Chlorophenylphenyl ether ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Chrysene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dibenzo (a,h)anthracene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dibromochloro-methane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,2-Dichloro-benzene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,3-Dichloro-benzene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,4-Dichloro-benzene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
3,3'-Dichloro-benzidine ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined septum	14 days
Dichlorodifluoro-methane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined septum	14 days
1,1-Dichloroethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,2-Dichloroethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,1-Dichloroethene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
trans-1,2-Dichloro-ethene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
2,4-Dichlorophenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
1,2-Dichloropropane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
cis-1,3-Dichloro-propene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
trans-1,3-Dichloro-propene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
Diethyl phthalate ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,4-Dimethylphenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dimethyl phthalate	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Di-n-butyl phthalate ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Di-n-octyl phthalate ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,3-Dinitrophenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,4-Dinitrotoluene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,6-Dinitrotoluene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Epichlorohydrin	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined septum	14 days
Ethylbenzene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
Fluoranthene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Fluorene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Hexachlorobenzene ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Hexachlorobutadiene ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Hexachlorocyclopentadiene ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Hexachloroethane ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Ideno(1,2,3-cd)pyrene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Isophorone ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

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Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Methylene chloride	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined cap	14 days
2-Methyl-4,6-dinitrophenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Naphthalene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Nitrobenzene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2-Nitrophenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
4-Nitrophenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
N-Nitrosodimethylamine ^{7, 10}	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
N-Nitrosodi-n-propylamine ^{7, 10}	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
N-Nitrosodiphenylamine ^{7, 10}	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,2'-Oxybis(1-chloropropane)	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
PCB-1016 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap,	7 days until extraction; 40 days after extraction
PCB-1221 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap,	7 days until extraction; 40 days after extraction
PCB-1232 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
PCB-1242 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
PCB-1248 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
PCB-1254 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
PCB-1260 ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Pentachlorophenol	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Phenanthrene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Phenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Pyrene ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ Store in dark	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,3,7,8-Tetra-chlorodi-benzo-p-dioxin ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
1,1,2,2-Tetrachloro-ethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
Tetrachloroethene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
Toluene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,2,4-Trichloro-benzene ⁷	Cool 4°C	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
1,1,1-Trichloroethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
1,1,2-Trichloroethane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
Trichloroethene	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
Trichlorofluoro-Methane	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2 ⁵	Glass, Teflon [®] -lined septum	14 days
2,4,6-Trichloro-phenol ⁷	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Vinyl chloride	Cool 4°C, 0.008% Na ₂ S ₂ O ₃ ¹ HCl to pH 2	Glass, Teflon [®] -lined septum	14 days ⁵
Pesticides Tests⁷			
Aldrin	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Ametryn	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Aminocarb	Cool 4°C pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Atraton	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Atrazine	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

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Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Azinphos methyl	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Barban	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
alpha-BHC	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
beta-BHC	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
delta-BHC	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Gamma-BHC (Lindane)	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Captan	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Carbaryl	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Carbophenothion	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Chlordane	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Chloropropham	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,4-D	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
4,4'-DDD	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
4,4'-DDE	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
4,4'-DDT	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Demeton-O	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dementon-S	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Diazinon	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dicamba	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Dichlofenthion	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dichloran	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dicofol	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dieldrin	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Dioxathion	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Disulfoton	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Diuron	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Endosulfan I	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Endosulfan II	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Endosulfan Sulfate	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Endrin	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Endrin aldehyde	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Ethion	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Fenuron	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Fenuron-TCA	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Heptachlor	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Heptachlor epoxide	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Isodrin	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Linuron	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

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Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Malathion	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Methiocarb	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Methoxychlor	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Mexacarbate	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Mirex	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Monuron	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Monuron-TCA	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Nuburon	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Parathion methyl	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Parathion ethyl	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
PCNB	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Perthane	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Prometron	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Prometryn	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Propazine	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Propham	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Propoxur	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Secbumeton	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Siduron	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/
Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

Parameter	Preservation	Container	Maximum Holding Time
Simazine	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Strobane	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Swep	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,4,5-T	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
2,4,5-TP (Silvex)	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Terbutylazine	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Toxaphene	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction
Trifluralin	Cool 4°C, pH 5-9 ¹⁰	Glass, Teflon [®] -lined cap	7 days until extraction; 40 days after extraction

Table 2.6 Required Preservation, Container and Maximum Holding Times for Solid/Hazardous Waste Samples (Soils, Liquids, Sediments, Sludges, and Ambient Air)

Parameter	Preservation	Container	Maximum Holding Time
Volatile Organics for soil/ sediment, and sludge	Cool 4°C	Glass Teflon [®] -lined cap	14 days
Volatile Organics (Non-Aqueous sample)	Cool 4°C, dark	Encore [™] or equivalent field core sampling/ storage containers & 60 ml septum sealed glass vial	Transfer immediately upon receipt to methanol and sodium bisulfate solution, analyze within 14 days
Volatile Organics (Non-Aqueous sample)	Cool 4°C, dark	Field preserved vials methanol & sodium bisulfate Glass, 40 ml vial stir bar [sodium bisulfate only], septum sealed glass vial & 60 ml septum sealed glass vial	14 days
Volatile organics in liquid samples	Cool 4°C, if residual Cl_2 add $\text{Na}_2\text{S}_2\text{O}_3$ and HCl to pH < 2	Glass, Teflon [®] -lined cap	14 days
Acrolein and Acrylonitrile in liquid samples	Cool 4°C Adjust to pH 4-5	Glass, Teflon [®] -lined cap	14 days
Semivolatile organics/ organochlorine pesticides/ PCBs and herbicides for soil/sediment, and sludge	Cool 4°C	Glass, Teflon [®] -lined cap	14 days until extraction; 40 days after extraction
Semivolatile organics/ organochlorine pesticides/ PCBs and herbicides for concentrated waste samples	Cool 4°C	Glass, Teflon [®] -lined cap	14 days until extraction; 40 days after extraction
Metals except Cr VI and Hg (total) for liquid samples	Cool 4°C, HNO_3 to pH < 2	P, G	6 months
Metals except Cr VI and Hg (dissolved) for liquid samples	Cool 4°C, Filter on-site HNO_3 to pH < 2	P, G	6 months
Metals except Cr VI and Hg (suspended) for liquid samples	Cool 4°C Filter on-site	P, G	6 months

Table 2.6 (continued) Required Preservation, Container and Maximum Holding Times for Solid/Hazardous Waste Samples (Soils, Liquids, Sediments, Sludges, and Ambient Air)

Parameter	Preservation	Container	Maximum Holding Time
Metals except Cr VI and Hg for solid samples	Cool 4°C	P, G	6 months
Chromium VI for solid samples	Cool 4°C	P, G	30 days to digestion; analysis 168 hours after digestion
Chromium VI for liquid samples	Cool 4°C	P, G	24 hours
Mercury (total) for liquid samples	HNO ₃ to pH < 2	P, G	28 days
Mercury (dissolved) for liquid samples	Filter on-site HNO ₃ to pH < 2	P, G	28 days
Mercury (total) for solid samples	Cool 4°C	P, G	28 days
Ambient Air Analysis			
TO-15 Volatile Organics in Specially Prepared Canisters – GC/MS	None	Specially prepared canisters	30 days from sample collection
TO-17 Volatile Organics in Ambient Air using Active Sampling onto Sorbent Tubes	Cool ≤4°C after sample collection and in refrigeration unless samples are analyzed the same day of collection. The samples must be stored in an organic solvent free environment. Small packages of activated charcoal/silica gel must be with each shipment container of multiple tubes.	Sorbent Tubes	30 days from sample collection; except 7days if limonene, carene, labile sulfur, bischloromethylether or nitrogen containing volatiles

Table 2.7 Required Preservation, Container and Maximum Holding Times From VTSR for CERCLA-CLP Aqueous and Non-Aqueous Samples

Parameter	Preservation	Container	Maximum Holding Time From Validated Time of Sample Receipt (VTSR)
Volatile Organics (Aqueous)	Cool 4°C, dark 0.08% Na ₂ S ₂ O ₃ if residual Cl ₂	Glass, white polypropylene or black phenolic plastic screw Teflon®-lined septum	10 days
Volatile Organics (Non-Aqueous)	Cool 4°C, dark	Glass, polypropylene cap, white Teflon® liner	10 days
Volatile Organics (Non-Aqueous)	Cool 4°C, dark	Encore™ or equivalent field core sampling/ storage container & 60 ml septum sealed glass vial	Transfer immediately upon receipt to methanol and sodium bisulfate solution analyze within 10 days
Volatile Organics (Non-Aqueous)	Cool 4°C, dark	Field preserved vials methanol & sodium bisulfate glass, 40 ml vial stir bar [sodium bisulfate only], septum sealed glass vial & 60 ml septum sealed glass vial	10 days
Pesticide/PCBs	Cool 4°C, dark	Amber Glass, white polypropylene or black phenolic, baked polyethylene cap	Extraction Aqueous: continuous liquid-liquid extraction must be started within 5 days, Non-Aqueous: 10 days analysis, 40 days from VTSR
Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Dibenzofurans (PCDFs) (Non Aqueous)	Cool 10°C, dark	Amber Glass, white polypropylene or black phenolic, baked polyethylene cap	Extraction: 30 days from VTSR, analysis 45 days from extraction

Table 2.7 (continued) Required Preservation, Container and Maximum Holding Times From VTSR for CERCLA-CLP Aqueous and Non-Aqueous Samples

Parameter	Preservation	Container	Maximum Holding Time From Validated Time of Sample Receipt (VTSR)
Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Dibenzofurans (PCDFs) (Aqueous)	Cool 4°C, dark	Amber Glass, white polypropylene or black phenolic, baked polyethylene cap	Extraction: 30days from VTSR, analysis: 45 days from extraction
Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Dibenzofurans (PCDFs) (Fish and Tissue Samples)	Cool 4°C, dark until prepared then -10°C until analysis	Wrapped in aluminum foil in field	Extraction: 1 year from VTSR. Once thawed, must be analyzed within 24 hours. Analysis: 45 days from extraction
Cyanide, total amenable to chlorination	Aqueous - 0.6g ascorbic acid if residual Cl_2 , NaOH to pH>12, cool 4°C, CaCO_3 in presence of sulfide	Plastic bottle, plastic cap, plastic liner	14 days
Metals except Hg (Aqueous)	HNO_3 to pH<2, cool 4°C, until analyzed	Plastic bottle, plastic cap, plastic liner	180 days
Metals – Dissolved except Hg (Aqueous)	Field filter 0.45 μm pore diameter filter, rinse bottle with sample then immediately HNO_3 to pH<2, cool 4°C until analyzed	Plastic bottle, plastic cap, plastic liner	180 days
Metals except Hg (Non-Aqueous)	Cool 4°C until analyzed	Flint glass bottle, black phenolic cap, polyethylene liner	180 days
Hg (Aqueous)	HNO_3 to pH<2, Cool, 4°C until analyzed	Plastic bottle, plastic cap, plastic liner	26 days
Hg – Dissolved (Aqueous)	Field filter 0.45 μm pore diameter filter, rinse bottle with sample immediately, HNO_3 to pH<2, Cool, 4°C until analyzed	Plastic bottle, plastic cap, plastic liner	26 days
Hg (Non-Aqueous)	HNO_3 to pH<2, Cool, 4°C until analyzed	Flint glass bottle, black phenolic cap, polyethylene liner	28 days

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Table 2.7 (continued) Required Preservation, Container and Maximum Holding Time From VTSR for CERCLA-CLP Aqueous and Non-Aqueous Samples

Parameter	Preservation	Container	Maximum Holding Time From Validated Time of Sample Receipt (VTSR)
Cyanide (Aqueous)	0.6g ascorbic acid if residual Cl_2 , NaOH to pH>12, cool 4°C until analyzed	Plastic bottle, plastic cap, plastic liner	14 days
Cyanide (Non-Aqueous)	Cool 4°C, until analyzed	Plastic bottle, plastic cap, plastic liner	14 days
Low Level Volatile Organics	Cool 4°C, dark, 0.008% $\text{Na}_2\text{S}_2\text{O}_3$	Glass, black phenolic or white polypropylene screw cap, Teflon [®] -lined septum	7 days
Low Level Semi-volatile Organics	Cool 4°C, dark	White polypropylene or black phenolic, baked polyethylene cap	Extraction: continuous extraction must be started within 5 days of VTSR. Analysis: 40 days from start of extraction
Low Level Pesticides/PCBs Organics	Cool 4°C, dark	Amber glass, white polypropylene or black phenolic, baked polyethylene cap	Extraction: continuous extraction must be started within 5 days of VTSR. Analysis: 40 days from start of extraction

Footnotes

- ¹ Use only in the presence of residual chlorine.
- ² Optionally, all samples may be tested with lead acetate paper before pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then the NaOH is added to pH 12.
- ³ Filter samples immediately on-site before adding preservatives for dissolved metals.
- ⁴ Applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
- ⁵ Sample receiving no pH adjustment shall be analyzed within seven days of sampling.
- ⁶ The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment shall be analyzed within three days of sampling.
- ⁷ When the extractable analytes of concern fall within a single chemical Category, the specified preservative and maximum holding times shall be observed for optimum safe guard of sample integrity. When the analyses of concern fall within two or more chemical categories, the sample may be preserved by cooling to four (4) degrees Celsius, reducing residual chlorine with 0.008% $\text{Na}_2\text{S}_2\text{O}_3$, storing in the dark and, for pesticides only, adjusting the pH to 6-9. Samples preserved in this manner may be held for seven days before extraction and 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in reference 1 (regarding the requirement for thiosulfate reduction of residual chlorine), and references 8 and 9 (regarding the analysis of benzidine).
- ⁸ Extracts may be stored up to seven days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- ⁹ For the analysis of diphenylnitrosamine, add 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- ¹⁰ The pH adjustment may be performed upon receipt at the environmental laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $\text{Na}_2\text{S}_2\text{O}_3$.
- ¹¹ Method 1631 Revision B: Mercury in Water by Oxidation, Purge and Trap and Cold Vapor Atomic Fluorescence Spectrometry is required. Samples may be shipped to laboratory unpreserved if collected in fluoropolymer bottles, filled to top with no headspace, capped tightly, and maintained at 4°C from time of collection until preservation. The samples must be acid preserved within 48 hours after sampling.
- ¹² First use of samples shall begin within 36 hours of collection. For storm water discharges, first use of the sample shall begin within 48 hours of collection.
- ¹³ Once collected if the assay can not begin within 8 hours then the sample must be frozen. Once defrosted, the sample can be held at 4°C until the assay begins. The assay must then be done the day that the sample is defrosted.
- ¹⁴ Elution, concentration and the application of the purified sample to the slide must be completed in one work day. The sample must be stained within 72 hours of the application of the purified sample to the slide. Up to 7 days are permitted between sample staining and examination.

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Appendix C-2: Required Preservation, Container, and Maximum Holding Times for Air Samples

Required Preservation, Container, and Maximum Holding Times for Air Samples

Parameter	Preservation	Container	Maximum Holding Times
Hexavalent Chromium	Cool $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$	47 mm PVC filter and cellulose backup pads loaded in a Federal Reference Method (FRM) type cassette with holder Place sample cassette assemblies in a clean Ziploc[®] bag	The laboratory SOP specifies holding times only for samples from chromium plating or paint operations. A maximum holding time of 30 days from sample collection which conforms to NJDEP requirements for hexavalent chromium in non-aqueous samples will be used. In general filter samples will be analyzed and reported within 5 business days of collection.
Particulate Matter (PM ₁₀)	None, ambient temperature	47 mm PM ₁₀ filter in static, dissipative plastic petri dish slides for particulate filter transit and/or storage	None

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Appendix D

Analytical Laboratory Standard Operating Procedures (SOPs)

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Section: Appendix E
Revision: 1
Date: June 2010

D-1: Accutest Laboratories SOPs

(Lab procedures are proprietary information and
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ACCUTEST LABORATORY SOP LIST
PPF FSP/QAPP

Matrix	Analysis	SOP Title	SOP No./Date	Method(s)	Certification Status
Solid and Aqueous	Polychlorinated Biphenyls (PCBs)	SW846 8082: Determination of Polychlorinated Biphenyls (PCBs) Using GC System	EGC8082-11 10/20/09	SW846 8082	Certified
Solid and Aqueous	Extractable Petroleum Hydrocarbons (EPH)	Extractable Petroleum Hydrocarbons	EGCNJEPH-01 1/7/10	NJDEP EPH	Certified
Solid	Percent Solids	Percent Solids and Total Solids in Soil/Solid Matrices	EGN007-08 9/22/09	SM 2540G, ASTM D4643-00	NA
Aqueous	Total Dissolved Solids (TDS)	Total Dissolved Solids (Total Filterable Residue)	EGN020-08 4/21/09	SM 2540C	Certified
Aqueous	Nitrate/Nitrite	Nitrate/Nitrite and Nitrate only by Cadmium Reduction Analysis (Lachat Autoanalyzer)	EGN026-06 02/09/09	EPA 353.2	Certified
Aqueous	Alkalinity	Alkalinity, Total (pH 4.5)	EGN037-07 10/06/08	SM 2320B	Certified
Aqueous	Total Suspended Solids (TSS)	Total Suspended Solids (Non-Filterable Residue)	EGN087-08 11/16/09	SM 2540D	Certified
Solid and Aqueous	Carbon Oxygen Demand (COD)	Chemical Oxygen Demand - HACH 8000, Aqueous Samples, HACH 8000, Modification for Solid Samples	EGN099-06 4/22/07	SM 5220 C	Certified aqueous, certification NA for soil
Aqueous	Orthophosphate	Orthophosphate	EGN102-06 3/18/10	SM 4500-P E	Certified
Aqueous	Nitrite	Nitrogen, Nitrite (Total-Waters), Nitrogen, Nitrite (soluble-Soils)	EGN103-05 07/29/04	SM 4500-NO2	Certified
Solid and Aqueous	Sulfide (acid soluble and insoluble)	Sulfide	EGN118-06 10/12/09	SW846 9034	Certified
Aqueous	Chloride	Chloride	EGN131-04 4/25/07	SM 4500-Cl C	Certified
Aqueous	Biological Oxygen Demand (BOD)	Biological Oxygen Demand and Carbonaceous Oxygen Demand	EGN134-08 3/11/09	SM 5210B	Certified
Solid and Aqueous	Ignitability	Ignitability	EGN140-09 12/22/09	SW846 1010A	Certified
Solid	TCLP -Organics	TCLP	EGN142-10 10/3/09	SW846 1311	Certified
Aqueous	Total Cyanide - Spectrophotometric	Cyanide (Lachat Autoanalyzer)	EGN207-14 12/14/09	EPA 335.4	Certified
Solid	Hexavalent Chromium - Colorimetric	Hexavalent Chromium (Soils)	EGN214-08 10/6/08	SW846 3060A for digestion SW846 7196A for analysis	Certified
Aqueous	Phenols	Phenols (Lachat Autoanalyzer)	EGN217-13 9/23/09	SW846 9066	Certified
Solid	Total Organic Halides (TOX)	Total Organic Halides, Solid and Oil Matrices	EGN219-04 5/6/08	SW846 9023	Certified
Solid and Aqueous	Reactivity	Sulfide Analysis and Reactive Sulfides	EGN228-06 1/2/03	SW846 9034	Certified
Aqueous	Hexavalent Chromium - Colorimetric	Hexavalent Chromium in Waters	EGN230-08 4/22/09	SW846 7196A	Certified
Solid	Total Organic Carbon (TOC)	Total Organic Carbon in Soils Samples	EGN233-07 11/8/07	SW846 9060	Certified
Aqueous	Total Organic Carbon	Total Organic Carbon in Aqueous Samples	EGN234-10 7/16/08	SM 5310 B	Certified
Aqueous	pH and Corrosivity	pH and Corrosivity for Aqueous and Multiphasic Wastes	EGN238-05 5/30/08	SW846 9040C	Certified
Solids	Synthetic Precipitation Leaching Procedure (SPLP) for Non-volatile Analytes	Synthetic Precipitation Leaching Procedure for Non-Volatile Analytes	EGN239-03 4/28/09	SW846 1312	Certified
Solids	Synthetic Precipitation Leaching Procedure (SPLP) Volatile Analytes	Synthetic Precipitation Leaching Procedure for Volatile Analytes	EGN240-03 4/28/09	SW846 1312	Certified
Solid	Cation Exchange Capacity (CEC)	Cation Exchange Capacity of Soils (Sodium Acetate)	EGN242-03 1/19/06	SW846 9081	Certified
Aqueous	Ferrous and Ferric Iron	Ferrous Iron	EGN243-05 3/20/09	SM 3500B-Fe B	Certified
Solid and Aqueous	Anions - bromide, chloride, sulfate (using Dionex DX500)	Determination of Inorganic Anions by Ion Chromatography	EGN251-08 5/16/06	EPA 300 & SW846 9056	Certified
Solid	Shake Extraction with Water	The Neutral Leaching of Solid Waste Samples Using Shake Extraction	EGN252-03 1/7/09	ASTM D3987-85	NA
Solid and Aqueous	Oxidation-Reduction Potential (Redox)	Oxidation-Reduction Potential	EGN253-07 10/6/08	ASTM D1498-76	NA
Aqueous	Total Phosphorus	Total Phosphorus	EGN256-08 8/10/09	EPA 365.3	Certified
Solid	Total Cyanide - Colorimetric	Cyanide Distillation/Soil Samples /Micro Method	EGN276-08 12/14/09	SW846 9012B M	Certified
Solid	Phenols	Phenols Micro Distillation, Soil Samples	EGN280-04 8/24/08	SW846 9065	Certified
Solid and Aqueous	Anions - bromide, chloride, sulfate (using Dionex ICS-2000)	Determination of Inorganic Anions by Ion Chromatography	EGN281-07 3/24/10	EPA 300 & SW846 9056	Certified

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PPF FSP/QAPP

Matrix	Analysis	SOP Title	SOP No./Date	Method(s)	Certification Status
Solid	Particle Size Reduction	Procedure for Particle Size Reduction (Crushing) of Solid Matrices	EGN297-01 08/06/07	NA	NA
Solid	Pore Water Extraction from Saturated Soils	Procedure for Pre Water Extraction from Soil Samples for Non-Volatile or Metals Analysis	EGN299-01 8/25/09	NA	NA
Aqueous/ Solid	Sample Waste Disposal	Sample Waste Disposal	EHS004-03 10/21/09	NA	NA
Solids	Mercury - Cold Vapor	Cold Vapor Analysis of Mercury for Soil Samples	EMA072-14 9/16/08	SW846 7471A	Certified
Aqueous	Mercury - Cold Vapor	Cold Vapor Analysis of Mercury for Water Samples	EMA215-09 9/16/08	SW846 7470A	Certified
Solid and Aqueous	Total and Dissolved Metals by ICP	Metals by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)	EMA217-08 7/31/08	SW846 6020	Certified
Solid and Aqueous	Total and Dissolved Metals by ICP-MS	Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) Using Solid State ICP	EMA222-07 1/13/10	SW846 6010B	Certified
Aqueous	Acid Digestion for Metals - Aqueous	Digestion of Non-Portable Waters for ICP or ICP-MS Analysis	EMP070-12 1/15/10	SW846 3010A	Certified
Solid	Acid Digestion for Metals - Solids	Digestion of Soils for ICP and ICP-MS Analysis	EMP073-12 9/1/09	SW846 3050B	Certified
Aqueous	Acid Digestion for Metals - Aqueous	Digestion of Non-Potable Waters for Total Recoverable or Dissolved Metals for ICP or Flame Analysis	EMP081-04 10/3/09	SW846 3005A	Certified
Solid and Aqueous	Volatile Organic Compounds (VOCs)	Method 8260B, Volatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS)	EMS8260-19 9/11/2009	SW846 8260B	Certified
Solid and Aqueous	Semivolatile Organic Compounds (SVOCs)	Method 8270C, Semivolatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS)	EMS8270-16 2/3/09	SW846 8270C	Certified
Aqueous	Separatory Funnel Extraction for SVOCs	Preparation of Semi-Volatile Extractables in Aqueous	EOP001-09 11/3/09	SW846 3510C	Certified
Solid	Ultrasonic Extraction - SVOCs	Extraction of Semivolatile Organics from Solids by Sonication (Base, Neutral, Acid Organics; Pesticides, Polychlorinated Biphenyls, Diesel Range Organics)	EOP002-11 9/20/07	SW846 3550B	Certified
Aqueous	Continuous Liquid-Liquid Extraction for SVOCs	Continuous Liquid-Liquid Extraction	EOP007-03 7/28/03	SW846 3520C	Certified
Solid and Aqueous	Preparation for PCBs	Preparation of Petroleum Oils and Organic Wastes for PCB Analysis by SW8082	EOP017-02 9/25/08	SW846 3580A	Certified
Solid	Cleanup - Sulfur Removal	The Removal of Elemental Sulfur from Organic Extracts using Tetrabutylammonium Sulfite	EOP018-01 9/27/04	SW846 3660B	Certified
Solid	Soxhlet Extraction - SVOCs	Preparation of Solids for Semi-Volatile Organics by Soxhlet Extraction	EOP020-03 7/29/03	SW846 3540C	Certified
Solid	Cleanup - Florisil	Florisil Column Cleanup	EOP3620-04 5/25/06	SW846 3620B	Certified
Solid	Cleanup - Sulfuric Acid	Sulfuric Acid/Permanganate Cleanup	EOP3665-03	SW846 3665A	Certified
Aqueous	Purge & Trap for VOCs	Purge-and-Trap Extraction for Aqueous Samples	EOP5030-03 8/6/03	SW846 5030B	Certified
Solid	Purge & Trap for VOCs - low level	Collection, Preservation, Management and Handling of Solid Samples for Volatile Organic Analysis by SW-846 Methodology	EOP5035-12 3/2/09	SW846 5035L & 5035H	Certified
Aqueous/ Solid	Sample Container Receipt, Cleaning, and Quality Control	Sample Container Receipt, Cleaning, and Quality Control	EQA006-07 10/18/06	NA	NA
Solid	Homogenization	Procedure for Obtaining Representative Sample Aliquots	EQA042-03 2/17/06	NA	NA

NA - Not applicable

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D-2: Air Laboratories SOPs

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AIR LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Analysis	Laboratory	SOP Title	SOP No./Date/Rev. #	Source Method	Certification Status
Air	Hexavalent Chromium	Galson	Preparation of PVC Filters for the Determination of Hexavalent Chromium by IC	II-CR6PREP	OSHA Method ID-215	Certified
Air	Hexavalent Chromium	Galson	Analysis of Hexavalent Chromium by Ion Chromatography	II-CR6IC	OSHA Method ID-215	Certified
Air	Particulates	AECOM	Filter Processing Method for the Determination of Suspended Particulates in Ambient Air	2000-105, March 2007, Rev. No. 6	40 CFR 50	Certified

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D-3: GeoTesting Express SOPs

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GEOTESTING EXPRESS SOP LIST
PPG FSP/QAPP

Matrix	Analysis	Laboratory	SOP Title	SOP No./Date/Rev. #	Source Method	Certification Status
Solid	Compressive Strength	GeoTesting Express	Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders ¹	D 1633 – 00 (Reapproved 2007)	ASTM D1633	NA
Solid	Moisture Content	GeoTesting Express	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock Mass	ASTM D 2216, June 2006, Revision 4	ASTM D2216 - latest revision	NA
Solid	Strength and stress-strain relationships of cohesive soil	GeoTesting Express	Test Method for Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils	ASTM D 2850, June 2006, Revision 3	ASTM D2850 - latest revision	NA
Solid	Grain Size Analysis	GeoTesting Express	Test Method for Particle Size Analysis of Soils	ASTM D 422, June 2009, Revision 6	ASTM D 422- latest revision	NA
Solid	Plasticity of soils	GeoTesting Express	Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils	ASTM D 4318, June 2006, Revision 3	ASTM D 4318 – latest revision	NA
Solid	Strength and stress-strain relationships of saturated cohesive soil	GeoTesting Express	Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils	ASTM D 4767, June 2006, Revision 3	ASTM D 4767 – latest revision	NA
Solid	Resistance of Solid Wastes to Freezing and Thawing	GeoTesting Express	Standard Test Method for Determining the Resistance of Solid Wastes to Freezing and Thawing ¹	D 4842 – 90 (Reapproved 2001)	ASTM D 4842	NA
Solid	Wetting and Drying Test of Solid Wastes	GeoTesting Express	Standard Test Method for Wetting and Drying Test of Solid Wastes ¹	D 4843 – 88 (Reapproved 1999)	ASTM D 4843	NA
Solid	Hydraulic Conductivity	GeoTesting Express	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter	ASTM D 5084, June 2006, Revision 6	ASTM D 5084 – latest revision	NA
Solid	Specific gravity	GeoTesting Express	Standard Test Method for Specific Gravity of Soil Solids by Water Pycnomete	ASTM D 854, June 2009, Revision 4	ASTM D 854 – latest revision	NA

NA - Not applicable

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D-4: Test America SOPs

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
NA	Solvent and Acid Lot Testing	Solvent & Acid Lot Testing & Approval	CA-Q-S-001 10/1/07 Rev. 0	None	NA
Solid and Aqueous	Calibration Curves	Calibration Curves (General)	CA-Q-S-005 12/15/09 Rev. 2	None	NA
Solid and Aqueous	Preparation and Screening for SVOC	Preparation and Screening of Semivolatile Organic Extracts for GC/MS Analysis	ED-GCS-001 1/24/08 Rev. 6	None	NA
Solid	Headspace for VOCs	Screening for Volatile Organics, Static Headspace with GC FID, SW846 Method 5021	ED-GCV-001 10/23/09 Rev. 8	SW846 5021	Certified
NA	Control of Non-Conformances	Standard Operating Procedure for Control of Non-Conformances and Corrective Action	ED-GEN-003 3/13/09 Rev. 3a	None	NA
Solid	SubSampling	SubSampling	ED-GEN-007 3/13/09 Rev. 2a	None	NA
NA	Reagents and Standards	Traceability and Storage of Standards and Reagents	ED-GEN-008 1/26/10 Rev. 3	None	NA
Solid	Calibration of Balances	Calibration of Analytical Balances	ED-GEN-010 6/8/09 Rev. 5	None	NA
Solid	Thermometer Calibration	Thermometer Calibration	ED-GEN-014 7/6/09 Rev. 5	None	NA
NA	Training	Training	ED-GEN-022 6/11/08 Rev. 1	None	NA
NA	Bulk Solvent testing	Bulk Solvent Testing and Approval	ED-GEN-023 4/1/08 Rev. 0	None	NA
Solid and Aqueous	Semivolatile Organic Compounds (SVOCs)	Semi-Volatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS), SW846 Method 8270C	ED-MSS-002 2/15/10 Rev. 10	SW846 8270C	Certified
Aqueous	Purge and Trap for VOCs in Aqueous	Purge and Trap for Aqueous Samples, SW846 Method 5030	ED-MSV-001 10/6/08 Rev. 7	SW846 5030B	Certified
Solid	Purge and Trap for VOCs in Solid Samples	Closed System Purge and Trap and Extraction for Volatile Organics in Soil, SW846 Method 5035A	ED-MSV-002 11/4/08 Rev. 7	SW846 5035A	Certified

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
Solid and Aqueous	Volatile Organic Compounds (VOCs)	SW846 Method 8260B, Volatile Organic Compounds By Gas Chromatography/ Mass Spectrometry (GC/MS)	ED-MSV-005 10/23/08 Rev. 8	SW846 8260B	Certified
Solid and Aqueous	Metals by ICP	Trace Metals Analysis by Inductively Coupled Plasma Emission Spectroscopy [Method No. SW846 Method 6010B]	ED-MT-004 6/26/08 Rev. 6	SW846 6010B	Certified
Solid and Aqueous	Use of ICP	The Use of the Thermo Jarrell Ash Model 61E Trace Simultaneous Inductively Coupled Plasma Emission Spectrometer	ED-MT-013 11/25/09 Rev. 6	None	NA
Solid	Mercury by Manual Cold Vapor	Mercury Analysis for Sediment and Soil Samples using the Leeman Mercury Analyzer (Cold Vapor Technique) by SW846 Method 7471A	ED-MT-016 3/17/09 Rev. 7	SW846 7471A	Certified
Aqueous	Mercury by Manual Cold Vapor	Mercury Analysis for Water and Wastewater using EPA 245.1 and SW846 7470A; Mercury in Drinking Water using EPA245.1; Leeman Mercury Analyzer (Cold Vapor Technique)	ED-MT-017 9/3/09 Rev. 6	SW846 7470A	Certified
Solid and Aqueous	Metals by ICP-MS	Trace Metals Analysis for Water, Wastewater, Soil, Sediment, and Leachate Samples by ICP-MS Method No(s). EPA Methods 200.8 and SW-846 Method 6020	ED-MT-029 9/11/09 Rev. 6	SW846 6020	Certified
Aqueous	Acid Digestion - SW and GW	Digestion of Water and Wastewater Samples for Analysis by ICP and ICP-MS [Method No. 3005A]	ED-MTP-002 10/20/09 Rev. 6	SW846 3005A	Certified
Aqueous	Acid Digestion for Metals - Aqueous	Digestion of Water and Wastewater Samples for Analysis by ICP and ICP-MS [Method No. 3010A]	ED-MTP-003 11/24/08 Rev. 6	SW846 3010A	Certified

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
Solid	Acid Digestion for Metals - Solids	Hot Block Digestion of Sediments, Sludges and Soils, SW846 Method 3050B	ED-MTP-005 3/30/10 Rev. 8	SW846 3050B	Certified
Aqueous	Separatory Funnel Extraction for SVOCs	Extraction of Semi-Volatile Organic Compounds in Aqueous Samples and Leachates - Separatory Funnel, (SW846 Method 3510C)	ED-ORP-002 11/24/08 Rev. 6	SW846 3510C	Certified
Aqueous	Continuous Liquid-Liquid Extraction for SVOCs	Extraction of Semi-Volatile Organic Compounds in Water by Continuous Liquid-Liquid Extraction, SW846 Method 3520C	ED-ORP-003 11/24/08 Rev. 6	SW846 3520C	Certified
Solid	Automatic Soxhlet Extraction for SVOCs	Automated Soxhlet Extraction of Solid Samples for Semivolatile Organic Compounds by SW846 Method 3541	ED-ORP-004 1/26/10 Rev. 7	SW846 3541	Certified
Solid	Ultrasonic Extraction for SVOCs	Extraction of Semivolatile Organic Compounds in Soil Using a Medium-Level Extraction Technique (SW846 Method 3550B)	ED-ORP-006 1/19/08 Rev. 3	SW846 3550B	Certified
Aqueous	Separatory Funnel Extraction for Pesticides and PCBs	Extraction of Pesticides and PCBs in Water by Separatory Funnel using SW846 Method 3510C	ED-ORP-014 10/30/09 Rev. 6	SW846 3510C	Certified
Solid	Automatic Soxhlet Extraction for Pesticides and PCBs	Automated Soxhlet Extraction of Solid Samples for Semivolatile Pesticides/PCBs Compounds by SW846 Method 3541	ED-ORP-016 1/25/10 Rev. 7	SW846 3541	Certified
Solid	Ultrasonic Extraction for Pesticides and PCBs	Ultrasonic Extraction of Pesticides & PCBs in Soils using SW846 Method 3550B	ED-ORP-018 12/1/09 Rev.6	SW846 3550B	Certified
Solid and Aqueous	Dilution	Waste Dilution Preparation for Pesticides and PCBs using SW846 Method 3580A	ED-ORP-019 11/23/09 Rev. 6	SW846 3580A	Certified
Solid	Cleanup - Florisil	Florisil Cleanup of Pesticide/PCB Sample Extracts by SW846 Method 3620B	ED-ORP-020 11/23/09 Rev. 5	SW846 3620B	Certified

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
Solid	Cleanup - Sulfur Removal	The Removal of Elemental Sulfur from Pesticide/PCB Extracts using SW846 Method 3660/3660B	ED-ORP-021 11/23/09 Rev. 5	SW846 3660B	Certified
Solid	Cleanup - Sulfuric Acid	Sulfuric Acid Cleanup of PCB Extracts using SW846 Method 3665A	ED-ORP-022 11/16/09 Rev. 6	SW846 3665A	Certified
Solid	TCLP for organic and inorganic analytes	Extraction Procedure Using the Toxicity Characteristic Leaching Procedure (TCLP), SW846 1311	ED-ORP-038 11/2/09 Rev. 7	SW846 1311	Certified
Solids	Synthetic Precipitation Leaching Procedure (SPLP)	Extraction Procedure Using the Synthetic Precipitation Leaching Procedure (SPLP), SW846 1312	ED-ORP-040 11/8/09 Rev. 4	SW846 1312	Certified
Solid	Shake Extraction with Water	ASTM Leachate Procedure for the Extraction of Solid Waste with Water	ED-ORP-041 10/28/09 Rev. 5	ASTM D3987-85	Certified
Solid and Aqueous	Polychlorinated Biphenyls (PCBs)	Analysis of Polychlorinated Biphenyls by Gas Chromatography using SW846 Method 8082	EDS-GCS-04 1/12/10 Rev. 7	SW846 8082	Certified
NA	Sample Storage and Handling	Sample Storage & Handling Procedures for Mitigation of Sample and Laboratory Contamination	ED-SPM-004 2/1/08 Rev. 5	None	NA
Aqueous/Solid	Laboratory Waste Disposal	Laboratory Waste Disposal Procedures	ED-SPM-008 Rev. 2	None	NA
Solid and Aqueous	Reactive Cyanide	Cyanide-Reactivity, Analysis of Cyanide Reactivity [Method No(s). Vol. 1c 7.3.3]	ED-WET-001 9/15/08 Rev. 4	Vol. 1c 7.3.3	NA
Solid and Aqueous	Cyanide	Analysis of Total and Amenable Cyanide in Water, Drinking water, Wastewater, and Soil- Automated [Method No(s). SW846 9012A/9012B; 335.4 and SM 4500CN-C]	ED-WET-002 9/28/09 Rev. 4	SW846 9012A EPA 335.4 SM 4500 CN C	Certified
Solid	Hexavalent Chromium Digestion	The Alkaline Digestion of Soil Samples for the Analysis of Hexavalent Chromium [Method SW846 3060A]	ED-WET-010 2/03/10 Rev. 9	SW846 3060A	Certified

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
Solid	Hexavalent Chromium by Colorimetric	The Analysis of Digestates for Hexavalent Chromium by SW846 7196A	ED-WET-011 8/25/09 Rev. 7	SW846 7196A	Certified
Aqueous	Hexavalent Chromium by Colorimetric	The Analysis of Waters for Hexavalent Chromium by EPA SW846 Method 7196A	ED-WET-012 1/22/08 Rev. 4	SW846 7196A	Certified
Aqueous	Nitrate/Nitrite	Analysis of Nitrate and Nitrite in Water, Wastewater, and Soil-Automated [EPA 353.2 and SM 4500-NO3F]	ED-WET-021 9/15/09 Rev. 4	SM 4500-NO3 F	Certified
Solid and Aqueous	Phenol	PHENOL, Analysis Total Phenols in Water and Wastewater - Discreet Analyzer [Method No(s). EPA 420.1 and SW846 9065]	ED-WET-026 5/20/08 Rev. 5	SW846 9065	Certified
Aqueous	Total Dissolved Solids (TDS)	TDS, The Determination of Filterable Residue [Method No. Standard Method 2540C]	ED-WET-027 7/16/08 Rev. 5	SM 2540C	Certified
Aqueous	Total Suspended Solids (TSS)	TSS, Analysis of Total Suspended Solids in Water and Wastewater Samples [Method No. Standard Method 2540D]	ED-WET-028 10/8/08 Rev. 5	SM 2540D	Certified
Solid	Percent Moisture	Percent Moisture Determination	ED-WET-32 2/16/10 Rev. 4	EPA CLP SOW SOM01.1	NA
Aqueous	Alkalinity	ALKALINITY, Analysis of Alkalinity in Water, Wastewater and Soil by Manual Titration or Auto-Titrator, Standard Method 2320B	ED-WET-039 11/10/08 Rev. 6	SM 2320B	Certified
Aqueous	Biological Oxygen Demand (BOD)	Analysis of Biological Oxygen Demand in Water and Wastewater [Method No. SM 5210B]	ED-WET-041 4/1/08 Rev. 7	SM 5210B	Certified
Aqueous	Chloride	Analysis of Chloride in Water, Wastewater, and Soil by Method No(s). SM 4500-CL B and SW846 9253	ED-WET-043 11/18/09 Rev. 4	SM 4500-CL B	Certified

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
Solid and Aqueous	Chloride - Colorimetric	Analysis of Chloride in Water, Wastewater, and Soil by Colorimetric Automated Ferricyanide [Method No(s). Standard Methods	ED-WET-044 10/1/09 Rev. 5	SM 4500-CL E SW846 9251	Certified
Aqueous	Carbon Oxygen Demand (COD)	Analysis of Chemical Oxygen Demand in Water Wastewater and Soil	ED-WET-048 5/5/06 Rev. 3	EPA 410.4 SM 5220D	Certified
Aqueous	Dissolved Oxygen (DO)	DISSOLVE OXYGEN, Titrimetric Analysis of Dissolved Oxygen by Standard Method 4500-O C	ED-WET-053 2/22/10 Rev. 5	SM 4500-O C	Certified
Aqueous	Ferrous Iron	Analysis of Ferrous Iron in Aqueous Samples by Discreet Analyzer	ED-WET-057 5/8/06 Rev. 3	SM 3500 - Fe D	NJDEP certifies ferrous iron determination only for analysis of aqueous samples in the field
Solid and Aqueous	Ignitability	IGNITABILITY, Setaflash Method for Determining the Ignitability of Soil and Water Samples [Method No. SW846 1020A]	ED-WET-058 7/9/08 Rev. 5	SW846 1020A	Certified
Solid and Aqueous	pH (Corrosivity)	Analysis of pH for Waters and Drinking water Measured Electrochemically [EPA 150.1, SM 4500 H ⁺ B, SW846 9040B]	ED-WET-060 10/5/09 Rev. 5	SW846 9040B	Certified
Solid	pH	Analysis of pH for Soils and Organic Samples Determined Electrochemically [Method No. SW846 9045C]	ED-WET-061 10/6/09 Rev. 4	SW846 9045C	Certified
Aqueous	Ortho Phosphate	Analysis of Orthophosphate in Water	ED-WET-064 5/8/06 Rev. 3	SM 4500-P E	Certified

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TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

Matrix	Technique Description	SOP Title	SOP No./Date/Rev. #	NJDEP Approved Method(s)	Certification Status
Solid and Aqueous	Oxidation-Reduction Potential (Redox)	REDOX, Analysis of Oxidation-Reduction Potential by Standard Methods 2580	ED-WET-066 11/30/09 Rev. 5	SM 2580	NA; NJDEP does not certify this parameter
Solid and Aqueous	Sulfate	Photometric Analysis of Sulfate in Water Wastewater and Soil	ED-WET-068 3/29/07 Rev. 5	SW846 9038	Certified
Solid	Sulfide Reactivity	Analysis of Sulfide Reactivity	ED-WET-070 5/5/06 Rev. 3	SW846 9034	Certified
Solid	Acid Soluble Sulfide	Analysis of Acid Soluble Sulfides in Soil, SW846 9030B & 9034	ED-WET-071 5/8/06 Rev. 3	SW846 9030B SW846 9034	Certified
Aqueous	Total Organic Carbon (TOC)	Analysis of Total Organic Carbon in Aqueous Samples, SW846 9060	ED-WET-073 11/12/07 Rev. 4	SW846 9060	Certified
Solid	Total Organic Carbon (TOC)	The Determination of Total Organic Carbon in Solid Samples by Flash EA 1122 Analyzer, Lloyd Kahn	ED-WET-076, 7/11/2007 Rev. 2	SW846 9060	Certified
Solid and Aqueous	Extractable Petroleum Hydrocarbons (EPH)	Preparation and Analysis of Extractable Petroleum Hydrocarbons (EPH) in Solid and Water Samples using NJDEP EPH 10/08: Analysis of Extractable Petroleum Hydrocarbon Compounds (EPH) in Aqueous and Soil/Sediment/Sludge Matrices	ED-GCS-012, 4/19/2010 Rev 2	NJDEP EPH Method 10/08, Rev. 2, October 2009.	Certified

NA - Not Applicable

Field Sampling Plan / Quality Assurance Project Plan

Non-Residential and Residential Chromium Sites
Hudson County, New Jersey

Section: Appendix E
Revision: 1
Date: June 2010

Appendix E

Sample Hit List

**Summary Hit List
PPG Industries, Inc.**

**Summary Hit List Format
PPG Industries, Inc**

Site Name	
NJDEP Case No.	
Sampling Date	
Lab Name/ID	
SDG No.	
Sample Matrix	

Trip Blank ID	
Field Blank ID	

Sample ID	Analyte Name ¹	Method Blank Results ²	Lab Concentration	Validator Concentration	QA Decision	Data Validation Qualifier ³	NJDEP Footnote ⁴
(Units)		(Units)	(Units)	(Units)			

Notes:

¹ - ND values are not listed

² - Units must be mg/kg for solid samples

³ - Flagging code added by validator

⁴ - NJDEP Reason Codes listed in Section 20 of *Standard Operating Procedures for the Completion of the Data Validation Report Forms and the Preparation of the Final Data Validation Report*, SOP 5.A.15, Rev. 2, October 2001.



Environment

Submitted to:
PPG Industries
Allison Park, Pennsylvania

Submitted by:
AECOM
May 2012

Program Health and Safety Plan

PPG Industries, Inc. Hudson County Chromium Sites

Jersey City, New Jersey

Prepared for:

PPG Industries
Allison Park, PA

Prepared by:

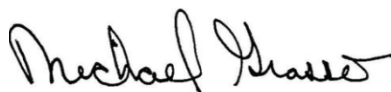
AECOM
30 Knightsbridge Rd. Ste 520
Piscataway, NJ 08854

May 2012

HEALTH AND SAFETY PLAN APPROVAL

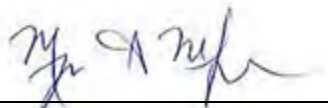
This Program Health and Safety Plan ("HASP") was prepared for AECOM employees performing a specific, limited scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present on the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards, which may be encountered during the completion of this project, adherence to the requirements of the HASP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve the HASP for the Program. This HASP has been written for the Hudson County Chromate Sites. This HASP has been written for the exclusive use of AECOM employees. The plan is written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Written by:

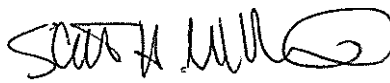
Michael Grasso, CIH
District Safety, Health & Environment Manager

May 31, 2012
Date

Reviewed/Approved by:

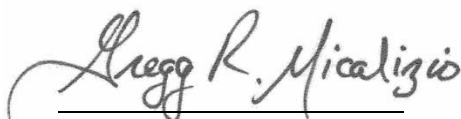
Megan Merdinger
Safety, Health & Environment
Coordinator

May 31, 2012
Date



Scott Mikaelian
Program Manager

May 31, 2012
Date



Gregg Micalizio
Program Operations Manager

May 31, 2012
Date



Christopher Martell
Project Manager

May 31, 2012
Date

Executive Summary

The purpose of this Health and Safety Plan ("HASP") is to provide a program-wide plan to manage health and safety concerns related to AECOM's activities at various "Hudson County Chromium" sites, located throughout Hudson County, New Jersey pursuant to its responsibilities under 29CFR1910.120 and 29CFR1926. The specific roles, responsibilities, authority, and requirements as they pertain to the safety of employees and the scope of services are discussed herein. The document is intended to identify known potential hazards and facilitate communication and control measures to prevent injury or harm to staff, subcontractors, and the general public. Additionally, provisions to control the potential for environmental impact from these activities are included where applicable.

Scope of Work

The scope of work associated with the Hudson County Chromium Program may include the following:

- Construction oversight;
- Health and Safety oversight;
- Engineering oversight;
- Implementing the air monitoring plan; and
- Assisting in waste management/records management.
- Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
- Physical characterization and sampling of soil samples from soil boring activities;
- Soil boring installation may also include the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at selected soil boring locations;
- Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
- Conduct an air monitoring program for particulates, volatile organic compounds ("VOCs") and other potential contaminants during all investigation activities.
- Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
- Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
- Oversight and direction of subcontractor installation and abandonment of temporary and permanent wells for monitoring, extraction, or injection and development of installed wells;
- Gauging, purging and sampling of groundwater monitoring wells;
- Geophysical and hydrologic testing of wells;
- Management of Investigative Derived Waste ("IDW");
- Oversight and direction of surveying services;
- Physical interior and exterior property inspection by AECOM where AECOM is accompanied by the resident, property owner, or an authorized representative for the purposes of identifying visual evidence of Chromate Chemical Production Waste ("CCPW") or other environmental impacts across the site, on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
- Oversight of the installation of interim remedial measures ("IRM") and continued quarterly inspection and maintenance of all installed IRMs.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,
- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,
- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Hexavalent chromium and chromium byproducts.

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;
- PCBs – associated with historic site operations.

Task Hazard Analysis

As a supplement to the Program HASP, a Task Hazard Analysis (“THA”) will be prepared for each activity proposed for a specific site by the field task leader. The THA for each activity will be reviewed by the Site Safety Officer (“SSO”) prior to being implemented. Once approved, the completed THA will be reviewed with all field personnel during the daily safety meeting to ensure it is specific to the needs of the current site conditions.

Task Specific Safety, Health & Environment (“SH&E”) Procedures

As discussed in this HASP, AECOM personnel may be exposed to a variety of chemical, physical, and radiological hazards resulting from task or equipment-specific activities. The controls for many of these hazards are discussed in Standard Operating Procedures (“SOPs”) found in the **Series 300 to 500** North America SH&E SOPs (refer to Appendix F).

SOP#	TITLE	SOP#	TITLE
S3NA 300 Series Field(Common)		S3NA 500 Series Industrial Hygiene	
☒	S3NA-301-PR	Confined Spaces	☒ S3NA-501-PR Asbestos
☒	S3NA-302-PR	Electrical, General	☒ S3NA-502-PR Benzene
☒	S3NA-303-PR	Excavation and Trenching	☐ S3NA-503-PR Blood borne Pathogen Program
☒	S3NA-304-PR	Fall Protection	☐ S3NA-504-PR Cadmium
☒	S3NA-305-PR	Hand and Power Tools	☒ S3NA-505-PR Cold Stress Prevention
☒	S3NA-306-PR	Highway and Road Work	☐ S3NA-506-PR Compressed Gases
☒	S3NA-307-PR	Housekeeping, Worksite	☐ S3NA-507-PR Hazardous Materials Communication / WHMIS
☒	S3NA-308-PR	Manual Lifting, Field	☒ S3NA-508-PR Hazardous Materials Handling and Shipping
☒	S3NA-309-PR	Mobile or Heavy Equipment	☒ S3NA-509-PR Hazardous Waste Operations and Emergency Response Activities
☒	S3NA-310-PR	Rigging, Hoisting, Cranes and Lifting Devices	☒ S3NA-510-PR Hearing Conservation Program
☐	S3NA-311-PR	Scaffolding	☒ S3NA-511-PR Heat Stress Prevention
☐	S3NA-312-PR	Ladders and Stairways	☐ S3NA-512-PR Laboratory Safety
☒	S3NA-313-PR	Wildlife, Plants and Insects	☒ S3NA-513-PR Lead
☒	S3NA-314-PR	Working Alone & Remote Travel	☐ S3NA-514-PR Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO)
☐	S3NA-315-PR	Water, Working Around	☐ S3NA-515-PR Nanotechnology
S3NA 400 Series Field (Uncommon)		☐ S3NA-516-PR	Radiation Safety Programs
☐	S3NA-401-PR	Aircraft Charters	☐ S3NA-517-PR Radiation, Non-Ionizing
☐	S3NA-402-PR	All Terrain Vehicles (ATVs)	☒ S3NA-518-PR Radiation, Gauge Source program
☐	S3NA-403-PR	Avalanches	☒ S3NA-519-PR Respiratory Protection Program
☐	S4NA(US)-404-PR	Commercial Motor Vehicles	☒ S3NA-520-PR Spill Response, Incidental
☒	S3NA-405-PR	Drilling and Boring	
☒	S3NA-406-PR	Electrical Lines, Overhead	
☐	S3NA-407-PR	Electro-fishing	
☐	S3NA-408-PR	Elevated Work Platforms and Aerial Lifts	
☐	S3NA-409-PR	Forklifts (operation of)	
☒	S3NA-410-PR	Hazardous Energy Control	
☐	S3NA-411-PR	Machine Guarding	
☐	S3NA-412-PR	Powder-Actuated Tools	
☐	S4NA(US)-413-PR1	Process Safety Management	
☒	S4NA(US)-414-PR	Railway Sites	
☒	S4NA(US)-415-PR	RCRA Regulated Facilities	
☐	S3NA-416-PR	Tunnel and Underground Work	
☒	S3NA-417-PR	Utilities, Underground	
☒	S3NA-418-PR	Welding, Cutting and Other Hot Work	
☐	S3NA-419-PR	Water, Marine Operations, Boating	
☐	S3-NA420-PR	Water, Underwater Diving	

AECOM employees are bound by the provisions of this HASP and are required to participate in a preliminary project safety meeting to familiarize them with the anticipated hazards and respective onsite controls. The discussion will cover the entire HASP subject matter, putting emphasis on critical elements of the plan; such as the emergency response procedures, personal protective equipment, site control strategies, and monitoring requirements. In addition, daily tailgate safety meetings will be held to discuss: the anticipated scope of work, required controls, identify new hazards and controls, incident reporting, review the results of inspections, any lessons learned or concerns from the previous day.

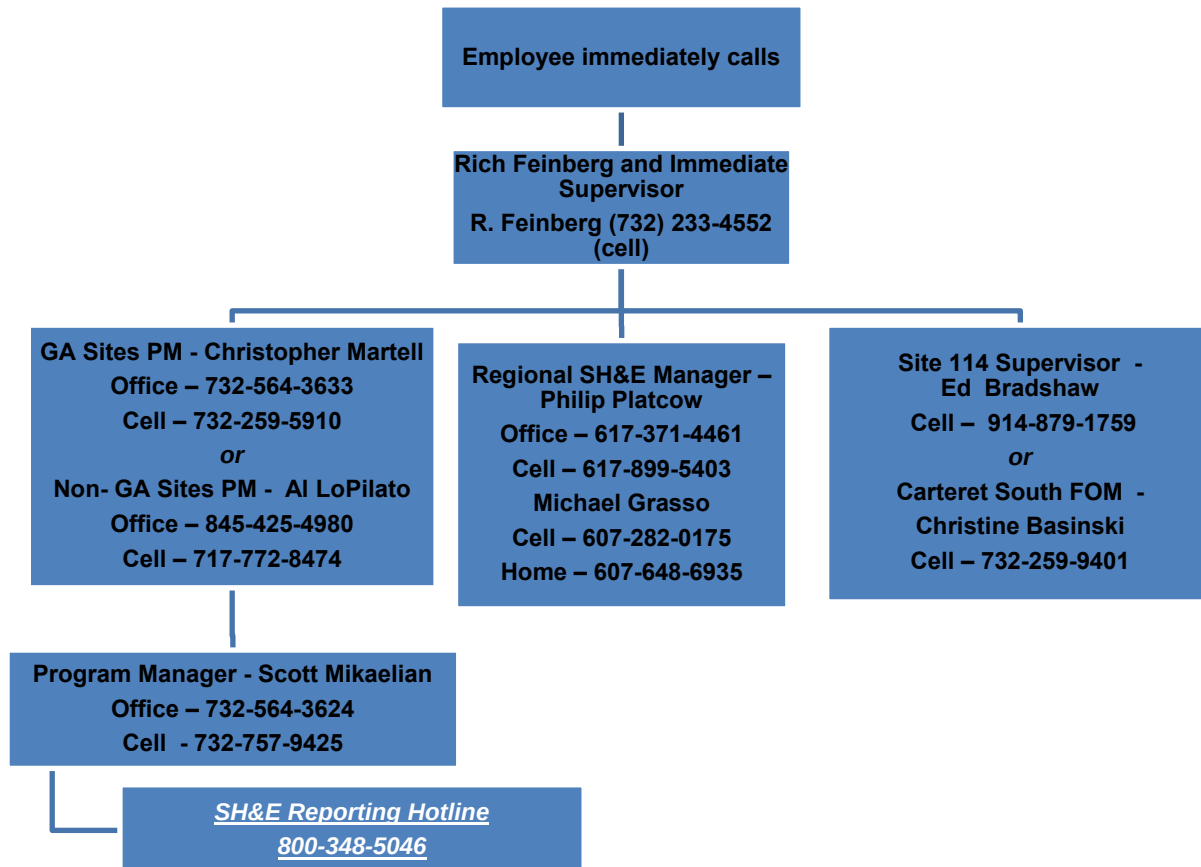
Incident Contact Phone Tree from HASP

Key Personnel:

AECOM Northeast Regional SH&E Manager – Philip Platcow
 AECOM Garfield Avenue Sites Project Manager – Christopher Martell
 AECOM Non-Garfield Avenue Sites Project Manager – Alfred LoPilato
 AECOM Field Operations Manager – Rich Feinberg
 AECOM Site 114 Supervisor – Ed Bradshaw
 AECOM Carteret South Supervisor – Mark Hayden
 AECOM Carteret South Field Operations Manager – Christine Basinski

NJDEP Spill Response Hotline - 877-927-6337

Report All Incidents Immediately to the AECOM SH&E Reporting Hotline



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1.0 Introduction

1.1 HASP Purpose

This Health and Safety Plan ("HASP") provides a clear plan to promote safe and healthful working conditions by identifying and controlling physical, chemical and biological hazards; to prevent work related injury, accidents, and damage to physical property or the environment; to create a plan to manage H&S incidents and emergencies; and to communicate potential hazards to employees or subcontractors working on the Hudson County Chromium Program.

1.2 General

The provisions of this HASP are mandatory for all AECOM personnel engaged in fieldwork associated with the environmental services being conducted at the subject site. In the event of a conflict among this HASP, AECOM Safety, Health & Environment ("SH&E") Standard Operating Procedures ("SOPs") and federal, state, and local regulations, workers shall follow the most stringent/protective requirements. Concurrence with the provisions of this HASP is mandatory for all personnel at the site covered by this HASP and must be signed on the acknowledgement page found in **Appendix A**.

1.3 Policy Statement

AECOM is committed to protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by our activities. We are also committed to protecting and preserving the natural environment in which we operate. The safety of persons and property is of vital importance to the success of these projects and accident prevention measures shall be taken toward the avoidance of waste and loss. It shall be the policy of these projects that all operations be conducted safely. Field Operations Managers ("FOMs") and/or Construction Managers ("CMs") are responsible for those they supervise by maintaining a safe and healthy working environment in their areas of responsibility, and by fairly and uniformly enforcing safety and health rules and requirements for all project personnel. All reasonable and practical measures shall be taken to promote safety and maintain a safe working environment. Contractors are wholly responsible for the prevention of accidents on work under their direction and shall be responsible for thorough safety and loss control programs and the execution of their own safety plans for the protection of workers.

1.4 AECOM Subcontractors

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in S3NA-213-PR Subcontractors. Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment ("PPE") and all required training.

AECOM considers each subcontractor to be an expert in the aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required

safety documentation for a subcontractor's work activities will be provided to AECOM for review prior to the start of onsite activities.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed with the AECOM Project Manager ("PM") or the FOM or CM prior to beginning work operations. The FOM, CM or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

1.5 HASP Modification

Should significant information become available regarding potential on-site hazards, it will be necessary to modify this HASP. All proposed modifications to this HASP must be reviewed and approved by the AECOM Regional Safety, Health & Environment Manager ("RSHEM") before such modifications are implemented. Any significant modifications must be incorporated into the written document as addenda and the HASP must be reissued. The AECOM PM will ensure that all personnel covered by this HASP receive copies of all issued addenda. Additionally, the HASP will be re-assessed for regulatory compliance and accuracy of its content one-year from the date of issuance.

1.6 Task Hazard Analysis

As a supplement to this Program HASP, a Task Hazard Analysis ("THA") will be prepared for each activity proposed for a specific site. The guidance for THA creation can be found in [S3NA-209-PR Project Hazard Assessment and Planning](#). Upon initiation of each work activity planned for the field, the selected Field Team Leader will develop a THA(s) for the specific work to be conducted. THAs can be saved and recycled for similar types of work, but must be reviewed and updated for each event. THA(s) will be sent to the Task Leader, PM, Field Ops Manager, Program H&S Manager, and the program SSO for review. The THA for each activity will be approved by the Site Safety Officer ("SSO") prior to being implemented. Once approved, the approved THA will be reviewed with all field personnel during the daily safety meeting to describe the specific H&S requirements of the tasks to be completed that day. A blank THA is presented in **Appendix B**.

1.7 HASP Availability

This HASP, applicable THAs, and other HASP addenda, including Material Safety Data Sheets ("MSDS"), may be printed out and placed in a binder for review or, if available, electronic copies can be kept on a lap top or tablet as long as site personnel are informed of their availability and how to access the documents. Applicable AECOM SHE SOPs are provided in **Appendix F** and are available via AECOM's intranet website.

1.8 Simultaneous Activities

During the course of the Hudson County Chrome Program, AECOM will be performing services simultaneously to other Contractors hired by PPG Industries Inc. ("PPG"). AECOM's first priority is the safety of their employees. Where simultaneous operations are taking place, AECOM PMs, FOMs, and/or CMs will coordinate their activities with other contractors.

Under the requirements of the Occupational Safety & Health Administration ("OSHA"), each employer is required to provide a safe and healthful working environment for employees. When several employers

are working simultaneously on the project, the activities of one employer could expose personnel of another company to a hazard.

Where an employer creates unsafe conditions, the exposing employer shall be responsible for exercising reasonable diligence to discover the condition, and for taking steps to protect their personnel and others working in the area. When the exposing employer has authority to correct the hazard, it shall do so. Where the exposing employer lacks the authority to correct the hazard, the employer shall ask the creating and/or controlling employer to correct the hazard; inform its personnel of the hazard; and take reasonable alternative protective measures. In extreme circumstances (e.g., imminent danger situations), the exposing employer shall remove their personnel from the area to avoid the hazard.

1.9 AECOM Safety Role

AECOM personnel shall not direct/manage the health and safety aspects of the work performed by contractors hired by PPG. If a possible safety hazard created by the contractor is observed, the AECOM representative should notify the contractor's onsite manager of the potential hazard only and not provide guidance or direction on how to correct the hazard. The safety hazard and corrective action should be documented by the SSO or FOM. If the hazard poses an imminent danger (condition where there is a reasonable certainty that a danger exists that can be expected to cause death or serious physical harm) to contractor's employees, the AECOM representative should stop the work and immediately notify the contractor's onsite manager the reason for stopping the work. If the contractor fails to correct the situation AECOM will immediately notify (verbally) the PPG contact of the hazardous situation. Verbal notification should be followed up by written notification. The initial stop work recommendation and the corrective action should be documented by the SSO or FOM.

1.10 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe and to assist in correcting these conditions as outlined in [S3NA-002-PR Stop Work Authority](#). Whenever the SSO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the SSO is authorized and required to stop work, which shall be immediately binding on all affected AECOM employees and subcontractors.

Upon issuing the stop work order, the SSO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the Safety Professional has concurred that workplace conditions meet acceptable safety standards.

2.0 Project Description

2.1 Site History

The Hudson County Chromate Chemical Production Waste Sites are located throughout Jersey City, Bayonne, and in surrounding towns in both Hudson and Essex Counties, New Jersey. The NJDEP has identified over 160 sites that are contaminated with chromite ore processing residue ("COPR"), also known as chromate waste. The chromate chemical production waste has been found at residential, commercial and industrial locations. The more than two million tons of waste disposed of over the area were generated by three chromite ore-processing plants which operated for approximately 70 years between 1905 and 1971. One of the plants, located in Hudson County, was owned and operated by PPG at its former chromium chemical production facility location at Garfield Avenue in Jersey City.

The chromate waste was used as fill in preparation for building foundations, construction of tank berms, roadway construction, filling of wetlands, sewer line construction and other construction and development projects. Chromate contamination has been found in a variety of places including the walls and floors of buildings, interior and exterior building surfaces, surfaces of driveways and parking lots and in the surface and subsurface of unpaved areas.

2.1.1 Site 016

Site 016 is located at 45 Linden Avenue East, Jersey City, New Jersey. Site 016 is approximately 12.9 acres comprised of a warehouse used for storing and shipping various materials or retail items (approximately 7.5 acres); asphalt cover area (approximately 2 acres); and unpaved areas (approximately 3.4 acres). Based on visual and analytical evidence, Site 016 had been partially filled with CCPW and/or CCPW-impacted material and was contaminated with chromium to a depth of about three feet bgs. CCPW was not encountered in any of the borings advanced inside of the Site 016 warehouse building, but, CCPW and CCPW-impacted materials were identified on the Site outside of the building. PPG began implementing additional IRMs (soil excavation in two areas along the east side of the warehouse building) at Site 016 in 2008-2009 including fencing and paving of the access road to the north of the Site installed to cover COPR containing soils. On site total chromium levels in soil ranged from < 100 to 15,500 mg/kg, and hexavalent chromium concentrations in soil ranged from ND to 709 mg/kg. Total chromium was detected at concentrations of non-detectable ("ND") to 2750 ug/l and hexavalent chromium was detected at concentrations of ND to 89 ug/l in unfiltered groundwater samples.

2.1.2 Site 063 and 065

Sites 63 and 65, located at 1 Burma Rd Jersey City, NJ, were determined to be potential sites of chromium contamination and listed as part of the Group 12 Hudson County Chrome sites. NJDEP collected a surface scraping sample from the base of the loading dock on the west side of the Baldwin Oil warehouse building on December 14, 1987. The total Cr concentration in the sample was 3,150 ppm. NJDEP collected a soil sample on February 22, 1988 north of utility pole #67563 near the edge of Burma Road from a depth of 4 to 6 inches below the asphalt. The concentration of total Cr in this sample was 910.3 mg/kg. It was determined that the fill beneath the building contained CCPW material. In 1998-1999, IRMs were implemented to demolish the building and included removal of the building's concrete floor slab and loading dock floor slab, removal of the CCPW-impacted fill, installation of a HDPE liner, backfilling, and grading. Drainage channels on the western and eastern sides of the site

were remediated and upgraded during the IRM to prevent CCPW impacts from entering the storm water collection system. A fence was installed around the Site to prevent unauthorized access. CCPW was visually identified in all 16 of the borings advanced through the building foundation, but was not found in any of the borings surrounding the platform. The highest concentrations of Cr+6 were detected in the middle of the building, toward the northern side. No Cr+6 exceeding 100 mg/kg IRM action level was detected in the borings advanced outside of the building. Total chromium was detected in groundwater at a concentration of 16.5 ug/L, and Cr+6 was not detected.

2.1.3 Site 107

Site 107 is located at 18 Chapel Avenue in Jersey City, NJ. The NJDEP conducted an inspection of Site 107 in January 1988 and identified yellow and green crystals on the exterior walls of the building. The total chromium results for soil samples ranged in concentration from 20 mg/kg to 11,000 mg/kg. The State of New Jersey Department of Health ("NJDOH") conducted an investigation of the building interior in May 1989 and reported yellow and white crystals on the walls of the building. Three "scrape samples" collected from the walls by NJDOH reported total chromium analytical results ranging from 54 to 4,660 mg/kg. PPG implemented IRMs at Site 107 in 1992 including the installation of polyethylene plastic and plywood coverings over contaminated interior building areas. Asphalt pavement was installed at exterior locations on the south side and northwest corner of the Site 107 building. Soil samples reported analytical results for total chromium ranging from 304 to 7,040 mg/kg. The repair and replacement work conducted by PPG in 1999 remedied the areas capped and sealed during the initial IRM work allowing the removal of the initial IRMs. The maximum concentrations reported for post-excavation samples were reported at a concentration of 7,550 mg/kg for total chromium and 8,540 mg/kg for hexavalent chromium. Additional IRMs conducted between 1999 and 2003. Soil samples were collected and temporary wells were installed and groundwater was sampled at Site 107 in September 2010. Total chromium ranged from 13.7 to 749 mg/kg, and hexavalent chromium concentrations ranged from ND to 390 mg/kg in soil samples collected during the September 2010 sampling event. Total chromium concentrations ranged from ND to 2690 ug/L, and hexavalent chromium was ND in groundwater samples collected during the 2010 sampling event.

2.1.4 Site 108

Site 108 is located at 20 Linden Avenue East in Jersey City, NJ. Minimal CCPW-related contamination was reported on Site 108 during previous investigations by Tapash Environmental Consultants in 2007; however, the extent of CCPW-related impact has not been fully determined. Tapash reported chromium at 139 ug/L in a groundwater sample collected from temporary monitoring well SB-7 located within the southern portion of the Site 108 building. A remedial investigation was conducted by Dresdner Robin in 2011 to further delineate the previously reported contamination.

2.1.5 Site 112A

Site 112A (Liberty National Golf Course) is located at 3 Linden Avenue East, in Jersey City, New Jersey. Previous sampling results indicate that total chromium was detected in Site 112A soils at a concentration of < 100 to 43,400 mg/kg, and hexavalent chromium was detected in soil at a concentration of ND to 12,800 mg/kg. Total chromium was detected in site groundwater at concentrations of ND to 6,410 ug/L, and hexavalent chromium was detected at concentration of ND to 7,220 ug/L. During recent sampling conducted on October 10, 2011, total chromium was detected in aqueous samples at a concentration of ND to 29.9 ug/l, and hexavalent chromium was ND in these samples.

2.1.6 Site 114 - Chromate Production Facility

Site 114 is located at 70 Carteret Avenue in Jersey City, NJ. The western half of Site 114 was the location of a chromate production facility from 1924 to 1963. Products produced at the plant included aluminum hydrate, sodium chromate, sodium bichromate, sodium sulfate, vanadium pentoxide and potassium bichromate. In 1964, the chromate chemical production facility was dismantled.

The residue remaining after the leaching of the roast constituted the only waste produced at the chromate plant. This waste is referred to as "chromate ore processing residue" or COPR. Some COPR was recycled through the process, but the majority was stockpiled on the southeast corner of Site 114 and on adjacent PPG Site 137, or used as fill material to close the Morris Canal. In addition, some material was transported to other Hudson County sites and was used as fill for other purposes.

2.1.7 Site 114 - Manufactured Gas Plant ("MGP")

Site 114 is located at 70 Carteret Avenue in Jersey City, NJ. The northeastern portion of Site 114 was the location of a manufactured gas plant ("MGP") that operated from 1886 to the mid-1930s. The MGP used the coal gas process, the water gas process and the carbureted water gas process. The most likely wastes generated at the MGP included: ash, clinker, iron oxide sponge, coke, tar, pitch, drip oil, ammonium sulfate, sulfur, and ammonia liquor.

2.1.8 Site 132

Site 132 is located at 91 Carteret Avenue in Jersey City, NJ. On Site 132 (Town & Country Linen), an Interim Remedial Measures ("IRM") [pavement cover and fencing] were installed between 1990 and 1992. A Remedial Investigation Workplan was submitted to New Jersey Department of Environmental Protection ("NJDEP") in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in soil at levels up to 20,900 milligrams per kilogram ("mg/kg") of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 85 parts per billion ("ppb") for total chromium. The IRMs (pavement cover and fencing) are inspected on a quarterly basis. Site 132 is proposed to become part of the PPG Carteret South Project.

2.1.9 Site 133

Site 133 includes 15 Halladay Street and 2-72 Halladay Street in Jersey City, NJ. On Site 133 (Ross Wax), an IRM [interior wall and floor coverings and exterior pavement] were installed in 1991. A Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 11,900 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 7,000 ppb total chromium in the adjacent right-of-way. The interior and exterior IRMs at Site 133 are inspected on a quarterly basis. 15 Halladay was part of the due diligence investigation conducted in early 2012.

2.1.10 Site 135

Site 135 is located from 51-99 Pacific Avenue in Jersey City, NJ. On Site 135 (Vitarroz), a Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 20 mg/kg of hexavalent chromium. On Site 135, hexavalent chromium was detected at 20.1 mg/kg in only one sample (PPG-135-MW1C). Total chromium was detected in site groundwater at levels up to 114 ppb for total chromium.

2.1.11 Site 137

Site 137 is located at 25 Halladay Street and 45 Halladay Street in Jersey City, NJ. On Site 137 (Rudolf Bass) at 45 Halladay Street, IRM [interior wall and floor coverings; and exterior pavement] were installed between 1990 and 1992. A Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 29,300 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 19,000 ppb for total chromium.

On Site 137 (Rudolf Bass) at 25 Halladay Street, a Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. The property has a building on it and is presently being used for light industrial purposes. Hexavalent chromium was detected in site soil at levels up to 26,000 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 5,300 ppb for total chromium. Interim remedial measures were implemented at Site 137 and engineering controls have been installed within the building interior and exterior to address observed chromium impacted surfaces. The IRMs are inspected on a quarterly basis. 25 Halladay was part of the due diligence investigation conducted in early 2012.

2.1.12 Site 143

Site 143 is located at 846 Garfield Avenue in Jersey City, NJ. On Site 143 (Talarico Auto), an IRM (exterior covering) was installed between 1990 and 1992. A Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 1,530 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater in the adjacent right of way at levels up to 25,000 ppb for total chromium. Site 143 was part of the due diligence investigation conducted in late 2011.

2.1.13 Site 146

Site 146 formerly contained a stockpile of CCPW reportedly covering an approximate 100 foot by 200 foot area partially beneath Commerce Street and on portions of the properties to the east and west of Commerce Street in Bayonne, NJ. NJDEP performed a site inspection at the foot of Commerce Street on May 15 and May 23, 1990 and found three small areas suspected to contain CCPW. As a result of these inspections, Site 146 was listed as one of the Group 13 HCC sites and a joint inspection of the Site was conducted by NJDEP and PPG. Following these inspections, IRM activities were performed in 1991. Concentrations of total chromium in surface soil samples were detected at a maximum concentration of 223 mg/kg at the northernmost location. IRMs included removal of piles of CCPW and asphalt capping of an 80-foot by 45-foot area in order to eliminate the possibility of exposure to CCPW. The asphalt cap extends on both sides of the roadway (Commerce Street) at the approach to the Kill Van Kull and adjacent fencing. No additional soil data for Site 146 was provided in available Site investigation/remediation references.

2.1.14 Site 147

Site 147 is located at 2 Port Imperial Boulevard in Weehawken, NJ. Since approximately 1880, the site has been reclaimed from the Hudson River via man made fill activities. The materials utilized for the fill included sand, brick, construction debris, blast roc, wood, cinders, coal ash, coal and COPR. In concert with the fill activities the site was utilized for various industrial activities including, but not limited to, ship loading and above ground storage facilities. Greater detail regarding the historic site activities and ownership can be found in the Remedial Investigation Work Plan (RIWP) prepared by ICF Kaiser and REM in September 1993. With the Remedial Investigation completed at the site, a site-wide remediation was conducted that included excavation and capping. The remediation also included converting the

property to a waterfront public park, which is how the site appears today. The contaminants of concern on site consist of volatile organic compounds ("VOCs") and metals (arsenic). The sampling program in place is designed for monitoring only; most levels of contaminants detected are below standard levels.

2.1.15 Site 156

Site 156 is located at 280 Marin Boulevard in Jersey City, NJ. On Site 156 (Metropolis Towers, also known as Gregory Park Apartments), a Remedial Investigation Report was submitted to the NJDEP in 1994. Additional investigation work was completed in 2006-2007. The Remedial Design and Remedial Action Workplan were submitted to the NJDEP in 2006. Impacted soil is primarily located beneath parking areas and recently demolished buildings. There are no known soil impacts beneath the residential towers. Soil samples collected during Langan remedial investigations indicated that samples contained total chromium concentrations ranging from not-detected ("ND") to 12,100 mg/kg; and hexavalent chromium was detected in soil samples at a concentration range of ND to 8,910 mg/kg. Total chromium has been detected in one groundwater monitoring well at levels up to 1,630 ppb for total chromium. In all other wells, total chromium groundwater concentrations have been below the Ground Water Quality Standards ("GWQS") for chromium. During additional soil and sediment sampling conducted at Site 156 in September-October 2011, hexavalent chromium concentrations ranged from ND to 2,980 mg/kg, and total chromium concentrations ranged from 5.5 to 17,000 mg/kg.

2.1.16 Site 174

Site 174 is located at 100 West 1st Street in Bayonne, NJ. On Site 174 (Dennis Collins Park), NJDEP first conducted soil sampling at the Site in response to information from a citizen during the summer of 1992. During the investigation, NJDEP discovered a pocket of material potentially indicative of the presence of CCPW at an approximate depth of 2 feet bgs in the face of an embankment along the shoreline of the Site. Total Cr analysis was completed on one soil sample collected on June 18, 1992, and total Cr was detected at a concentration of 4,760 mg/kg. The investigation did not include analysis for Cr+6. Additional investigations were conducted between 1992 and 1993 with total chromium concentrations in soil ranging from ND to 1,630 mg/kg. The areas with the highest concentrations of total Cr and Cr+6 were located along the 48-inch diameter underground sewer piping southwest of the restroom and adjacent to the Kill Van Kull. IRMs installed in 1993 included the placement of approximately 300 tons of rip-rap material along a portion of the Kill Van Kull shoreline near the sewer outfall, and the installation of approximately 600 square feet of a bituminous concrete/Permalon liner cap approximately 10 feet southwest of the restroom structure.

Between 1998 and 2002, additional sampling was conducted resulting with a maximum total chromium concentration of 2,130 mg/kg, and hexavalent chromium concentrations ranged from not detected to 30.5 mg/kg. Other metals detected in the soil samples above NJDEP soil remediation standards included antimony, beryllium, nickel, and vanadium which were above the NJDE RDCSRS but below the NRDCSRS. Total chromium concentrations were less than the total chromium GWQS of 70 µg/L in all samples analyzed; however, thallium and nickel were detected in groundwater samples above their respective GWQS.

A "Preliminary Site Characterization Report with Final Site Characterizations, Hudson County Chromate Sites, Group I, Remediation Investigation" was submitted to the NJDEP in June 2001. A "Final Remedial Investigation Report, Hudson County Orphan Site, Group 1, Site 174, Dennis P. Collins Park, Remedial Investigation and Remedial Alternative Selection Evaluation" was submitted to NJDEP in October 2003. Hexavalent chromium has been detected in site soil at levels up to 31 mg/kg for hexavalent and total chromium. Groundwater levels for total chromium were below the GWQS for chromium.

2.1.17 Site 186

Site 186 is located at 947 Garfield Avenue in Jersey City, NJ. On Site 186, Garfield Avenue No. 1 (Orphan Site), a Final Remedial Investigation Report was submitted to the NJDEP in 2003. Hexavalent chromium has been detected in site soil at levels up to 18 mg/kg. Groundwater levels for total chromium were below the GWQS for chromium on site. During sampling investigations conducted in 1997 by L. Robert Kimball & Associates ("Kimball"), antimony was detected in soil at levels up to 40 mg/kg, lead concentrations were detected in soil at levels up to 529 mg/kg, and vanadium was detected in soil at concentrations up to 416 mg/kg above their respective NJDEP Soil Remediation Standards (N.J.A.C. 7:26D), ("SRS"). Hexavalent chromium was not detected above 20 mg/kg, the most stringent Soil Cleanup Criteria for Chromium (hexavalent). Aluminum (7,570 ppb), manganese (48,400 ppb), sodium (117,000 ppb), lead (47 ppb) and iron (10,500 ppb) were detected at a maximum concentration above the GWQS in one or both wells installed and sampled (unfiltered) by Kimball.

2.1.18 Site 202

On Site 202 (Caven Point Realty), no remedial investigation activities have been completed by PPG. As a result, no data is available.

2.1.19 Site 203

On Site 203 (Claremont Associates), no remedial investigation activities have been completed by PPG. As a result, no data is available.

2.1.20 Site 204

On Site 204 (Conrail Edgewater Branch railroad right-of-way), no remedial investigation activities have been completed by PPG. As a result, no data is available.

2.1.21 Site 207

Site 207 is located in the Berry Lane Park Area and is located between Garfield Avenue, Communipaw Avenue, Woodward Street and the NJ Transit Light Rail Line in Jersey City, NJ. On Site 207, Garfield Avenue No. 2 (Orphan Site), hexavalent chromium has been detected in site soil at levels up to 332 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 240 ppb for total chromium. Recent site investigation activities conducted by Jersey City Redevelopment Authority also indicate that there are chromium impacts; however, the reports generated from these activities have not been completely reviewed. Reach Associates soil boring data collected in 1997 indicates that on Site 207, total chromium was reported at a maximum total chromium concentration of 26,863 mg/kg and hexavalent chromium concentration was reported at a concentration greater than 332 mg/kg at sample location RAI-9B. At Reach Associates soil boring RAI-3B, total chromium concentrations were reported at 24,101 mg/kg and hexavalent chromium soil concentrations were reported at 61.2 mg/kg.

2.1.22 Berry Lane Park Area

Sites 121 and 207 are situated within the Berry Lane Park Area and are located between Garfield Avenue, Communipaw Avenue, Woodward Street and the NJ Transit Light Rail Line in Jersey City, NJ. Soil and groundwater sampling activities were also conducted by Langan Associates ("Langan") on various properties (Property 3, 4, 5, 6, 7, 8 & 9) within the Berry Lane Park Area. Several volatile organic compounds, polycyclic aromatic hydrocarbons ("PAHs") and metals were detected in soil above the NJDEP SRS at the maximum concentrations summarized below:

- Total petroleum hydrocarbons (5,830 parts per million (“ppm”))
- Benzene (2.26 ppm)
- Naphthalene (13.1 ppm)
- Benzo(a)anthracene (1.76 ppm)
- Benzo(a)pyrene (1.31 ppm)
- Benzo(b)fluoranthene (1.61 ppm)
- Arsenic (25.3 ppm)
- Lead (1,817 ppm)
- Hexavalent chromium
 - o Property 5 sample location P5-SB1 (11,500 ppm)
 - o Property 8 sample location P8-SB2 (12,600 ppm)

In groundwater samples collected by Langan from Properties 3, 4, 5, 6, 7, 8, & 9, the following compounds were detected at concentrations above the GWQS at one or more location:

- Benzene (2,270 ppb)
- Toluene (6,680 ppb)
- Ethylbenzene (3,470 ppb)
- Xylenes (11,730 ppb)
- Naphthalene (705 ppb)
- tert-Butyl Alcohol (418 ppb)
- Hexavalent chromium (200,000 ppb) – Property 5 well location P5-GWHEX(P5-SB4)

2.1.23 Additional Sites

During the Hudson County Chrome Program, additional sites may be identified that will require investigation by AECOM. When these sites are identified, the historical background information can be added in **Appendix D** and a site-specific THA will be created according to AECOM's scope of work for the Hudson County Chrome Project. If the scope of work at the new site does not fall under a scope of work designed in this HASP, the Hudson County Chrome Program HASP will have to be revised to include the new scope of work before the work can be conducted.

2.2 Scope of Work for Garfield Avenue Group Sites

AECOM has been retained by PPG to conduct construction management activities during Remedial Action Work Plan (“RAWP”) activities at the Garfield Avenue Group of Sites. The activities being conducted during the proposed RA are detailed in attached RAWP. The RAWP activities include surface concrete slab removal, subsurface debris and mass source waste removal. A separate HASP for the IRM#1 dated February 2010 was developed for IRM Activities. Since Feasibility Study activities are anticipated to occur while RAWP activities are ongoing, this HASP incorporates the requirements from the previous IRM #1 HASP.

2.2.1 AECOM's Scope of Work for Garfield Avenue Group Sites

As part of the construction management task, AECOM's scope of work includes:

- Monitoring AECOM's contractor's performance and compliance with the contract requirements;
- Oversight of field activities to monitor whether work is being performed in accordance to work plan and/or other approved documents;

- Implementing the air monitoring plan; and
- Assisting in waste management/records management.

2.2.1.1 Overview of RAWP, Interim Remedial Measures and Feasibility Study ("FS") Activities

Site activities will include the following:

- Conducting the excavation work
 - o Southwest Excavation ("SW TEP") will consist of a mass removal excavation and associated sampling and disposal activities;
 - o RAWP – Remaining portion of the Garfield Avenue Sites (with exception of Site 186) Excavation will consist of a mass removal excavation and associated sampling and disposal activities;
- Conducting a Backfill Amendment treatment full scale application using FerroBlack-H; and
- Conducting an In-Situ Groundwater treatment using biological amendments.

Many of these activities will be occurring at the same time.

The proposed RAWP and the SW TEP work is comprised generally of mass removal actions but also includes waste characterization activities and geotechnical investigation activities. The mass removal actions which will be performed consist primarily of dewatering, shoring installation, excavation, backfilling and regrading. The SW TEP focuses on the Southwest portion of the site and the Morris Canal area adjacent to the Southwest area and IRM#1. PPG's Remediation Contractor will perform the construction-related activities for the project. Amended backfill is approved for use within a portion of the former Morris Canal area and will follow the applicable health and safety and storage and handling procedures discussed in **Appendix H**.

Previous FS work that was comprised of pilot scale studies were used to evaluate remedial technologies. The successful studies, using FerroBlack-H, will be used to model the current full scale Backfill Amendment. Treatment activities which will be performed consist of excavation, ex-situ and in-situ soil treatment, and groundwater injection. Work will be performed by a combination of contractors including an excavation contractor, and firms with specialty treatment technologies. **Appendix H** provides a description of the treatment applications and health and safety guidelines to be followed during these activities at Site 114.

During the remedial activities, groundwater extracted from the excavation areas will be stored onsite in 250,000 gallon modular tanks or other approved containers containing groundwater extracted from onsite excavation activities for treatment by the on-site water treatment facility or disposal by tanker trucks. Groundwater will be disposed of as hazardous waste and transported to an appropriately licensed disposal facility if the treatment system is not operating.

2.2.2 Project Duration and Shifts Work

The start of this project was in June, 2010 with field work expected to continue through December 2014. Limited post-treatment sampling will continue after excavation activities. Field work typically takes place Monday through Friday from 0700 to 1500 hours, but may last until 1900 hours. Work on Saturday may be required; however, work will not generally take place after dark or on weekends or major holidays. AECOM expects to staff the project with approximately eight to twelve people.

2.2.3 AECOM Contractors

As required by AECOM policy and procedures, subcontractors to AECOM are pre-qualified based on their prior experience with AECOM, total OSHA injury and illness rate, as provided on their OSHA 300A Form for the past three years, experience modification rate (EMR of less than 1) and their corporate safety program. A copy of their corporate safety program is technically reviewed by the RSHEM Manager. Subcontractors to AECOM are also required to submit Job Safety Analysis ("JSAs")/THA and a project HASP for acceptance by AECOM.

Subcontractors are required to provide a safe and healthful working environment for employees that are free from recognized hazards that are causing or likely to cause harm to their employees and other project personnel.

AECOM will be performing most of the In-Situ groundwater injection pilot study work. Subcontractors (to be determined) will include drilling, electrical, and plumbing subcontractors.

Contractors who AECOM has retained for this project and their area of expertise are as follows:

Contractor	Expertise/Scope of Work
Borbas Surveying and Mapping	Survey of all site features
EAI	Provide air monitoring support
SGS Environmental Services	Subsurface drilling and well installation
D'elia Electric	Electrician for on-site wiring and connection

2.2.4 PPG Contractors

The environmental construction contractors and the remediation/treatment contractors who will be performing the feasibility study work will be subcontracted directly to PPG. The PPG contractor is responsible for their staff's health and safety, although AECOM has stop-work authority as will be specified in their contract to PPG. Subcontractors acquired by PPG contractors are responsible for their staff's health and safety and will adhere to the project-specific SH&E documentation agreed upon by PPG and their contractor.

Contractors who PPG has retained for this project and their area of expertise are as follows:

Contractor	Expertise/Scope of Work
<i>Contractor to be determined</i>	RAWP Excavation work and Backfill Amendment
ENTACT (including subcontractors)	SW TEP Excavation work and Backfill Amendment
ARCADIS	In-Situ Soil Treatment H ₂ SO ₄ /Bio
AquaBella	Water treatment
WTS (including subcontractors)	Waste management services
Clean Earth	Waste disposal services

2.3 Scope of Work for Environmental Site Investigations

The PPG Non-Residential Chromium Remediation Project consists of approximately twenty chromium-contaminated properties located in Hudson County, New Jersey. Under the terms of an Administrative Consent Order (“ACO”) between PPG and the NJDEP, these properties are to be investigated for soil and groundwater impacts due to the potential presence of COPR or other chromium-related wastes. The current list of properties subject to the ACO is listed below in **Table 2-1**.

The remedial investigation will involve approximately twenty properties located in Hudson County, New Jersey. The locations of the properties are listed below in **Table 2-1**.

Table 2-1 Non-Residential Chromate Chemical Production Waste Sites

ACO Site Number	Site Name/Location
114	70 Carteret Avenue, Jersey City, New Jersey
132	91 Carteret Avenue, Jersey City, New Jersey
133	22 Halladay Street, Jersey City, New Jersey 15 Halladay Street, Jersey City, New Jersey
135	51-99 Pacific Avenue, Jersey City, New Jersey
137	Rudolf Bass, 45 Halladay Street, Jersey City, New Jersey 25 Halladay Street, Jersey City, New Jersey
143	Talarico Auto, 846 Garfield Avenue, Jersey City, New Jersey
207	Various Properties bound by Garfield Avenue, Communipaw Avenue, NJ Transit Light Rail Line, Woodward Street, and Forrest Street
16	45 Linden Avenue East, Jersey City, New Jersey 07305
63	1 Burma Road, Jersey City, New Jersey
65	Right-of-way on Burma Road, Jersey City, New Jersey
107	18 Chapel Avenue, Jersey City, New Jersey 07305
108	20 Linden Avenue East, Jersey City, New Jersey 07305
156	Metropolis Towers, 280 Marin Boulevard, Jersey City, New Jersey
174	Dennis Collins Park, 1st Street, Bayonne, New Jersey
202	Pine St. and C.R.R, Jersey City Central R.R.ETC West I
186	Garfield Avenue #1, 947 Garfield Avenue, Jersey City, New Jersey
203	346 Claremont Avenue, Jersey City, New Jersey 371 Westside Avenue, Jersey City, New Jersey 417-444 Claremont Avenue, Jersey City, New Jersey West Side Avenue Park and Ride (along Claremont Avenue)
204	Conrail Edgewater Branch Johnston Avenue

2.3.1 AECOM's Scope of Work for Environmental Site Investigations

AECOM has been retained by PPG to conduct a remedial investigation to determine if the soil and groundwater on the property and subsequent adjacent properties have been impacted by the activities of the former chromate production facility. AECOM's scope of field work is as follows:

- Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
- Physical characterization and sampling of soil samples from soil boring activities;
- Soil boring installation may also include the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at selected soil boring locations;
- Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
- Conduct an air monitoring program for particulates, volatile organic compounds ("VOCs") and other potential contaminants during all investigation activities.
- Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
- Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
- Oversight and direction of subcontractor installation and abandonment of temporary and permanent wells for monitoring, extraction, or injection and development of installed wells;
- Gauging, purging and sampling of groundwater monitoring wells;
- Geophysical and hydrologic testing of wells;
- Management of Investigative Derived Waste ("IDW");
- Oversight and direction of surveying services;
- Physical interior and exterior property inspection by AECOM where AECOM is accompanied by the resident, property owner, or an authorized representative for the purposes of identifying visual evidence of Chromate Chemical Production Waste ("CCPW") or other environmental impacts across the site, on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
- Oversight of the installation of IRMs and continued quarterly inspection and maintenance of all installed IRMs.
- Oversight of environmental site investigation work conducted by an outside consultant for PPG.

Soil borings will be drilled for the purpose of collecting soil samples for field screening, geologic logging, and laboratory analysis, and to facilitate well construction. Borings may be drilled using direct push, hollow stem auger, tripod, or air-, mud- or water-rotary methods depending on the material to be penetrated, the target depth, and well installation or other factors.

Air monitoring will be conducted for VOCs, particulates, CO and other applicable contaminants during all subsurface and indoor investigations. Air monitoring will be conducted in the work zone and at the exclusion zone perimeter and will follow Section 8.0 guidelines in this HASP.

Temporary wells may be installed in borings to allow collection of "grab" groundwater samples for laboratory analysis.

Permanent monitoring wells will be installed in certain borings. The monitoring wells are typically constructed using two-inch diameter polyvinyl chloride ("PVC") screen and riser. A sand pack is placed around the screen, followed by a bentonite seal. A cement/bentonite grout is placed from the top of the seal to the ground surface. Bedrock wells may be constructed with a four to six inch diameter open hole rather than a screen. Outer steel casings will be grouted in place.

Groundwater samples will be collected from the newly installed and/or existing permanent wells, typically using low-flow sampling techniques, as described in the NJDEP Field Sampling Procedures Manual ("FSPM"). Prior to sampling, the depth to water will be measured using an interface or depth to water meter.

Test pits and trench excavations may be required during the remedial investigation. Excavation activities will be conducted by an environmental contractor and AECOM will conduct air monitoring, soil sampling and health and safety oversight.

Site walks and inspections will be conducted prior to a site investigation, during a due diligence investigation or during an IRM inspection. An AECOM employee will be accompanied by the site owner and/or the site tenant, and will conduct the site walk/inspection while being aware of current on-site operations and hazards. Site walks and inspections can include the collection of samples from sumps, concrete or other potentially contaminated surfaces to determine the necessity of an IRM. An IRM may be installed by creating a temporary barrier between the contaminated surface and the rest of the property to prevent exposure. An IRM can consist of wood paneling or an epoxy material applied to the contaminated surface or it can include the removal and replacement of the contaminated surface (IE concrete flooring) via controlled demolition or excavation activities.

Most of the remedial investigation activities are successive and will not typically occur concurrently.

2.3.1.1 Project Duration and Shifts Work

Field work typically takes place Monday through Friday from 0700 hour to 1700 hours, but may last until 1900 hours. Work on Saturday maybe required. Work will not generally take place after dark or on weekends or major holidays. AECOM proposes to staff the project with five to eight people.

2.3.1.2 AECOM Contractors

As required by AECOM policy and procedures, subcontractors to AECOM are pre-qualified based on their prior experience with AECOM, total OSHA injury and illness rate, as provided on their OSHA 300A Form for the past three years, experience modification rate (EMR of less than 1) and their corporate safety program. A copy of their corporate safety program is technically reviewed by the RSHEM Manager. Subcontractors to AECOM are also required to submit JSAs/THA and a project HASP for acceptance by AECOM.

Subcontractors are required to provide a safe and healthful working environment for employees that are free from recognized hazards that are causing or likely to cause harm to their employees and other project personnel.

Contractors who AECOM has retained for this project and their area of expertise are as follows:

Contractor	Expertise/Scope of Work
SGS Environmental Services	Advance soil borings, and install and develop groundwater monitoring wells, using a direct push drill rig (Geoprobe®) or other drilling method
Borbas Surveying and Mapping	Survey wells
Jersey City Police Department	Provide off-duty police officers for off-site protection and traffic control

Contractor	Expertise/Scope of Work
TPI Environmental, Inc.	Utility clearance for drilling locations and advance soil borings using a direct push drill rig (Geoprobe®) method as needed

2.4 Scope of Work for Residential Site Investigations

In June 2009, PPG entered into a Judicial Consent Order (“JCO”), which requires the investigation and if necessary, the remediation of chromate chemical production waste (“CCPW”) at residential properties within the vicinity of the PPG Sites. On behalf of PPG, AECOM has prepared a Residential Site Investigation Work Plan (“RSIWP”), which outlines the proposed general scope of work to conduct Residential Site Investigation (“RSI”) activities at residential properties located in Hudson County, New Jersey. A summary of the scope of work is presented below.

- Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of CCPW impacts on the exterior of any structures as well as the ground floor and basement or crawl space, if present.
- Surface or subsurface soil sampling may be conducted at residential sites per the RSIWP based on the site inspection findings and/or at the request of the property owner. Surface soil samples are described as samples collected in the first 24 inches of soil below ground surface (“bgs”) (Section 5.3 of the NJDEP FSPM). This may include samples collected directly under asphalt or concrete cover at the surface. Subsurface samples are described as soil samples collected from below the first 24 inches of soil encountered in the soil column. A utility clearance will be performed for any subsurface samples that are collected via the installation of borings by drilling or test pit excavation.
- If evidence of CCPW (e.g., chromium “bloom”, suspected CCPW in contact with masonry) is observed during the site inspection, exterior walls and foundations will be sampled. Foundations are typically constructed of masonry units such as concrete, concrete block, or brick. Walls are typically constructed of brick or concrete masonry units, but could also be constructed of wood and covered with vinyl or metal siding.
- Chip sampling may be used to obtain surface samples from porous masonry. Chip samples are obtained by striking a decontaminated chisel with a hammer against a masonry structure, or using an electric chipping hammer, thereby producing masonry chips for sample collection.
- Concrete core sampling may be utilized to obtain samples from masonry walls, foundations or floors at the surface or at depth.
- If interior evidence of CCPW (e.g., chromium “bloom”, suspected CCPW in contact with masonry) is observed during the site inspection and/or at the request of the property owner, interior masonry walls and/or floors of the lowest level in the structure will be sampled, including basements and crawl spaces where accessible. Basements walls are typically constructed of masonry units such as concrete, concrete block, or brick and may or may not be covered with wood, plaster, or sheetrock walls.

2.4.1 Project Duration and Shifts Work

The start date of this project was January 21, 2010. Field work will typically take place by appointment Monday through Saturday between 0800 hours and 1700 hours by discretion of the property owner. AECOM proposes to staff the project with two to four people.

2.5 Scope of Work for Operations and Maintenance Activities

On behalf of PPG, AECOM is conducting biannual or quarterly ground water monitoring and site maintenance activities on select Hudson County Chrome sites that have already undergone Remedial Action activities. These activities include:

- Conducting a synoptic gauging round on existing wells on the properties;
- Conducting biannual or quarterly groundwater sampling events using low-flow sampling techniques;
- Inspecting existing wells on the properties and maintaining their functionality;
- Inspecting existing Remedial Action structures and maintaining their functionality;
- Oversight of additional remedial or construction activities conducted by other consultants in the vicinity of existing Remedial Action structures

The site included in operation and maintenance activities are located:

ACO Site Number	Site Name/Location
112A	3 Linden Avenue East, Jersey City, New Jersey
146	Commerce Street, Bayonne, New Jersey
147	2 Port Imperial Boulevard, Weehawken, New Jersey

2.5.1 Project Duration and Shift Work

The operation and maintenance activities have been implemented upon completion of the Remedial Action activities and will continue for the duration of the NJDEP groundwater monitoring requirements. Field work will typically take place Monday through Friday between 0800 hours and 1700 hours. AECOM proposes to staff the project with two to four people.

3.0 Organization/Responsibility

3.1 Key Personnel

Scott Mikaelian	Program Manager
Gregg Micalizio	Program Operations Manager (Acting H&S Lead)
Al LoPilato	Project Manager (Non-Garfield Ave Sites)
Chris Martell	Project Manager (Garfield Ave Group of Sites)
Bob Cataldo	Remedial Investigation Lead
Bill Spronz	Remedial Investigation Lead
Craig MacPhee	Engineering Lead
Rich Simun	Residential Site Inspection Program Lead
Rich Feinberg	Field Operations Manager - Garfield Ave Group of Sites
Christine Basinski	Field Operations Manager- Carteret South Properties
Mark Hayden	Construction Manager -Carteret South Properties
Ed Bradshaw	Site 114 Construction Manager
Ron Kantor	SSO/Site 114 Asst. Construction Manager
Brian McGuire	PPG Project Contact
Phil Platcow	Northeast Regional Health and Safety Manager
Michael Grasso	District Health and Safety Manager

An organizational chart showing the hierarchy of the Hudson County Chrome project management is provided in **Appendix I**.

3.2 Staff H&S Responsibilities

3.2.1 Program Manager

The Program Manager (“PgM”) is responsible for the overall implementation and success of the H&S program, for setting H&S policies, goals, and directives; and to conduct periodic management site visits to audit the effectiveness of the H&S program plan and its implementation.

3.2.2 Program Operations Manager (to be replaced by Program H&S Manager)

The Program Operations Manager (“POM”) is the Program Manager’s delegate and is responsible to manage and direct the implementation of the H&S program and set policy and procedures to achieve program goals. The POM or authorized delegate will conduct biweekly H&S management meetings to track program H&S issues and improvements in program policies, procedures, and goals.

3.2.3 Project Managers

The AECOM PMs are the individual who has the primary responsibility for ensuring the overall health and safety of staff conducting work related to this project. The specific safety responsibilities for the PM are listed in Section 4.1.2 of S3NA-209-PR Project Hazard Assessment and Planning (http://my.aecomnet.com/deployedfiles/Intranet/Geographies/Americas/Functions/Safety/2012%20SOP/200%20Series/S3NA_209_PR_Hazard_Assessment_and_Project_Planning.pdf). The PM will provide the Field Operation Managers with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations. As such, the PM is responsible for ensuring that the requirements of this HASP are implemented. Some of the PM's specific responsibilities include:

- Allocate the resources necessary for the successful implementation of all necessary safety procedures;
- Provide AECOM subcontractor(s) with a copy of this HASP;
- Document that AECOM subcontractor(s) have provided their own site-specific SH&E documentation or provided a written statement of adoption of the provisions in AECOM's project SH&E documentation.
- Communicate health and safety expectations to field staff and subcontractors;
- Select subcontractors with consideration to their safety and health performance metrics;
- Support the H&S decisions made by the field team;
- Maintaining regular communications with the field team and, if necessary, the RSHEM;
- Update the site-specific HASP to reflect changes in site conditions or the scope of work. HASP updates must be reviewed and approved by the Safety Professional; and
- Conducting random project audits (Management Site Visits).

3.2.4 Technical Leads (e.g. investigation, engineering)

In many instances, PMs will delegate all or a portion of their H&S responsibilities to Technical Leads ("TLs"), who have the overall responsibility to plan and execute field activities. The Technical leads will generally assign staff responsibility to execute planned work according to workplans or other directives. In addition to delegated responsibilities, the TLs will ensure that field team leaders complete and submit JHAs as appropriate to the SSO and that the SSO approves the JHAs prior to initiating field activities. The TLs will also conduct random project audits.

3.2.5 AECOM Field Operation and Construction Managers

Field Operations Managers ("FOMs") and Construction Managers ("CMs") have the responsibility and authority to direct work operations at the job site according to the provided work plans and as necessary to maintain a safe workplace.

The FOM and CM are responsible to:

- Assist the SSO with the implementation of this HASP and ensuring compliance;
- Maintain awareness of activities being conducted, staff responsible, and any special H&S considerations related to that work;
- Discuss deviations from the work plan with the SSO and PM;

- Discuss safety issues with the PM, SSO, and field personnel;
- Assist the SSO and field team with the development and implementation of corrective actions for site safety deficiencies; and
- Assist the SSO with inspections of the site for compliance with this HASP and applicable SOPs.

3.2.6 AECOM Site Safety Officers

All AECOM field technicians are responsible for implementing the safety requirements specified in this HASP. However, one field technician will serve as the SSO. The SSO will be appointed by the FOM and/or the PM. The Field Team Leader (“FTL”) serves as the SSO for projects where a dedicated SSO is not assigned. The SSO will be on-site during all activities covered by this HASP. The SSO is responsible for enforcing the requirements of this HASP once work begins. The SSO has the authority to immediately correct all situations where noncompliance with this HASP is noted and to immediately stop work in cases where an immediate danger is perceived.

Some of the SSO's specific responsibilities include:

- Documenting that all AECOM personnel to whom this HASP applies have reviewed this HASP, and submitted a completed copy of the HASP review and acceptance form (**Appendix A**);
- Assuring that all personnel to whom this HASP applies have attended a pre-entry briefing and any subsequent safety meetings that are conducted during the implementation of the program;
- Be aware of changes in AECOM Safety Policy;
- Monitor the lost time incidence rate, incident rate, and other H&S statistics for this project and work with the FOM and POM to develop strategies for improving H&S performance;
- Inspect the site for compliance with this HASP and the SOPs using the appropriate audit inspection checklist provided by an AECOM Safety Professional or using the checklist provided in [S3NA-212-PR](#);
- Work with the FOM, CM, TM/PM, and POM to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s);
- Provide a means for employees to communicate safety issues to management in a discreet manner (i.e., suggestion box, etc.);
- Procuring the air monitoring instrumentation required and performing air monitoring for investigative activities;
- Procuring and distributing the PPE and safety equipment needed for this project for AECOM employees;
- Verifying that PPE and health and safety equipment used by AECOM is in good working order;
- Verifying that AECOM subcontractors have a written HASP, workers are trained in accordance with the requirements of this HASP and that subcontractors are prepared with the PPE and other safety equipment required for this project;
- Preparing an initial THA with the FTL during the initial mobilization and revising the THA if conditions or tasks change and communicating with all workers the results of the THA;
- Notifying the FOM or CM of all noncompliance situations and stopping work in the event that an immediate danger situation is perceived;

- In coordination with the FOM and CM, the SSO will determine emergency evacuation routes for each work site and post local emergency telephone numbers as appropriate;
- Ensure that all site personnel and visitors have received the proper training and medical clearance prior to conducting field work;
- Establish any necessary controlled work areas (as designated in this HASP or other safety documentation) or delegate this responsibility to a FTL;
- Conducting accident/incident investigations and preparing accident/incident investigation reports;
- Review and approval of THAs prior to field team initiating work and incorporate THA issues into the pre-entry and tailgate meetings, Conducting the pre-entry briefing prior to beginning work and subsequent tailgate safety meetings and maintain attendance logs and records;
- Discuss potential health and safety hazards with the CM, FOM, TL/PM, and the POM as necessary and appropriate.
- Initiating emergency response procedures in accordance with **Section 13.0** of this HASP; and selecting an alternate SSO by name and inform him/her of their duties, in the event that the SSO must leave or is absent from the site. The alternate SSO must be approved by the FOM and PM.

3.2.7 AECOM District Safety, Health & Environment Manager

The AECOM DSHEM (Mike Grasso) is the individual responsible for the preparation, interpretation and modification of this HASP. Modifications to this HASP which might result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the DSHEM. Specific duties of the DSHEM include:

- Writing, approving and amending the HASP for this project;
- Reviewing for acceptance subcontractors HASP and THAs for the project;
- Advising the PM and field team on matters relating to health and safety on this site;
- Recommending appropriate PPE and respiratory equipment to protect personnel from potential site hazards;
- Facilitating Incident investigations;
- Maintaining regular contact with the PM, SSO, and field team to evaluate site conditions and new information which might require modifications to the HASP; and
- Conducting random project audits.

3.2.8 AECOM Field Personnel

All AECOM field personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner.

Some of the specific responsibilities of the field personnel associated with this project are discussed below.

Responsibilities of employees associated with this project include:

- Understanding and abiding by AECOM policies and procedures as well as those specified in the HASP;

- Communication of H&S concerns, verifying issues that may be unclear and providing feedback to management relating to possible omissions or suggested modifications in the HASP or other safety policies;
- Notifying the SSO verbally and in writing (if necessary) of unsafe conditions and acts;
- Prepare H&S observation forms as necessary and appropriate and communicate them to the project team and H&S management; and,
- As part of their oversight duties, AECOM personnel shall be responsible for observing site personnel for at-risk behavior and work areas for unsafe conditions. At-risk-behavior of individuals or unsafe conditions shall be promptly reported to the contractor's supervisory personnel who is in charge of the activity or personnel. The at-risk-behavior or unsafe condition and action taken by the responsible party shall be documented.

The health and safety authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work authority when the employee feels that the work is unsafe (including subcontractors or team contractors), or where specified safety precautions are not adequate or fully understood;
- The right to refuse to work on any site or operation where the safety procedures specified in this HASP or other safety policies are not being followed; and,
- The right to contact the SSO, CM, POM, TL/PM and/or the RHSM at any time to discuss potential concerns.

3.2.9 AECOM Subcontractors

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in [S3NA-213-PR Subcontractors](#). Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required PPE and all required training.

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior to the start of onsite activities, if required.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM CM or the FOM prior to beginning work operations. The AECOM personnel are to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

Some of the specific responsibilities of the subcontractors are as follows

- Provide AECOM with a copy of the contractor's site specific HASP and THA/JSAs;
- Provide AECOM with documentation that employees have the safety and health training and qualifications as specified in this document ;

- Attending the required pre-entry briefing prior to beginning on-site work and any subsequent safety meetings that are conducted during the implementation of the program;
- Conduct daily toolbox safety talks with their crew or participate/collaborate with AECOM pre-entry and daily safety meetings;
- Ensuring that their equipment is in good working order via daily inspections;
- Perform daily safety inspections of the work area;
- Operating their equipment in a safe manner;
- Appointing a competent person to interface with the AECOM FTL and/or SSO;
- Providing AECOM with copies of MSDS for all hazardous materials brought on-site; and,
- Reporting all incidents that result in injury and/or loss of equipment or damage to property immediately to AECOM after providing or obtaining appropriate medical and emergency assistance.

AECOM subcontractor(s) are required to provide their own site-specific SH&E documentation or provide a written statement of adoption of the provisions in AECOM's project SH&E documentation. Note that if the AECOM project SH&E documentation does not cover the scope required for the subcontractor's activities, the subcontractor cannot adopt AECOM's HASP and must provide their own site-specific SH&E documentation.

3.2.10 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the site will be briefed by the CM or the SSO on the hazards present at that location. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training and PPE which are required for entry to any controlled work area; visitors must comply with these requirements. Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

4.0 Chemical Hazard Assessment and Control

4.1 Chemical Contaminants of Concern

The predominant contaminants of concern associated with the Hudson County Chromium sites are hexavalent chromium and trivalent chromium. Semi-Volatile Organic Compounds ("SVOCs"), including Polycyclic Aromatic Hydrocarbons ("PAHs"), Volatile Organic Compounds ("VOCs"), Polychlorinated Biphenyls (PCBs), pesticides, and other metals may be present at program sites at concentrations exceeding direct contact standards.

4.1.1 Metals

Target Analyte List ("TAL") metals consist of twenty-three metals:

silver ("Ag"),	chromium ("Cr"),	nickel ("Ni"),
aluminum ("Al"),	copper ("Cu"),	lead ("Pb"),
arsenic ("As"),	iron ("Fe"),	antimony ("Sb"),
barium ("Ba"),	mercury ("Hg"),	selenium ("Se"),
beryllium ("Be"),	potassium ("K"),	thallium ("Tl"),
cadmium ("Cd"),	magnesium ("Mg"),	vanadium ("V"),
calcium ("Ca"),	manganese ("Mn"),	zinc ("Zn").
cobalt ("Co"),	sodium ("Na"),	

Selected information is presented below:

Antimony is a silvery-white metal that is found in the earth's crust. Antimony ores are mined and then mixed with other metals to form antimony alloys or combined with oxygen to form antimony oxide. Antimony is found naturally in the environment. The general population is exposed to low levels of it every day, primarily in food, drinking water, and air. Workers in industries that process it or use antimony ore may be exposed to higher levels.

Exposure to antimony at high levels can result in a variety of adverse health effects. Inhaling high levels for a long time can irritate eyes and lungs and can cause heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers. Antimony can irritate the skin if it is left on it.

Ingesting large doses of antimony can cause vomiting. Other effects that may be caused by ingesting antimony are not known. Long-term animal studies have reported liver damage and changes in blood chemistry when animals ingested antimony.

OSHA has set an occupational exposure limit of 0.5 milligrams of antimony per cubic meter of air (0.5 mg/m³) for an 8-hour workday, 40-hour workweek. The American Conference of Industrial Hygienists ("ACGIH") and National Institute for Occupational Safety and Health ("NIOSH") currently recommend the same guidelines for the workplace as OSHA.

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. Inorganic

arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

Inhaling high levels of inorganic arsenic can produce a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet. Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as inorganic arsenic. Skin contact with inorganic arsenic may cause redness and swelling.

OSHA has set a limit of 10 micrograms arsenic per cubic meter of workplace air (10 micrograms per cubic meter or $\mu\text{g}/\text{m}^3$) for 8 hour shifts and 40 hour work weeks.

Beryllium is a hard, grayish metal. In nature, beryllium can be found as compounds in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and purified for use in electrical parts, machine parts, ceramics, aircraft parts, nuclear weapons, and mirrors. Beryllium compounds have no particular smell.

The inhalation of beryllium-containing dusts is harmful. The health effects depend on the amount and length of exposure. High levels of beryllium in air can cause lung damage and a disease that resembles pneumonia. Some people become hypersensitive to beryllium. These individuals develop an inflammatory reaction to low levels of beryllium. This condition is called chronic beryllium disease, and can occur long after exposure to small amounts of beryllium. Symptoms of the disease are feeling weak and tired, and difficulty in breathing. Both the short-term, pneumonia-like disease and the chronic beryllium disease can cause death.

Swallowing beryllium has not been reported to cause effects in humans because very little beryllium can be transported from the stomach and intestines into the bloodstream. Beryllium contact with scraped or cut skin can cause rashes or ulcers.

The Department of Health and Human Services ("DHHS") has determined that beryllium and certain beryllium compounds may reasonably be anticipated to be carcinogens. This determination is based on animal studies and studies in workers. None of the studies provide conclusive evidence, but when taken as a whole, they indicate that long-term exposure to beryllium in the air results in an increase in lung cancer.

OSHA sets a limit of 2 micrograms of beryllium per cubic meter of workroom air ($2 \mu\text{g}/\text{m}^3$) for an 8-hour work shift.

Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics.

Inhaling high levels of cadmium can severely damage the lungs and can cause death. Eating food or drinking water with very high levels can severely irritate the stomach, leading to vomiting and

diarrhea. Long-term exposure to lower levels of cadmium in air, food, or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects are lung damage and fragile bones. It is unknown if humans develop any of these diseases from ingesting (eating or drinking) cadmium. There are no known health effects from dermal contact with cadmium in humans or animals.

OSHA limits workplace air to 100 micrograms cadmium per cubic meter ($100 \mu\text{g}/\text{m}^3$) as cadmium fumes and $200 \mu\text{g}/\text{m}^3$ as cadmium dust.

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. Chromium is present in the environment in several different forms. The most common forms are chromium (0), trivalent (or chromium (III)), and hexavalent (or chromium (VI)). Chromium (III) occurs naturally in the environment and is an essential nutrient required by the human body to promote the action of insulin in body tissues so that sugar, protein, and fat can be used by the body.

Chromium (VI) and chromium (0) are generally produced by industrial processes. No known taste or odor is associated with chromium compounds. The metal chromium, which is the chromium (0) form, is a steel-gray solid with a high melting point. It is used mainly for making steel and other alloys. The naturally occurring mineral chromite in the chromium(III) form is used as brick lining for high-temperature industrial furnaces, for making metals and alloys (mixtures of metals), and chemical compounds. Chromium compounds, mostly in chromium (III) or chromium (VI) forms, produced by the chemical industry are used for chrome plating, the manufacture of dyes and pigments, leather tanning, and wood preserving. Smaller amounts are used in drilling mud, rust and corrosion inhibitors, textiles, and toner for copying machines.

The health effects resulting from exposure to chromium (III) and chromium (VI) are fairly well described in the scientific literature. In general, chromium (VI) is more toxic than chromium (III). Breathing in high levels ($>2 \mu\text{g}/\text{m}^3$) of chromium (VI), such as in a compound known as chromic acid or chromium (VI) trioxide, can cause irritation to the nose, such as runny nose, sneezing, itching, nosebleeds, ulcers, and holes in the nasal septum. These effects have primarily occurred in factory workers who make or use chromium (VI) for several months to many years. The OSHA Permissible Exposure Limit ("PEL") for hexavalent chromium is 5 micrograms per meter cubed (" $\mu\text{g}/\text{m}^3$ ") as an 8-hour, time-weighted average ("TWA₈").

Lead is a potent, systemic poison that serves no known useful function once absorbed by the human body. When taken in large enough doses, lead can lead to death in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from respiratory arrest. A short-term dose of lead can lead to acute encephalopathy. Short-term occupational exposures of this magnitude are highly unusual, but not impossible. However, similar forms of encephalopathy may arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects, which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

Chronic overexposure to lead may result in severe damage to the body's ability to form blood, resulting in nervous, urinary and reproductive system problems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. Lead colic can

cause severe abdominal pain. Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents, either one or both of whom were exposed to excess lead levels, are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood. Overexposure to lead also disrupts the blood-forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

The PEL set by the standard is 50 micrograms of lead per cubic meter of air (50 ug/ m^3), averaged over an 8-hour workday. In addition to the PEL OSHA has established an action level for lead. The action level is 30 micrograms of lead per cubic meter of air (30 ug/ m^3), averaged over an 8-hour workday. The action level triggers several ancillary provisions of the OSHA standard (29 CFR 1926.62) such as exposure monitoring, medical surveillance, and training.

Mercury is a naturally occurring metal, which has several forms. Metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas. Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methyl mercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methyl mercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

The nervous system is very sensitive to all forms of mercury. Methyl mercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

OSHA has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

Inorganic mercury wastes, generated from coal-burning power plants, may be deposited in a water body where anaerobic bacteria in the detritus of the floor convert the inorganic mercury into methyl mercury. Because of this, methyl mercury has become concentrated in the natural food webs, poisoning fish and shellfish. As such, the primary route of exposure to methyl mercury is via the oral route due to ingestion of contaminated foods.

Methyl mercury produces a much more devastating human illness than elemental mercury, affecting primarily the central nervous system, including the brain, with many disturbances including paralysis, constriction of the visual fields or tunnel vision and blindness. Severe poisoning may produce irreversible brain damage resulting in loss of higher functions. Methyl mercury is also extremely dangerous to the developing fetus. Children exposed to methyl mercury *in utero* are born with severe developmental effects including impaired motor and mental function, hearing loss and blindness.

From an occupational standpoint, the primary concern is direct dermal contact with methyl mercury since it can be directly absorbed through the skin and causes the same systemic effects described above. The OSHA PEL for organic mercury is 0.01 mg/m³.

Nickel is a very abundant natural element. Pure nickel is a hard, silvery-white metal. Nickel can be combined with other metals, such as iron, copper, chromium, and zinc, to form alloys. These alloys are used to make coins, jewelry, and items such as valves and heat exchangers. Most nickel is used to make stainless steel.

The most common harmful health effect of nickel in humans is an allergic reaction. Approximately 10 to 15% of the population is sensitive to nickel. People can become sensitive to nickel when jewelry or other things containing it are in direct contact with the skin. Once a person is sensitized to nickel, further contact with the metal will produce a reaction. The most common reaction is a skin rash at the site of contact. The skin rash may also occur at a site away from the site of contact. Less frequently, some people who are sensitive to nickel have asthma attacks following exposure to nickel. Some sensitized people react when they eat nickel in food or water or breathe dust containing it.

Workers employed in nickel refineries or nickel-processing plants inhale greater levels of nickel than found in the environment. As a result, these same workers have experienced chronic bronchitis and reduced lung function. Workers who ingested water containing high amounts of nickel had stomach aches and suffered adverse effects to their blood and kidneys. Cancers of the lung and nasal sinus have resulted when workers inhaled dust containing high levels of nickel compounds while working in nickel refineries or nickel processing plants.

To protect workers, OSHA has set a limit of 1 milligram of nickel per cubic meter of air (1 mg/m³) for metallic nickel and nickel compounds in workplace air during an 8-hour workday, 40-hour work week.

Thallium is a bluish-white metal that is found in trace amounts in the earth's crust. In the past, thallium was obtained as a by-product from smelting other metals. In its pure form, thallium is odorless and tasteless. It can also be found in combination with other elements such as bromine, chlorine, fluorine, and iodine. When combined with these other elements, thallium can appear colorless-to-white or yellow.

Exposure to high levels of thallium can result in harmful health effects. A study on workers exposed on the job over several years reported nervous system effects, such as numbness of fingers and toes, from inhaling thallium. Human studies reported vomiting, diarrhea, temporary hair loss, and effects on the nervous system, lungs, heart, liver, and kidneys for those who ingested large amounts of thallium over a short time have. Thallium-related deaths have occurred. The effects from ingesting low levels of thallium over a long time are not known. There is no information available on the health effects of skin contact with thallium in people or animals.

OSHA has set an exposure limit of 0.1 milligrams per cubic meter (0.1 mg/m³) for thallium in workplace air. The ACGIH has established the same guidelines as OSHA for the workplace

Vanadium is a compound that occurs in nature as a white-to-gray metal, and is often found as crystals. Pure vanadium has no smell. It usually combines with other elements such as oxygen, sodium, sulfur, or chloride. Vanadium and vanadium compounds can be found in the earth's crust and in rocks, some iron ores, and crude petroleum deposits. Vanadium is commonly combined with other metals to make special metal mixtures called alloys. Vanadium in the form of vanadium oxide is combined in special kinds of steel that is used for automobile parts, springs, and ball bearings. Most of the vanadium used in the United States is used to make steel. Vanadium oxide is a yellow-orange powder, dark-gray flakes, or yellow crystals. Vanadium is also mixed with iron to make important parts for aircraft engines. Small amounts of vanadium are used in making rubber, plastics, ceramics, and other chemicals.

Exposure to high levels of vanadium can cause harmful health effects. Inhaling high levels of vanadium may affect the lungs, throat, and eyes. Workers who inhaled vanadium for short and long durations showed one or more of the following symptoms: lung irritation, coughing, wheezing, chest pain, runny nose, and/or sore throat. These symptoms stopped soon after they stopped inhaling the vanadium contaminated air. Similar effects have been observed in animal studies. No other significant health effects of vanadium have been found in humans.

OSHA has set an exposure limit of 0.05 milligrams per cubic meter (0.05 mg/m³) for vanadium pentoxide dust and 0.1 mg/m³ for vanadium pentoxide fumes in workplace air for an 8-hour workday, 40-hour workweek.

Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal. Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. A zinc and copper alloy is used to make pennies in the United States.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments. Zinc is an essential element in our diet. Too little zinc can cause health problems; however, too much zinc is also harmful.

Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. If taken for an extended period, it can cause anemia and decrease levels of good cholesterol in humans. Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. The long-term effects of inhaling high levels of zinc are not known. Placing low levels of certain zinc compounds on the skin of rabbits, guinea pigs, and mice caused skin irritation. It is likely that dermal contact on humans would also produce skin irritation.

To protect workers, OSHA has set an average limit of 1 mg/m³ for zinc chloride fumes and 5 mg/m³ for zinc oxide (dusts and fumes) in workplace air during an 8-hour workday, 40-hour workweek.

4.1.2 Miscellaneous Inorganics

Cyanide is usually found joined with other chemicals to form compounds. Examples of simple cyanide compounds are hydrogen cyanide, sodium cyanide and potassium cyanide. Certain bacteria, fungi, and algae can produce cyanide, and cyanide is found in a number of foods and plants. In certain plant foods, including almonds, millet sprouts, lima beans, soy, spinach, bamboo shoots, and cassava roots (which are a major source of food in tropical countries), cyanides occur

naturally as part of sugars or other naturally-occurring compounds. However, the edible parts of plants that are eaten in the United States, including tapioca which is made from cassava roots, contain relatively low amounts of cyanide.

Hydrogen cyanide is a colorless gas with a faint, bitter, almond-like odor. Sodium cyanide and potassium cyanide are both white solids with a bitter, almond-like odor in damp air. Cyanide and hydrogen cyanide are used in electroplating, metallurgy, organic chemicals production, photographic developing, manufacture of plastics, fumigation of ships, and some mining processes.

Persons are not likely to be exposed to large enough amounts of cyanide in the environment to cause adverse health effects. The severity of the harmful effects following cyanide exposure depends in part on the form of cyanide, such as hydrogen cyanide gas or cyanide salts. Exposure to high levels of cyanide for a short time harms the brain and heart and can even cause coma and death. Workers who inhaled low levels of hydrogen cyanide over a period of years had breathing difficulties, chest pain, vomiting, blood changes, headaches, and enlargement of the thyroid gland.

Some of the first indications of cyanide poisoning are rapid, deep breathing and shortness of breath, followed by convulsions (seizures) and loss of consciousness. These symptoms can occur rapidly, depending on the amount eaten. The health effects of large amounts of cyanide are similar, whether it is injected or inhaled. Cyanide can enter the body through dermal contact; however, the exposure rate is slower than the other means of exposure. Dermal contact with hydrogen cyanide or cyanide salts can irritate the skin and produce sores.

OSHA has set a limit for hydrogen cyanide and most cyanide salts of 10 parts cyanide per 1 million parts of air (10 ppm) in the workplace.

Cyanide wastes at MGP sites exist mostly as stable iron cyanide complexes, such as ferric ferrocyanide, which are associated with oxide box wastes common to coal gas sites. A small percentage (< 5%; Luthy et al. 1994) of the total cyanide-containing waste is in the form of less stable metallo-cyanides and cyanide salts. The release of cyanide to air at MGP sites is theoretically possible, but because such releases would occur from very slow dissociation of iron cyanides followed by rapid volatilization and dissipation, this is unlikely to be an exposure issue. Thus, the reported effects of free cyanide are not applicable. Neither OSHA nor the ACGIH have established exposure limits for ferrocyanide.

4.1.3 Total Volatile Organic Compounds ("TVOCs")

The TVOCs include benzene, toluene, ethylbenzene, and xylenes ("BTEX"). Exposure to the vapors of BTEX above their respective OSHA PELs may produce irritation of the mucous membranes of the upper respiratory tract, nose and mouth. Overexposure may also result in the depression of the central nervous system. Symptoms of such exposure include drowsiness, headache, fatigue and drunken-like behaviors. Prolonged overexposure to benzene vapors has detrimental effects on the blood-forming system ranging from anemia to leukemia.

The PEL for benzene is 1 ppm, as TWA₈. The OSHA PEL for ethylbenzene is 100 ppm. The PEL for toluene is 200 ppm. Xylene is a flammable, colorless liquid with an OSHA PEL of 100 ppm as an 8-hour TWA. Inhaling xylene vapors above the PEL may result in motor activity changes, irritability and drunken-like behaviors. Xylene vapors are also irritating to the eye.

4.1.4 Semi Volatile Compounds

PAHs are a subgroup of SVOCs that may be formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale, yellow-green solids. PAHs are found in coal tar, crude oil, creosote, asphalt sealcoat, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides. Some properties of PAHs are listed below:

- PAHs can occur in air attached to dust/soot particles.
- PAHs may enter soil and groundwater through discharges from industrial facilities.
- Most PAHs do not dissolve readily in water. They adsorb to solid particles and may settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or groundwater; however, this is a slow process, and most PAHs are considered to be persistent in the environment.
- In soils, PAHs are most likely to adsorb to particles, although certain PAHs move through soil to contaminate groundwater.
- The concentration of PAHs in plants and animals may be much higher than concentration of PAHs in the soil or water in which they live.

OSHA has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m³) including anthracene, benzo(a)pyrene, phenanthrene, chrysene and pyrene.

Naphthalene is a byproduct of coal gasification associated with MGP wastes. Naphthalene is a black, viscous liquid or semi-solid with a strong odor (mothball) and sharp, burning taste.

Exposure to large amounts of naphthalene may damage or destroy some red blood cells. This could cause a reduced level of red blood cells until the body replaces the destroyed cells. This condition is called hemolytic anemia. Some symptoms of hemolytic anemia are fatigue, lack of appetite, restlessness, and pale skin. Exposure to large amounts of naphthalene may also cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. Animals sometimes develop cloudiness in their eyes after swallowing high amounts of naphthalene. It is not clear whether this symptom also develops in humans. Rats and mice exposed to naphthalene vapors daily for a lifetime developed irritation and inflammation of their nose and lungs. The International Agency for Research on Cancer (IARC) concluded that naphthalene is possibly carcinogenic to humans.

OSHA set a limit of 10 ppm for the level of naphthalene in workplace air during an 8-hour workday, 40-hour workweek.

Benzo(a)pyrene, a coal tar pitch volatile, is a polynuclear aromatic hydrocarbon which forms yellowish crystals melting at 179°C. Synonyms are 3,4-Benz(a)pyrene or B[a]P. Benzo(a)pyrene is a polycyclic aromatic hydrocarbon (PAH) that has no commercial-scale production.

Benzo(a)pyrene is produced in the United States by one chemical company and distributed by several specialty chemical companies in quantities from 100 mg to 5 g for research purposes. Although not manufactured in great quantity, benzo(a)pyrene is a by-product of combustion. It is estimated that 1.8 million pounds per year are released from stationary sources, with 96% coming from coal refuse piles,

outcrops, and abandoned coal mines; residential external combustion of bituminous coal; coke manufacture; and residential external combustion of anthracite coal.

Human exposure to benzo(a)pyrene can occur from its presence as a by-product of chemical production. The number of persons exposed is not known. Persons working at airports in tarring operations, refuse incinerator operations, power plants, and coke manufacturers may be exposed to higher benzo(a)pyrene levels than the general population. Scientists involved in cancer research or in sampling toxic materials may also be occupationally exposed. The general population may be exposed to benzo(a)pyrene from air pollution, cigarette smoke, and food sources. Benzo(a)pyrene has been detected in cigarette smoke at levels ranging from 0.2 to 12.2 ug per 100 cigarettes. Benzo(a)pyrene has been detected at low levels in foods ranging from 0.1 to 50 ppb.

The PEL is 0.2 mg/m^3 and the REL is 0.1 mg/m^3 . ACGIH has designated benzo(a)pyrene as an industrial substance suspect of carcinogenic potential for man, with no TWA value set.

Harmful effects and symptoms of benzo(a)pyrene are potential local and systemic carcinogenic effects. Coal-tar and other materials which are known to be carcinogenic to man may contain benzo(a)pyrene. A 1% solution applied to the skin caused skin irritation, swelling, flaking, coloration of skin, and formation of warts.

Level C, with a combination HEPA, acid gas, and organic vapor cartridge, can be used up to 2 mg/m^3 . Above this value, level B is required. Determination in air is via collection of PTFE filter and XAD-2 adhering to NIOSH Methods 5506 or 5515.

4.1.5 Polychlorinated biphenyl ("PCB")

PCBs are a series of technical mixtures, consisting of many isomers and compounds that vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins. The variability is based upon the degree of chlorination (and location of chlorine atoms) on the diphenyl rings that act as the skeleton for PCBs. The name Aroclor® 1221, 1233, 1242, 1248, 1254, 1260 etc. correspond as to the percentage that the diphenyl rings have been instituted, i.e., 21%, 33%, 42%, etc. The most commonly encountered PCBs are chlorodiphenyl (42% chlorine) [Aroclor® 1242] and chloridiphenyl (54% chlorine) [Aroclor® 1254]. These compounds are light, straw-colored liquids with typical chlorinated aromatic odors; 42% chlorodiphenyl is a mobile liquid and 54% chlorodiphenyl is a viscous liquid. Chlorodiphenyl (42% chlorine) boils between 617° and 691° and freezes at -2°F . Chlorodiphenyl (54% chlorine) boils between 689° and 734°F and freezes at 50°F . The synonyms for PCBs are chlorodiphenyls, Aroclors, and Kanechors. Names further defining PCBs, based upon chlorine substitution are Aroclor® 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268, 2565, 4465, 5442, 5460 and Kanechlor 300, 400, 500. PCBs are incompatible with strong oxidizers.

PCBs are used alone and in combination with chlorinated naphthalenes. They are stable, thermoplastic, and nonflammable, and find chief use in insulation for electric cables and wires, in the production of electric condensers, as additives for extreme pressure lubricants, and as a coating in foundry use. PCBs are one member of a class of chlorinated aromatic organic compounds which are of increasing concern because of their apparent ubiquitous dispersal, persistence in the environment, and tendency to accumulate in food chains, with possible adverse effects on animals at the top of food webs, including man. The OSHA PEL and ACGIH TLV are 1 mg/m^3 for chlorodiphenyl 42% Cl and 0.5 mg/m^3 for 54% Cl. The NIOSH REL for both 42% and 54% are 0.001 mg/m^3 . The IDLH level is 5 mg/m^3 .

Routes of entry are via inhalation of fume or vapor and percutaneous absorption of liquid, ingestion, eye and skin contact. Harmful effects from short term exposure are as follows:

Inhalation - May produce irritation to nose, throat, and lungs. Levels above 10 mg/m³ are reported to be unbearable. Inhalation may contribute significantly to all symptoms of long term exposure.

Skin - Absorption is moderate. Contributes significantly to all symptoms of long term exposure. Sensitized individuals may develop a rash after 2 days exposure by contact or inhalation.

Eyes - May produce irritation. Levels of 10 mg/m³ are severely irritating.

Ingestion - Absorption in the digestive system contributes significantly to all symptoms of long term exposure. There are no reported deaths of humans due to a single ingestion. However, experiments in animals suggest that ingestion of 6 to 10 fluid ounces would cause death to a healthy 150 pound adult.

Long term exposure to PCBs at high levels of 1 to 10 mg/m³ may produce a burning feeling in the eyes, nose and face; dry throat; lung and throat irritation; nausea, dizziness, chloracne, and the aggravation of existing acne. Liver damage and digestive disturbance have been reported in some individuals. OSHA has identified PCBs as a dermal carcinogen. PCBs may impair the function of the immune system. PCBs at high levels have been shown to produce cancer and birth defects in laboratory animals. Whether PCBs produce these effects in humans is not known.

North and MSA do not approve the use of APRs for protection against 42% and 54% chlorodiphenyl as a Determination in air is via collection on a particulate filter or with a florasil tube, adhering to NIOSH Method 5503 for PCBs' vapor. However, if it is a particulate concern via adhering to soil, level C with HEPA filters can be used.

4.1.6 Pesticides

Pesticides such as Chlordane, DDT, Lindane, and Toxaphene are found as solids incorporated into soil, dissolved in petroleum products, or in very dilute concentrations in ground water. These chemicals are essentially insoluble in water unless significant amounts of other organics are dissolved in the water. Most pesticides are soluble in both chlorinated and petroleum solvents. If contaminated dusts are present use air purifying respirators with HEPA filters and goggles or a full face respirator. DDT can be absorbed into the body by skin contact or ingestion; thoroughly wash exposed skin prior to leaving the work site.

Dieldrin and **Aldrin** are also known as HEOD, Compound 497, and Octalox. Dieldrin is a light tan-to-brown powder. It is used as an insecticide, and is also formed from aldrin in the environment. Exposure may produce dizziness, sweating, jerks of the limbs, and convulsions. It is a neurotoxin. The half-life of dieldrin in humans is reported to be as long as 9 months. Dieldrin may be an animal carcinogen, but cancer has not been proven in humans. The 8-hour PEL for Dieldrin is 0.25 mg/m³. Pure Dieldrin is corrosive to skin and eyes, the chemical can cause severe respiratory tract, eye and skin burns. If ingested, Dieldrin may cause severe digestive tract irritation with possible burns. Dieldrin can be absorbed through the skin.

4.1.7 Concrete Dust

During the demolition of concrete foundations construction workers have a potential exposure to crystalline silica. Operations such as dumping of rock, jack hammering, abrasive blasting, sawing, drilling or demolition of concrete and masonry structures are some of the activities that could produce this exposure.

Crystalline silica (quartz) is a common mineral found in the earth's crust and is found in many types of rock including sedimentary, metamorphic or igneous. Silica is present in both work and non-work environments, and exposure to crystalline silica dust has long been known to cause a disease called silicosis. When crystalline silica is inhaled, the lung tissue reacts by developing fibrous tissue around trapped silica particles.

This condition of the lung is called silicosis. Dust containing the crystalline forms of silica particles small enough to enter the deep parts of the lung can cause "silicosis", which is a scarring of the lung tissues, cancer and other forms of lung disease, including an increased risk of getting tuberculosis. The effects of silicosis can be undetected for several years before the problem is known. Elevated exposures can produce health problems sooner. At first, there may be no symptoms of disease, and then shortness of breath, fatigue, severe cough and chest pain can develop later on. Silicosis cannot be reversed and requires a lung transplant in advanced stages. Therefore, minimizing exposure to crystalline silica is the best prevention for silicosis.

Routes of exposure include contact and inhalation. Concrete dust exposure in the eyes may cause immediate or delayed irritation and inflammation. Skin contact with concrete dusts may cause drying of the skin with consequent mild irritation. Inhaling concrete dust may irritate the moist mucous membranes of the nose, throat and upper respiratory system.

4.2 Chemical Exposure and Control

4.2.1 Chemical Exposure Potential

Soils and groundwater at program sites have the potential to be significantly impacted with the contaminants of concern and the potential for exposure to the contaminants is considered to be moderate to high depending on the site location and site task being performed. All employees must be prepared to don protective clothing and respiratory protection should engineering controls be insufficient to reduce dust and/or vapor levels during the implementation of subsurface investigations.

The inhalation of dusts is the primary potential route of exposure during the implementation of IRMs and FS activities by PPG's contractor. The potential for dust generation will be managed through the implementation the Dust Control Plan ("DCP") which is part of the IRMWPs#1 and IRMWPs#2. A robust DCP has been submitted to NJDEP under separate cover that provides information regarding activities with the potential to generate dust during the on-site activities, and the proposed techniques to control same. The use of protective clothing and respiratory protection by AECOM personnel may be necessary if the dust action levels are exceeded and engineering controls are insufficient to reduce the dust levels to below the action limit. If truck traffic is anticipated to occur over unpaved or unvegetated soil areas that would result in loose dirt and visible dust, AECOM will evaluate the need for additional dust control measures. Typical best management practices to control dust may include spraying of water or foam, or the use of plastic over uncovered roadways for access over unpaved and/or unvegetated areas.

The vapor pressures of the volatile organic compounds found in MGP wastes are not high enough to generate a potential vapor hazard during typical IRM activities, such as those planned for this project. However, the inhalation of dusts impacted with VOC compounds will be a potential concern, especially during activities that have a potential to generate dust. The BTEX compounds associated with MGP wastes are volatile enough that the inhalation of vapors may be of concern if coal tars are encountered.

Direct dermal contact with impacted soils is another potential route of exposure during the collection of samples or other intrusive activities.

Although unlikely, exposure to all of the contaminants of concern can occur via ingestion (hand-to-mouth transfer). The decontamination procedures described in **Section 12.0** address personal hygiene issues that will limit the potential for contaminant ingestion.

4.2.2 Chemical Hazard Control

The chemical hazards associated with project activities and sampling activities can be controlled in several ways, including:

- Maintaining a upwind position during intrusive activities that have the potential to generate dust;
- When conducting work in residential areas, conduct interior sampling prior to exterior sampling to minimize potential for tracking soil inside the residence;
- Containing work area with poly-sheeting;
- Limiting the number of personnel in the work area;
- Use of mists or wetting for dust control;
- Use of a HEPA vacuum to control point source dusts;
- Shrouding the chisel when chipping masonry surfaces;
- Use of personal protective equipment; and
- Following decontamination procedures.

Garfield Avenue Group Sites

A Dust Control Plan (“DCP”) will be implemented for all activities that may generate contaminated dust particles. A DCP was submitted to NJDEP under separate cover that provides information regarding remedial activities with the potential to generate dust during remedial activities at the GA group of sites. As discussed in that plan, the use of protective clothing and respiratory protection by AECOM personnel may be necessary if the dust action levels are exceeded and engineering controls are insufficient to reduce the dust levels to below the action limit. Typical best management practices to control dust may include spraying of water or foam, or the use of plastic over uncovered and/or non-vegetated surface areas.

A copy of Dust Control Plan is available to AECOM personnel at the following location:

[\\uspsw2vp001\DATA_USPSW2VFP001\Environment\Piscataway\Project\PPG-NJCProgram\7-Deliverables\7.1B-GAGroup\IRMWP-1\Appendices\Appendix C - DCP\2010_06 FINAL Dust Control Plan_FD.pdf](\\uspsw2vp001\DATA_USPSW2VFP001\Environment\Piscataway\Project\PPG-NJCProgram\7-Deliverables\7.1B-GAGroup\IRMWP-1\Appendices\Appendix C - DCP\2010_06 FINAL Dust Control Plan_FD.pdf)

4.2.3 Hazard Communication

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item’s MSDS to the SSO for review and filing (the SSO will maintain copies of all MSDS on site, communicate the information to the Project Team and make sure that copies are transferred electronically to the Piscataway file server for the project). MSDS may not be available for locally-obtained products, in which case some alternate form of product hazard documentation will be acceptable in accordance with the requirements of [S3NA-507-PR Hazardous Materials Communication/WHMIS](#).

All personnel shall be briefed on the hazards of any chemical product they use, and shall be aware of and have access to all MSDS.

All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

5.0 Biological and Other Hazard Control

During the course of field work employees are at risk of being exposed to poisonous plants, insects, spiders and snakes. The two most prevalent biological hazards are poison ivy and ticks. Additional information on Biological Hazards can be found in [S3NA-313-PR Wildlife, Plants and Insects](#).

5.1 Poison Ivy

Poison ivy is a common cause of a skin irritation called contact dermatitis that may result in a red, itchy rash consisting of small bumps, blisters or swelling. This native perennial grows throughout the Northeast, in woods, fields, and sometimes in the garden. It grows in sun or shade, and in wet or dry places. Its growth habit depends on where it is growing, resulting in a trailing ground cover, free-standing shrub, or a vine supported by trees, shrubbery and fences. All parts of the poison ivy plant contain, urushiol, which causes the allergic reaction. Most poisonings occur during the growing season when the presence of lush foliage increases the chance of contact, but the dormant stems and roots of the vine can cause winter poisoning as well.

The best protection against poison ivy is to avoid contact with the plant (leaves, stems and roots). The best defense against contracting poison ivy is to recognize the plants. The adage “leaves of three, let it be” refers to the groupings of three leaflets connected to a common stem that characterize most of these plants. However, if you cannot avoid poison ivy, follow these precautions to help prevent contact:

- Wear protective clothing such as long-sleeved shirts, long trousers, boots or sturdy shoes with socks and gloves;
- Use a barrier cream such as CoreTex IvyX™ Pre-Contact solution; and
- If heat stress will not be a problem the use of a Tyvek™ coveralls and nitrile gloves is recommended for areas with heavy poison ivy infestation.

If contact with poison ivy has been made or is suspected, follow these guidelines:

- As soon as possible (within 5–10 minutes of contact), wash all exposed skin with strong soap (i.e. Dawn) and water to remove the oil. If this is not possible, rinse thoroughly with water.
- Use a post-contact skin cleanser such as Technu® skin cleanser or CoreTex IvyX™ cleanser towelettes.
- Put on gloves to remove clothes and shoes, and wash clothing in hot water and detergent to remove any plant oil that may be on them.
- Notify your supervisor if contact or suspected contact is made with poison ivy.
- If a severe allergic reaction develops, seek medical attention.

5.2 Ticks

Ticks transmit bacteria that cause illnesses such as Lyme disease or Rocky Mountain spotted fever. Ticks wait for a host from the tips of grasses and shrubs (not from trees). When brushed by a person, they quickly let go of the vegetation and climb onto the host. Ticks can only crawl; they cannot fly or jump. The tick season typically lasts from April through October; peak season is May through July;

seasons can vary depending on climate. Ticks can be active on winter days when the ground temperatures are about 45° Fahrenheit.

The best way to protect oneself against tick borne illness is to avoid tick bites. This includes avoiding known tick-infested areas. However, if wooded areas or areas with tall grass and weeds are visited, the following precautions can be used to help prevent tick bites and decrease the risk of disease:

- Wear protective clothing such as long-sleeved shirts, long trousers, boots or sturdy shoes and a head covering. (Ticks are easier to detect on light-colored clothing).
- Tuck trouser cuffs in socks. Tape the area where pants and socks meet so ticks cannot crawl under clothing.
- Apply insect repellent containing 10 percent to 30 percent N,N-Diethyl-meta-toluamide ("DEET") or 5 percent to 10 percent picaridin primarily to clothes. Apply sparingly to exposed skin. Do not spray directly to the face; spray the repellent onto hands and then apply to face. Avoid sensitive areas like the eyes, mouth and nasal membranes. Be sure to wash treated skin after coming indoors.
- Use repellents containing permethrin to treat clothes (especially pants, socks and shoes) but not skin. Always follow label directions; do not misuse or overuse repellents.
- Those who wish to avoid the use of insect repellent or treated clothing should consider the use of the Original Bug Shirt® and pants, and tick/chigger garters.
- Personnel should carefully inspect themselves each day for the presence of ticks or any rashes. This is important since prompt removal of the tick can prevent disease transmission. Removal of the tick is important in that the tick should not be crushed and care must be taken so that the head is also removed. Contact the RSHEM for guidelines on removing ticks.
- Report tick exposure and bites to your supervisor.

5.3 Wasp and Bees

Wasps (hornets and yellow-jackets) and bees (honeybees and bumblebees) are common insects that may pose a potential hazard to the field team if work is performed during spring, summer or fall. Bees normally build their nests in the soil. However, they use other natural holes such as abandoned rodent nests or tree hollows. Wasps make a football-shaped, paper-like nest either below or above the ground. Yellow-jackets tend to build their nests in the ground but hornets tend to build their nests in trees and shrubbery.

To avoid bees and wasps:

- If you see insects flying to and from a particular place, avoid it.
- If you are going to be in an area where disturbing a nest is likely, wear long pants and a long sleeved shirt. Insect repellent applied to your skin or clothing will not deter these stinging insects.
- Wear light colored clothing.
- Remain as calm as possible if a bee or wasp lands on your skin.

- If you don't want to wait for it to leave, gently and slowly brush it away. It is best not to wear perfume, cologne, or other scented soaps or scented shampoos as this attracts bees and wasps.
- Never swing, strike or run rapidly away since quick movement often provokes attack and painful stings.
- Restrain from throwing rocks or spraying nests with water.
- Avoid creating loud noises and disturbance near the nest.

When a wasp or a bee stings a person, it injects a venomous fluid under the skin. The venom causes a painful swelling that may last for several days. The following should be followed to minimize the reaction of a bee or wasp sting:

- Gently scrape the area of the bite using a blunt object like a fingernail or a credit card to remove the stinger. If removed within 15 seconds of the sting, the severity of the sting is reduced.
- Try not to rub or scratch the sting site after the stinger is removed.
- Wash the sting site with soap and water.
- Apply a cold or ice pack wrapped in cloth for a few minutes.
- If you develop hives, difficulty breathing or swallowing, wheezing or similar symptoms of allergic reaction, SEEK MEDICAL ATTENTION IMMEDIATELY. People with known allergies to insect stings should NEVER work alone.
- A person with a history of severe allergic reaction to an insect sting may be advised by their physician to carry an insect sting allergy kit to counteract the allergic reaction whenever they may encounter stinging insects. Also they should consider wearing a medical ID bracelet and notify others on the field team.

5.4 Sharps

Sharps are defined for the purpose of this HASP as syringes or hypodermic needles used for the injection of legal or illegal drugs. Sharps used by intravenous drug users are capable of spreading disease such as hepatitis, skin abscesses, human immunodeficiency virus ("HIV"), endocarditis (an infection of the heart), and other diseases involving microorganisms.

While these disease are associated with needle sharing among substance abusers, persons who come into contact with sharps/dirty needles maybe at risk of developing one of these diseases, if they are accidentally punctured by a sharp.

Vigilance must be exercised when working in areas where sharp could be present. If you see a sharp leave it alone and warn others. Prior to kneeling on the ground or handling soil samples look before you kneel or handle soil. When handling soil samples it is suggested that Kevlar gloves be used under the sampling gloves. When handing equipment that is stored on the ground, it is suggested that leather work gloves be used to prevent contact with sharps. If contact is made with a sharp immediately notify your supervisor of the incident. In the event of a sharp exposure medical help and consultation with a physician will be made available to the employees.

5.5 Animals

5.5.1 Dogs

Domestic and stray dog may be encountered during field activities. To prevent possible injuries from dogs:

Prevent Contact with Dogs:

- Alert dog to your presence (whistle; honk horn; slam car door)
- Back car in
- Leave car door open
- Get back in car if there is time
- Notify police or Animal Control
- Stay in car if dog is loose or tied or behind a screen door in insecure pen
- Do not enter yard of loose or tied dog or dog in insecure pen

If Contact is Unavoidable:

- Calm the dog (let him sniff the back of your hand, drop treats)
- Stand sideways to the dog
- Stand still
- Stand quietly with head down and avoid eye contact

Defensive Action:

- Try to be still and quiet and wait for help
- Retreat slowly if dog backs off
- Never turn your back
- Don't let fearful dog get behind you
- Drop treats on the ground

If a Dog Attacks:

- Shout "NO" before he gets to you
- Feed him something - jacket; clipboard; dog bumper
- Protect face and neck
- Try to be still and quiet
- Never run away or try to fight off an attacking dog
- Notify the Animal Control

Domestic animals (dogs) will protect their territory no matter how friendly they may appear. For the safety of the domestic animal and your personal safety, the resident should be advised to secure their pets. If a domestic animal is chained outside, avoid approaching the animal or harassing it.

5.5.2 Critters

Critters (skunks, opossums, squirrel, raccoons, etc.) may be encountered especially in urban areas. Avoidance of critters is important to prevent being bitten. Prior to entering abandon buildings, crawlspace, etc., the area should be full illuminated to look for critters. If a critter is spotted and does not leave, Animal Control should be contacted for advice on relocating the critter. Entry into the crawl space should not be made until the critter leaves or is removed.

5.5.3 Rodents

Rodents such as rats and mice may be encountered during site activities. Rodents are nocturnal and avoid human contact. The illumination of an area and the presence of humans should cause rodents to scurry away. Nevertheless, personnel should avoid contact with rodents. If bitten/scratched, get medical attention immediately.

Live rodents can spread diseases (rat-bite fever, tularemia) through their urine and droppings. In addition, dead rodents can spread diseases. AECOM will not enter any rodent infested areas. These areas must be cleared and cleaned by the property owner prior to being accessed by AECOM.

5.6 Weather

5.6.1 Severe Weather

Prior to mobilization the project manager or field team personnel should be cognizant of the long range and short range weather forecast for the region in which they will be working in. If severe weather is forecasted work should be temporarily postponed until the weather is more favorable. Daily, field team members should check the weather forecast for inclement or severe weather. A weather radio or radio set on an AM channel is the best sources for weather information and weather alerts. On the internet the Storm Prediction Center's web page can be check for alerts and warnings.

<http://www.spc.noaa.gov/products/www/>.

All four seasons can bring about severe weather to the region, ranging from extremely cold temperatures to high winds and thunder and lightning storms. Hurricanes have been known to hit the northeast and while rare, tornados do occur in the northeast.

In the event of server weather is forecast the following steps should be taken:

- Temporarily stop work and secure the site.
- Seek shelter in a vehicle or safe indoor location.
- Stop all work and seek a safe area when lightning is within range of the site (by the time you hear thunder, you are ALREADY within lightning range). Safe areas include low areas (NOT subject to flash floods), grounded metal structures or vehicles. Follow the 30/30 rule: If you see lightning and cannot count to 30 before hearing thunder, stay indoors for 30 minutes after hearing the last clap of thunder.
- Shut down generators and electrical equipment in an orderly manner to protect the equipment from electrical surges and abrupt power loss.
- Move all personnel off crawler-type equipment and boom equipment. Lower booms.

When working in low areas, be alert for the potential of flash flooding and plan a route to reach higher ground.

5.6.2 Cold and Heat Stress

AECOMs Heat Stress Prevention Plan can be found in [S3NA-511-PR](#) and Cold Stress Prevention Plan can be found in [S3NA-505-PR](#). Procedures found in these plans must be implemented as necessary to prevent thermal stress.

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress.

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties.

5.6.3 Responding to Heat-Related Illnesses

The guidance below will be used in identifying and treating heat-related illness.

Table 5-1 Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • If an air-conditioned spot is available, this is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work place should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (<i>avoid drafts or sudden chilling</i>). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (<i>Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing</i>). • If the victim is conscious, it may be helpful to give him/ her sips of water. • Transport victim to a medical facility ASAP.

5.6.4 Responding to Cold-Related Illnesses

The guidance below will be used in identifying and treating cold-related illness.

Table 5-2 Identification and Treatment of Cold-Related Illness

Type of Cold-Related Illness	Description	First Aid
Frostbite	Lack of feeling in the affected area; skin that appears waxy, is cold to the touch, or is discolored (flushed, white or gray, yellow or blue).	- Move the person to a warm place. - Handle the area gently; never rub the affected area. - Warm gently by soaking the affected area in warm water (100–105 °F) until it appears red and feels warm. - Loosely bandage the area with dry, sterile dressings. - If the person's fingers or toes are frostbitten, place dry, sterile gauze between them to keep them separated. - Avoid breaking any blisters. - Do not allow the affected area to refreeze. - Seek professional medical care as soon as possible
Hypothermia	- Signs and symptoms of hypothermia include— shivering, numbness, glassy stare; apathy, weakness, impaired judgment; loss of consciousness. - A person with hypothermia usually isn't aware of his or her condition,	- CALL 9-1-1 or the local emergency number. - Gently move the person to a warm place. - Monitor breathing and circulation. - Give rescue breathing and CPR if needed. - Remove any wet clothing and dry the person. - Warm the person slowly by wrapping in blankets or by putting dry clothing on the person. Hot water bottles and chemical hot packs may be used when first wrapped in a towel or blanket before applying. Do not warm the person too quickly, such as by immersing him or her in warm water. Rapid warming may cause dangerous heart arrhythmias. Warm the core first (trunk, abdomen), not the extremities (hands, feet). This is important to mention because most people will try to warm hands and feet first and that can cause shock.

5.7 Personal Security

Field activities have the potential to take personnel into areas where criminal activities take place or where field personnel can be a crime victim. Vagrants, suspected gang members, and other criminal elements may frequent the project areas. To protect yourself: stay out of the area at night; use the buddy system; let someone in the office know when you arrive on site and when leaving; call in regularly; pay attention to what is going on around you; if it does not look safe to get out of your vehicle lock the doors and drive off quickly. Further, no site worker shall knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If site workers encounter hostile individuals within the project locations or a confrontation develops in the work area, staff will suspend activities, immediately leave the area of concern, and contact local 911 for assistance.

If field team members feel that their security is threatened by the neighborhood or activities taking place in the vicinity of a property, the field team members should not leave their vehicle, but shall lock the vehicle, drive to safe location and notify the CM or PM and, as appropriate, the police.

At a minimum, police personnel will accompany field team during night work or any environmental investigations performed on sidewalks, in roadways, or in abandoned buildings. Field team members will be equipped with a cell phone in the event of an emergency.

In general, follow the four **As**:

- Be **AWARE** of your surroundings and who or what is nearby.
- **ASSESS** the situation and possible threat.
- **ACT** quickly and decisively. Change your route, go into a store, use your voice, etc.
- Maintain a confident **ATTITUDE**. Don't appear to be an easy target.

Each two-person team must have at least one charged and otherwise functioning cell phone to facilitate emergency communications. Cellular phone operation shall be confirmed at the start, mid-point, and near the end of each working day.

As a personal security precaution AECOM may employ/request the services of a police detail from the South District Station of the Jersey City Police Department. A police detail would serve to deter crime and provide traffic control as necessary.

Safety tips from the National Crime Prevention Council are as follows:

- Stay alert in your surroundings -- make eye contact with everyone.
- Walk purposefully...head up, eyes forward.
- Carry a small amount (\$10.00 or so) of "mugger's money." Sometimes assailants become angry if they do not get anything.
- Limit your contact with strangers on the street.
- Communicate confidence, be in control of the environment and show it.
- Consider your options in the event you are confronted, e.g., scream or blow a whistle to attract attention, flee to a safe area, etc. Decide what you plan to do and practice your responses so you can recall them in a real situation.
- Don't carry a lot of cash or valuables.
- Photocopy contents of your wallet and keep in a safe location for future reference. This will be valuable to report stolen credit cards and other personal items.
- Don't carry a gun, knife, club, chemical spray, or other weapon. Some are illegal to carry and all could be used against you.
- Report suspicious persons or activities to the local precinct. Remember to dial "911" should you require emergency police or medical service.

Although it is always best to be polite, even to strangers, it is a good idea to be very wary of anyone you don't know that approaches you. They may ask for directions, money or anything else. Answer quickly, and continue on your way. If they persist, tell them that you are unable to help and mention that a police officer would be better suited to provide assistance.

If you feel threaten get in your vehicle lock the door and drive away quickly. If it is not possible to drive away, get in your vehicle, lock the doors, and call 911 from the vehicle. It is suggested that you

notify the South District Jersey City Police Department (non-emergency number 201-547-5456) when working in this area as they may send a patrol car by to deter crime.

- South District Jersey City Police Department – 191 Bergen Ave, Jersey City, NJ

A map to the South District Station will be provided to the field team.

5.7.1.1 When Confronted or Threatened by Hostile Individuals

- Be calm and follow instructions exactly. Don't make any sudden moves.
- Don't risk your personal safety. Don't resist and try to be a hero.
- Consider all guns as loaded weapons.

Observe the criminal's features, clothing, behavior, means of escape, etc. without being obvious about it. Being a good witness is critical in helping the police to locate and arrest the criminal.

5.8 Hazardous Waste Management

Wastes generated during the field operations, including investigation-derived wastes ("IDW"), will be handled as detailed in Section 9.0 of the Field Sampling Plan/Quality Assurance Project Plan ("FSP-QAPP"), and in the Work Plans developed for the Sites. Wastes that may be generated include drill cuttings, masonry cuttings, used PPE, decontamination fluids, decontamination water, and general garbage. Solids such as drill cuttings derived from test borings and decontamination solids will be containerized in USDOT approved 55-gallon drums. Drums will be shipped from the site to a licensed facility in accordance with state and US EPA Resource Conservation and Recovery Act ("RCRA") regulations.

At the Garfield Avenue Sites, drums will be staged at Site 114 at temporary waste storage areas pending waste characterization and off-site disposal. The location of the drum storage and waste stockpile areas are subject to change as the remediation of the site progresses. At other sites, a drum storage pad will be constructed at a location designated by the FTL or SSO.

5.9 X-ray Fluorescence ("XRF") Device

An XRF is being used to provide environmental characterization and remediation services in the Garfield Avenue Group of Sites. The XRF unit(s) is registered with the NJDEP Bureau of X-Ray Compliance and an x-ray survey has been completed for the units at Site 114. The XRF is used only by personnel registered in the dosimeter program and trained to use the device. An [XRF Radiation Protection Plan](#) has been developed for the XRF devices onsite.

6.0 Physical Hazards and Controls

6.1 Back Safety

Using the proper techniques to lift and move heavy pieces of equipment is important to reduce the potential for back injury. Manual lifting is address in [S3NA-308-PR](#). The following precautions should be implemented when lifting or moving heavy objects:

- Bend at the knees, not the waist. Let your legs do the lifting;
- Do not twist while lifting;
- Bring the load as close to you as possible before lifting;
- Be sure the path you are taking while carrying a heavy object is free of obstructions and slip, trip and/or fall hazards;
- Use mechanical devices to move objects that are too heavy to be moved manually; and,
- If mechanical devices are not available, ask another person to assist you.

6.2 Confined Space

Crawlspaces may be considered a non-permit confined space in accordance with 29 CFR 1910.146 and AECOM [S3NA-301-PR](#) if the crawlspace does not have known or potential hazards (health and physical). AECOM personnel are not permitted to access confined spaces.

AECOM employees shall not enter a confined space without prior authorization from the RSHEM. AECOMs confined space entry procedures and training requirements are listed in [S3NA-301-PR Confined Spaces](#).

Confined spaces on this project may include but not limited to: pipes, vaults, tanks, manholes, and excavations/trenches or any other space that has limited or restricted means for entry or exit and is not designed for continuous employee occupancy.

Confined space entry shall be performed in such a manner as to protect personnel from the hazards associated with entering a confined space such as lack of oxygen, toxic gases and vapors and physical hazards. AECOM's Contractor/Subcontractors whose personnel shall enter a confined space are responsible for compliance with 29 CFR 1910.146 when working in confined spaces. The SSO is responsible for identifying and labeling potential confined spaces.

Prior to confined space entry by AECOM Contractor/Subcontractors a specific confined space procedure must be develop and approved by the SSO with concurrence by the AECOM RSHEM. All aspects of the permit-required confined space entry program, required by the Confined Space Standard, (29 CFR 1910.146) must be included in the procedure. A summary of confined space requirements are as follows:

- If confined spaces exist on a project, warn workers of danger by posting signs and prevent unauthorized entry.
- Regardless, the atmosphere in the confined space (permit or non-permit) must be monitored prior to initial entry.
- Identify and evaluate the hazards associated with confined space entry including the hazards posed by the work that will take place in the confined space.
- No worker shall enter a confined space that contains less than 19.5% oxygen or more than 23.5% oxygen as indicated with testing equipment. Nor shall workers enter a confined space that is at or above 10% Lower Explosive Limit ("LEL"), or an Immediately Dangerous to Life or Health ("IDLH") atmosphere.
- Specify acceptable entry conditions, (i.e., prescribe PPE to be worn, emergency rescue equipment that must be available, hazard controls to be followed, etc.).
- The following equipment shall be provided to workers and procedures must be in place to ensure that it is used correctly:
 - Testing and monitoring equipment (test before and during entry operations)
 - Ventilating equipment
 - Communications equipment
 - PPE
 - Lighting equipment
 - Barriers and shields
 - Ladders
 - Rescue and emergency equipment
- Develop and implement site-specific procedures for summoning rescue and emergency services. Rescuers must be trained to use PPE, rescue equipment, and perform rescue duties including; first aid, cardiopulmonary resuscitation ("CPR"), and rescue breathing.

The training shall meet the requirement as found in 29 CFR 1910.146 and that the training can be verified by documentary evidence. If confined spaces are identified, the SSO/site supervisor will inform AECOMs Contractors/Subcontractors of the location of confined spaces and prevent unauthorized entry. AECOMs confined space entry procedures and training requirements are listed in S3NA-301-PR Confined Spaces is applicable only to AECOM employees.

6.3 Control of Hazardous Energy

AECOM employees initiating lockout/tagout shall do so by following AECOM procedure [S3NA-410-PR Hazardous Energy Control](#).

Lockout procedures for the control of hazardous energy shall be implemented and enforced. Lockout procedures are required to render inoperative electrical systems, pumps, construction equipment, motors, pipelines, valves and all other such energy systems that may accidentally be energized while employees are working on them on or before they are ready and released for service. Control of hazardous energy shall comply with Subpart J of 29 CFR 1910. The general lockout requirements are as follows:

- Notify affected personnel and facility staff.

- Shut down equipment by normal stopping procedure.
- Isolate from energy sources using blocks, caps or blanks.
- Apply locks with tag identifying the person performing the lockout. Each authorized person working on equipment applies his/her own lock.
- Release any stored energy.
- Verify isolation.
- Remove guards or covers as necessary and perform work.
- When work is complete, reinstall guards and inspect equipment to ensure it is operational.
- Notify affected personnel.
- Remove locks. Each authorized individual removes his/her own.
- Return the equipment to service and notify affected personnel.

6.4 Construction Equipment

AECOM personnel are to remain clear of operating heavy equipment to the extent feasible. Specific requirements for construction equipment can be found in [S3NA-309-PR Mobile or Heavy Equipment](#)

The use of construction equipment on a project such as loaders, excavators, dump trucks compactors pose the potential hazard of employees being struck by the equipment or caught between the equipment and a fixed object such as a wall.

Use of construction equipment (excavators, dump trucks etc) will require all personnel to wear steel-toed boots, hard hat, high visibility garment, and safety eyewear. Personnel shall not remain in the vicinity of construction equipment unless it is required for their work responsibilities. When employees must work near construction equipment, eye contact and clear communication must be maintained. When working around construction equipment, employees must:

- Make sure that the operator/driver is aware of your presence/activities;
- Stay in the operator's line of sight, don't work in his/her blind spot;
- Approach areas where equipment is operating from a direction visible to the operator;
- Be aware of the swing radius of the excavator and sudden movement of equipment;
- Do not walk or work underneath loads handled by digging equipment or expelled by the screen/crusher plant or pug mill;
- Stand away from trucks being loaded or unloaded to avoid being struck by any spillage or falling materials;
- Cell phone, text messaging or the use of personal headsets is prohibited when working near construction equipment;
- Prior to daily use, construction equipment shall be inspected by the operator;
- Exposed moving machinery parts on screen/crusher plant or pug mill that present a hazard shall be guarded; and
- Operating equipment, such as but not limited to, screen/crusher plant and pug mill shall be locked out at the controls whenever the equipment is being worked on or the equipment is out of service.

Additionally, when samples are collected from an excavator bucket the collector must establish a verbal communication and work protocol to ensure that the equipment operator is aware of their presence, the bucket is lowered to the ground while samples are collected, and during sample collection the equipment operator will remove their hands from the controls; it is preferred that the equipment be completely turned off and de-energized while sample collection occurs. The operator will not re-engage the equipment until the sample collector has left the area.

6.5 Drilling

AECOM employees are not authorized to operate any type of mobile drill rig, and shall stay out of the path of travel of a drill rig and away from rotating and moving parts of a drill rig when it is operating. AECOM employees must maintain a distance of at least 15 feet from the drilling operations. Specific requirements for drilling and boring can be found in [S3NA-405-PR Drilling and Boring](#).

The hazards associated with drill rigs are caught by or between moving or rotating parts, struck by the movement of the drill rig or material being handled, contact with above ground and below ground utilities, and slips trips and falls on slippery surfaces, hose lines, and drilling material.

Prior to drilling it is important and the law that underground utilities be identified by calling 811 to have buried utilities identified and located. It is also important to identify aboveground utilities, such as electrical lines, cable television or telephone wires that may be in the vicinity of the proposed bore hole or path of travel of the drill rig. The minimum safe clearance distance from above ground utilities such as electrical wires is 15 feet.

- Except for the driller and helper, all personnel will stay away (e.g., 15+ ft) from the rig when it is operating;
- If required to approach the drill rig for the collection of samples or down hole observations the drill rig must be taken out of gear to stop movement of boring tools. Only then can you approach the rig;
- Loose fitting clothing must be secured when in the vicinity of drilling operations;
- The drill rig operator shall perform a visual safety of the drill rig daily and after it has been moved to a new location;
- As necessary hearing protection shall be used when near drilling operations; and
- Personnel should avoid walk through drilling mud, crossing over hoses and other drilling material.

6.6 Demolition

Demolition activities involve the use of construction equipment in which employees maybe struck by. In addition employees working near demolition activities can be exposed to dust, struck by debris and trip fall over debris. During demolition activities AECOM personnel must:

- Not enter any structure undergoing demolition unless accompanied by the demolition contractor's competent person;
- Do not enter areas containing asbestos or where asbestos abatement is being performed;
- Walk or work behind or alongside a building being demolished;
- Maintain an upwind position least a distance of 4x the building height away from structures being demolished; and

- Do not walk on debris piles.

The demolition contractor shall comply with Demolition Standard as found in, 1926 Subpart T (1926.850-1926.860), address hazards associated with demolition.

Prior to any demolition operation, construction documents must be filed with the local code official showing the design and construction of any temporary vehicle passageways, pedestrian protection, fencing and/or similar devices that contractor may utilize/require.

Prior to the start of the demolition operations, an engineering survey of the structure shall be made by a qualified or competent person to determine the type and condition of the building's walls and floors so that action can be taken, if needed, to prevent premature collapse of any portion of the structure/building. This may include bracing and shoring of walls, floors and/or adjacent buildings. Consideration should also be given to potential soil retention systems.

All utilities shall be shut-off, capped or controlled at or beside the building line. "Dig Safe" or "utility locator" service must be contacted. In each case, the responsible utility company shall be notified in advance, and its approval or services be obtained.

Entrances to the building being demolished should be protected by an overhead structure providing protection at a minimum of 8 feet out from the front of the building and capable of sustaining a load of 150-lb/sq ft (pounds per square foot).

Stairs, passageways and ladders must be designated as a means of access to the building or structure. All other access ways shall be entirely closed off at all times. Provide illumination, natural or artificial.

Where a hazard may exist from fragmentation of glass, all glazed openings should be removed or protected

During demolition, inspections by the Contractors competent persons shall be made as the work progresses to detect hazards resulting from weakened or deteriorated floors, walls or loosened materials. No worker shall be permitted to work where such hazards exist until they are corrected by shoring, bracing or other means.

The control (continuous wet down) of dust being generated by the demolition operations and/or on-site crushing operations must be provided for.

Only those employees necessary, for the performance of those operations, shall be permitted when demolition operations are being performed.

In the operation of cranes or derricks, a standard signal system shall be used. All personnel assigned to such operation shall be fully instructed in and knowledgeable of these signals and will be required to use and observe them. All employees shall be kept clear of any loads that are about to be lifted and of suspended loads.

Before any demolition work is begun, every thoroughfare adjacent to the work shall be closed, relocated or protected. Travel ways that must be used by the public and emergency response teams shall be kept clear and unobstructed at all times.

An inspection should be made an appropriate amount of time (1 hour) following the daily completion of burning operations to check for possible fires. Hot work procedure/permit must be followed.

Fire suppression equipment shall remain activated or an impairment notice filled with the local fire department. Provisions shall be made by the contractor to implement a fire prevention plan and to provide suitable fire extinguishers.

6.6.1 Concrete Demolition

Demolition of existing building foundations or other concrete structure will either be broken into manageable pieces by the use of an excavator or the use of a pneumatic point attached to the arm of an excavator. Personnel shall stay out of the area where concrete is being demolished to avoid being struck by flying concrete pieces or concrete that is being handled which may contain sharp edges or have rebar sticking out. If concrete is to be cut using a concrete or masonry saw, only wet methods will be used to minimize concrete dust generation and extend the life of the saw blade. AECOM personnel should avoid being in the immediate vicinity where concrete cutting is taken place and should observe such operations from an upwind location.

6.7 Driving Safety

Drivers must be licensed to drive the class of vehicle they are operating and trained in defensive driving. Only AECOM personnel may drive AECOM vehicles or vehicles rented for AECOM business; client, subcontractor, or other work-related personnel may ride. Drivers and passengers must comply with all traffic laws and posted signs, and will not operate a vehicle if under the influence of impairing medication, alcohol, or any other substance. Specific requirements for driving safety can be found in [S3NA-005-PR Vehicle and Driver Safety Program](#).

Make sure that the following basic safe driving practices are followed at all times while working on this project:

- Always wear a seat belt while operating a motor vehicle or while traveling as a passenger.
- Obey speed limits and local traffic laws at all times.
- Obtain proper directions to the site in advance and take the route that is most likely to be free of known traffic hazards (e.g., congestion, construction, etc.) and that avoids travel through potentially dangerous neighborhoods.
- Abstain from distractions while driving (e.g., the use of cell phones, texting, eating/drinking, reading maps, etc.) If necessary, stop the vehicle and pull over to perform such activities safely. **The project policy is engine on, cell phone off.** It is strongly suggested that AECOM employees do NOT operate a vehicle while talking on their cell phone, regardless of “hands free” or not. If the employee needs to make a call, they should pull over to answer it. Do NOT allow other distractions to interfere with the safe operation of the vehicle.
- Do not operate a motor vehicle if you are tired and/or have not had sufficient rest. Additional information on vehicle safety can be found in [S3NA-005-PR Driver and Vehicle Safety Program](#).

6.7.1 Garfield Avenue Group Driving Safety

Due to the large-scale construction and remediation activities on Site 114 and Carteret South, the on Site traffic will be managed by PPG’s construction contractor through the implementation of the [Traffic Safety Control Plan](#) (“TSCP”) which was developed by AECOM to safely control the traffic throughout the program. The TSCP details truck routes, waiting areas, and other aspects of the transportation of impacted soil as a part of IRM activities. Access to Site 114 will be via the gate on Carteret Avenue.

Site truck routes will be maintained, as needed, to provide easy access to the project area and to reduce tracking of soil out of the excavation area. AECOM is also contractually required to only allow project staff with clean driving records to operate vehicles on site.

The potential for traffic generated dust will be managed through the implementation the [DCP](#) and an [Air Monitoring Plan](#) ("AMP"), which are part of the IRM activities. A robust AMP and DCP have been submitted to NJDEP under separate cover that provides information regarding activities with the potential to generate dust during the on-site activities, and the proposed techniques to control same.

6.8 Excavation Hazards

AECOM employees will be working in proximity to excavations required for the removal of impacted soils. In addition, personnel shall maintain at least 3 foot distance from the edge of the excavation that is not protected by a guardrail system, fence or other barriers. Additional information on excavation and trenching can be found in [S3NA-303-PR Excavation and Trenching](#).

The principle hazards associated with excavation and trench activities are striking buried utilities, struck by material being handled and engulfment from soil caving in. In addition, excavations and trenches constructed in a hazardous area such as near a gasoline station, landfill or hazardous waste site maybe classified as permit required confined space do to potential that the atmosphere may contain hazardous gases or vapors, or be oxygen deficient.

It the responsibility of the excavation contractor retained by PPG or AECOM to ensure that a competent person conducts a dally inspection of the excavation and that excavations are properly constructed and site personnel are prevented from falling into an excavation or trench.

In accordance with OSHA regulations, a competent person must conduct daily inspection of each trench or excavation, the adjacent hazards and protective systems for evidence of possible cave-in/failure of protective systems, hazardous atmosphere, and other hazardous condition and determine the necessary precautions to take.

AECOM employees should not enter an excavation or trench if they feel that entry is unsafe or does not meet the requirements presented below:

- Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by calling 811. Markings made during the utility investigation must be maintained throughout the course of work.
- When personnel are required to enter a trench or excavation over 4 feet deep, an adequate means of exit, such as a ladder, steps, or ramp must provided and located so as to require no more than 25 feet of lateral travel. Ladders will extend at least 3 feet above the edge of the trench and will be securely staked in place.
- Walkways or bridges with standard railings and toe board must be provided when personnel or equipment are required to cross over excavations.
- The walls and faces of excavations in which personnel are exposed to danger from moving ground must be guarded by a shoring system, sloping of the ground, or some other equivalent means as required by 29 CFR 1926 Subpart P.
- No person shall be permitted under loads handled by excavators or other material handling equipment.
- The spoils pile shall be placed at one side of the excavation. At a minimum, the toe of the spoil pile shall be at least 2 feet away from the edge of the excavation. The spoils pile shall be

moved farther back in proportion to the depth of the excavation. The spoils pile height shall not exceed the depth of the excavation and shall be sloped to prevent the soil and rocks from sliding into the excavation.

- Protective system(s) to prevent cave-in shall be used when personnel enter excavations 5 feet or greater in depth or if the competent person determines it is necessary at shallower depths. Protective system(s) shall be compliant with the requirements of 29 CFR 1926 Subpart P. A Registered Professional Engineer must design protective systems for excavations/trenches 20 feet or greater in depth.
- Where protective systems are used such as trench boxes, hydraulic shoring, etc., they shall be used in accordance with the manufacturer's specifications and limitations. The manufacturer's tabulated data for such systems must be maintained on the project.
- Employees should never enter an excavation that show signs of a cave-in, has water seeping into it, or contains free standing water.
- Excavation or trenches that pose an atmospheric hazard must be tested for oxygen content, explosive gases/vapors and toxic gases/vapors (i.e. carbon monoxide, hydrogen sulfide, contaminants of concern) prior to and during entry.

6.9 Electrical Hazards

AECOM employees are not authorized to work on electrical equipment or near any part of an electrical circuit unless they are protected against shock by guarding or by de-energizing and grounding the circuit. Information on general electrical safety can be found in [S3NA-302-PR Electrical, General](#) and information on hazard energy control (lockout) is found in [S3NA-410-PR Hazardous Energy Control](#).

All temporary and permanent electrical work, installation, testing and maintenance and all electrical equipment and appliances shall conform to the requirements of the National Electrical Code and comply with the requirements of 29 CFR 1926 Subpart K.

Potential electrical hazards include electric shock, electrocution, burns, fires, and explosion. Electrical cords used to carry electrical power pose a trip and fall hazards. The use of portable generator poses an electrical hazard and also the hazard associated with exposure to carbon monoxide.

To prevent potential electrical incidents the following basic electrical practices must be followed at all times while working on this project.

- Only qualified electricians with full knowledge of the electrical code requirements will be allowed to perform electrical work.
- The use ground-fault circuit interrupters ("GFCIs") are required on this project. Additionally, inspection and testing shall be conducted to locate defective electrical equipment, tools, and cords, which may expose personnel to electrical hazards. An assured grounding program shall not be used on this project.
- Temporary electrical cords must be rated for extra hard usage or hard usage and must be of the three-wire type with a grounding pin and a grounding receptacle. Look for the following letters on the cord: S, SJ, ST, or SO markings on the cord.
- Temporary electrical cords must be protected or elevated a minimum of 8 feet. They must be kept clear of walkways and other location where they may be exposed to damage or create a trip hazard. Do not hang extension cords with bare wire, nails, staples or objects that will cut/damage cords.

- Inspect all electrical cords for signs of wear and exposed wiring, strain, and ripped, torn, cut or burned insulation. Defective cords shall be removed from service.
- Electrical tools and equipment must be grounded, of the double insulated or cordless type battery operated.
- All 120-volt, 15- and 20-amp receptacles must be protected by a GFCI. Follow manufacturers' recommended testing procedure to insure GFCI is working correctly.
- Temporary lighting shall have guards that protect the entire bulb surface. Broken and burned-out lamps shall be replaced immediately.
- If needed, before cutting or drilling into walls, ceilings and floors it must be ascertain by inquiry or direct observation, or by instruments, whether any energized electrical power circuit or pressurized lines are concealed. Where such circuits or lines are identified workers shall be notified of their location and protective measures to be taken.
- Check the work area for overhead and underground electrical utilities. Employees must be protected from overhead hazards by meeting the guidelines listed below.
 - If the overhead power line is 50 kilovolts ("kV") or less, then stay at least 10 feet away. For everything else, keep at least 35 feet away. Contact the power company if power lines needed to be, moved, de-energized and grounded, or have insulated sleeves installed.
- In potentially hazardous environments, electrical equipment must meet the National Electrical Code ("NEC") classification for hazardous locations. Consult the RSHEM for the proper type of equipment
- When work is to be performed on electrical equipment, lockout procedures are required to ensure that the equipment is de-energized and isolated.
- Energized wiring in junction boxes, circuit breaker panels and similar places shall be covered at all times. The covers must be secured.
- Fuel generators before use and re-fuel only after the engine has been shut down and allowed to cool.
- Never use a portal generator indoors. Locate a generator so that the exhaust is downwind from your position or locations where carbon monoxide can enter (e.g. confined spaces, indoor locations etc.).

6.10 Falls

6.10.1 Same Level

Falls from slips and trips are common workplace occurrences that can result in serious injuries and disabilities. The most common types of falls: is falls at the same level. Fall hazards of exist in most workplaces including offices, manufacturing and construction. Slips and trips can be prevented by following these guidelines:

- Personnel shall be vigilant in providing clear footing, clearly identifying obstructions, holes, stick ups, or other tripping hazards and maintaining an awareness of uneven terrain and slippery surfaces.
- Walking and working surfaces shall be kept free of materials, obstructions, and substances that could cause a surface to become slick or otherwise hazardous.
- Makeshift substitute ladders such as toolboxes, buckets, and coolers shall not be used.

- The use of cellular telephones (testing, making or receiving calls) for personal use is prohibited in the work area.
- Walk around, not over or on, debris or equipment that might have been stored in the work area.
- Do not jump from platforms or truck beds.
- When carrying equipment, identify a path that is clear of any obstructions. It might be necessary to remove obstacles to create a smooth, unobstructed access point to the work areas on site.

During the winter months, snow shovels and salt crystals or calcium chloride should be kept on site to keep work areas free of accumulated snow and ice. Furthermore, use sand or other aggregate material to help keep work surfaces from being slippery, especially where salt/calcium chloride cannot be used. In addition, make sure work boots have soles that provide good traction. When walking on ice is necessary crampons or Yaktrax® should be used.

6.10.2 Elevated Surfaces

Falls from elevation greater than 6 feet above a lower level or less than 6 feet above dangerous equipment can result in serious injury and even death. To prevent falls from elevations the walking and working surface must be surrounded on all open sides by standard railings or their equivalent (fence, barricade or cover), or by employees who are protected by a personal fall arrest system. Information on elevated platforms and fall protection can be found in [S3NA-304-PR Fall Protection](#).

To use a personal fall arrest system employees must be trained in their use, limitations and care of the system. A personal fall arrest system consists of the following:

- Anchor point capable of supporting 5000 pounds;
- Full body harness meeting ANSI requirements;
- Shock absorbing lanyard meeting ANSI requirements that limit free fall distance to six feet; or
- Self-retracting lanyard that meets ANSI requirements for limiting the free fall distance to two feet.

It is the responsibility of the Contractor/Subcontractor who created the fall hazards to provide a standard railing or equivalent around openings greater than 6 feet above a lower level or less than 6-feet above dangerous equipment. In addition, excavation 6 feet or more in depth not readily seen must have a standard railing or equivalent around openings. Employee at the edge of a well, pit, shaft, and similar excavation 6 feet or more in depth must be protected from falling by standard railing or equivalent.

Falls from elevations can be prevented by following these guidelines:

- Where an employee observes that a fall hazard exists in the workplace that is not protected by a standard rail the employee shall promptly notify the responsible party. AECOM employees must avoid the area until the responsible party has taken the necessary corrective actions;
- Stay away (at least 15 feet) from unprotected opening;
- Do not lean on or climb on a standard railing or equivalent;
- Avoid walking on floor hole covers and do not remove floor hole covers; and
- Where a standard railing is not provided or when removed employee must use a personal fall arrest system.

6.10.3 Stairways

Stairways in residential structures pose a potential fall hazard due to lack of maintenances, steps used for storage and poor lighting. Personnel should ask the residence if the stairways are safe to step on, if not an alternative route should be found. It is suggested that the resident should lead the way. Information on working in stairways safely can be found in [S3NA-312-PR Stairways and Ladders](#). Precautions that should be taken to prevent falling down stairways include:

- Illuminate the area;
- Visually inspect stairways for clutter missing steps etc;
- Sound questionable steps with a broom stick or tool handle before stepping;
- Step to the side of the steps where supports are;
- Use handrails; and,
- Use a backpack to keep hands free.

6.11 Hand Tools

Hazards associated with hand tools are cuts, lacerations, electrocution, and struck by flying objects. Frequent and prolonged use of hand tools can cause soreness, aches, pains, and fatigue, which, when ignored, can lead to chronic musculoskeletal injuries ("MSIs"). Additional information on hand tool safety can be found in [S3NA-305-PR Hand and Power Tools](#).

Many injuries have been caused by the use of fixed open blade knives such as a jack knife or box cutter. Cutting tools that can be used by AECOM employees for cutting include shears, snips, tubing cutters, ratchet type pipe cutters, side cutters, and retractable blade utility knife or concealed blade knife. The use of fixed opened blade knives is prohibited.

Basic safety rules can help prevent hazards associated with the use of hand tools:

- Use the right tool for particular work activity being conducted (e.g., don't use a file or a screwdriver as a pry bar).
- Examine each tool for damage before use (e.g., worn, splintered handles, etc.) and do not use damaged tools.
- Use properly the right PPE (e.g. eye protection, gloves, hearing protectors).
- Hold work in a clamp or vise, not in your hand.
- Position your body securely while working with the tool.
- Plastic covered tool handles are for comfort only, not protection from electrical current.
- Claw hammers are for driving and removing finishing and common, unhardened nails. Don't strike other steel tools such as chisels, punches or masonry nails with a claw hammer.
- When working with a wrench, always pull the wrench, never push the wrench.
- Hand sockets should never be used on power or impact wrenches. Hand sockets usually have bright finish but may have black finish.

- Discard any chisel or punch that is chipped or mushroomed.
- Don't use a screwdriver for prying, punching, chiseling, scoring or scraping. Screwdrivers should only be used to drive or remove screws.
- Never use an extension bar such as a length of pipe to increase leverage on a wrench. This could result in breakage of the wrench and personal injury.
- Ball peen hammers of appropriate size or hand drilling hammers should be used to strike chisels, punches and star drills. Do not use the claw hammer.
- Select a wrench whose opening exactly fits the nut. Too large an opening can spread the jaws of a wrench. Too large a box- or socket wrench can mar or turn the corners of the nut. Exercise care in selecting inch wrenches for inch fasteners and metric wrenches for metric fasteners.
- Only spark-resistant tools made from brass, plastic, aluminum, or wood to should be used around flammable substances.
- For continuous work, use comfort grips or gloves, take frequent breaks, avoiding awkward positions, and consider using a power tool.

6.12 Illumination

Basements and crawl spaces of residential structures may not be adequately illuminated to prevent spill trips and falls or allow for visual acuity for this reason the use of flashlights and portable work lights will be necessary.

Field personal should have available for use a battery-powered flashlight/lantern to illuminate the walking surface and work area. In entering a crawl space a hand free head lamp should be used.

Portable work lights shall be guarded to prevent the breakage of the lens and bulb. Broken and burned-out lamps shall be replaced immediately. The electrical cord for the light must contain a ground prong and be plugged into an outlet containing a GFCI. Portable lights generate heat and should be located away from combustible or flammable material. Personnel must be careful to avoid handling the work light when it is hot. Allow the light to cool down before handling.

6.13 Noise Exposure

The use of construction equipment can expose the field team to noise levels that exceed the 85 dB for an 8-hour day. Exposure to noise can result in the following:

- Temporary hearing losses where normal hearing returns after a rest period;
- Interference with speech communication and the perception of auditory signals;
- Interference with the performance of complicated tasks; and,
- Permanent hearing loss due to repeated exposure resulting in nerve destruction in the hearing organ.

Since personal noise monitoring will not be conducted during the proposed activities, employees must follow this general rule of thumb: If the noise levels are such that you must shout at someone two (2) feet away from you, you need to be wearing hearing protection. Employees can wear either disposable earplugs or earmuffs but all hearing protection must have a minimum noise reduction rating ("NRR") of 27 decibels ("dB").

AECOM has a Hearing Conservation Program which can be found in [S3NA-510-PR Hearing Conservation Program](#).

6.14 Traffic Control

During certain work tasks, the establishment of traffic control to adequately protect workers and the public may be required on-site. Site specific requirements will be determined by the Contractor on a case-by-case basis. Only approved traffic control devices per accordance with the Manual of Uniform Traffic Control Devices ("MUTCD") will be used on public road ways per accordance with the applicable State regulatory guidance.

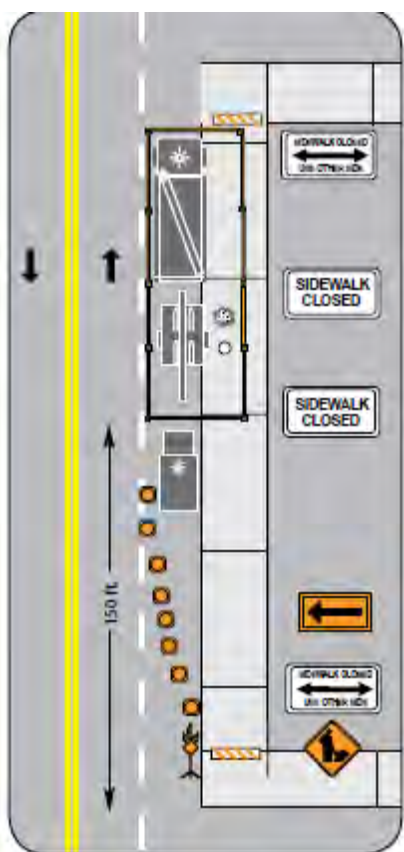
During on-site GA Group, IRM and FS remedial activities, traffic on Site 114 will be managed by PPG's construction contractor through the implementation of the [TSCP](#), which details truck routes, waiting areas, and other aspects of the transportation of impacted soil as a part of IRM activities. An on-site speed limit of 5 miles per hour will be maintained on Site. Access to the Site will be via the gate on Carteret Avenue. The TSCP for the Garfield Avenue Group sites is a working document and will be amended as work progresses to the south of Carteret Avenue (on Site 132, 133, 135, 137 and 143).

General traffic control precautions include placing a work vehicle between your worksite and oncoming traffic whenever possible. Not only is it a large, visible warning sign, but also if an oncoming car should fail to yield or deviate, the parked vehicle rather than your body would absorb the first impact of a crash. Turn the vehicle wheels so that if it was struck, it would swing away from the worksite. Cones or other traffic channeling devices must be at the proper taper length and spacing to provide adequate warning to on-coming traffic. In addition, proper PPE is to be worn during traffic operations, to include hardhat and high-visibility vests. Refer to [S3NA-306-PR Highway and Road Work](#).

When working in high traffic areas, the following precautions will be implemented so that motorists are warned of your presence:

- Wear an ANSI-approved Class II safety vest.
- Set up work zone signs at a minimum of 150 feet in front of the work area.
- Taper cones at least 125 feet in front of work zone.
- Position vehicle upstream from work site to begin channeling traffic.
- Designate work zone with cones.
- Taper cones at least 50 feet downstream from work zone.
- Use trained flaggers.
- Use the services of local law enforcement to maintain traffic control, where deemed appropriate.

Figure 1 Blue print of work area



Blueprint of work area

6.14.1 Site-Specific Traffic Safety and Control Plan

A site-specific [Traffic Safety and Control Plan](#) ("TSCP") has been prepared to support RAWP and IRMWPs #1 activities. This TSCP has been prepared to assist in traffic control, and motorist and community safety during the IRM trucking activities, and to facilitate early discussion with stakeholders regarding the potential impact of IRM activities on local traffic and the community. In addition, emergency responders will be informed and consulted regarding the location of the truck routes and safety measures described in this plan. This TSCP may be updated as necessary and also used for future remedial activities at the Garfield Avenue Group of Sites.

6.15 Utility Hazards

6.15.1 Underground Utilities

Law requires that a utility clearance be performed prior to initiation of any subsurface work. The number to call in this area to request a mark-out of natural gas, electric, telephone, cable television, water and sewer lines in the proposed excavation or boring locations is 811. Additional information on underground utilities can be found in [S3NA-417-PR Utilities, Underground](#).

The PPG Remediation Contractor or AECOM's Contractor will be responsible to perform the NJ One Call notification. Work will not begin until the required utility clearances have been verified or performed.

Utility clearance organizations typically do not mark-out underground utility lines that are located on private property. As such, Contractor must exercise due diligence and try to identify the location of any private utilities on the property being investigated. This element will be fulfilled in several ways, including:

- Obtaining as-built drawings for the areas being investigated from the property owner;
- Visually reviewing each proposed excavation location with the property owner or knowledgeable site representative;
- Performing a geophysical survey to locate utilities;
- Hiring a private line locating firm to determine the location of utility lines that are present at the property;
- Identifying a no-dig zone;
- Use of air or hydro vacuum extraction methods; or
- Hand digging in the proposed excavation locations if insufficient data is available to accurately determine the location of the utility lines.

Non-destructive vacuum extraction, otherwise known as Potholing or air-knifing, is used to physically expose a marked utility to verify existence and determine its exact location. This method helps reduce the potential for damage to an existing utility by construction activities. A typical pothole measuring 12 inches square and 4 to 5 feet deep can be dug in 15 minutes or less with an average time of 7 to 8 minutes in all soil conditions.

An air knife (Vacuum Excavating) may be used for utility clearance prior to any ground intrusion, such as drilling, backhoe, and other heavy equipment. The air knife is particularly useful when public utility maps show lines extending on to a site, but private records cannot confirm onsite locations. The air knife is the best alternative to conventional hand clearing, such as the hand auger, post-hole digger or spud bar and hammer. An air knife is capable of penetrating soil and exposing utility lines with minimal risk to the lines.

6.15.2 Overhead Utilities

Accidental contact with an energized line or arcing between a high power line and grounded equipment can cause electrocution of equipment operators or nearby ground personnel, and damage to power transmission and operating equipment. While maintaining a safe distance from all energized lines is the preferred means for control of this hazard, site conditions may not always accommodate this.

If work will (or may) occur within 50 feet of any energized line. The safe working distance to an energized line is the minimum distance which must be maintained between any energized electrical line and any part of the operating equipment to maintain adequate safety margins, and is based on the line voltage of the power line. The following safe working distance criteria will be applied for all AECOM operations:

- Determine the voltage of the power line by contacting the utility company or owner;
- Unless verified, it will be assumed that all lines are energized;
- Line Voltage (Kilovolts) Minimum Safe Working Distance (refer to minimum safe working distance in the table below); and
- Additional information on Overhead Electrical Lines can be found in [S3NA-406-PR Electrical Lines, Overhead](#).

Line Voltage (Kilovolts)	Minimum Safe Working Distance
0 – 50	10 feet
>50 – 200	15 feet
>200 – 350	20 feet
>350 – 500	25 feet
>500 – 750	35 feet
>750 – 1000	45 feet
Source: American National Standards Institute, Publication B30.5	

7.0 Safe Work Standards and Rules

7.1 Introduction

As a minimum all employees are responsible for adhering to all AECOM safe work standards, rules, requirements and instructions presented below:

7.1.1 Safe work practices

1. Perform all job duties in a responsible manner, following and complying with regulatory standards, AECOM safety policies, industry standards, work practices, guidelines, and project-specific requirements governing the scope of work.
2. Be aware of the job site conditions, work environments, client operations, contractor activities, and general public (if applicable) that may impact an employee or be impacted by or affected by one's work.
3. Work in a manner that will not put oneself, other personnel or equipment or facilities at risk.
4. Identify hazardous conditions and activities in the work environment consistent with the job and training.
5. If one cannot remove a hazard, it should be reported to the SSO, CM, TM, and/or PM promptly.
6. Implement established control methods consistent with project procedures and/or training.
7. Unsafe employee actions or behavior are prohibited.
8. Employees performing inspections, construction observations, investigations, reviews, surveys or visits to remote sites shall work in teams of a minimum of two persons present (buddy system), or an alternate communication plan must be provided.
9. Work involving the removal, handling, storage or disposal of hazardous materials or wastes requires the approval of the appropriate SH&E Department representative.
10. Immediately report all potentially dangerous conditions and injuries, regardless of severity, to the Field Task Manager.
11. Report all accidents that result in medical treatment, AECOM equipment damage or near miss incidents to supervision immediately.

7.1.2 Personal standards

1. Any employee who willfully disregards AECOM or client safety standards, rules or requirements is subject to disciplinary action, including removal from the project and dismissal.
2. Carrying firearms or other weapons on AECOM or a client's property is prohibited.
3. Fighting and gambling are not permitted.

4. Be considerate of the safety and welfare of others. Distracting other's attention or engaging in practical jokes and horseplay is prohibited.
5. Employees are not permitted to use, sell or distribute, be under the influence, or have in their possession any controlled substances, drugs, or alcohol. The only exception is if an employee is taking prescription medication(s) under the direction of a physician. It is then the responsibility of the employee to notify one's PM if the medication may impair their ability to perform their job function in a safe manner, in which case they shall be removed from that task.
6. Smoking is prohibited in any area specifically designated as "NO SMOKING" and in all AECOM facilities.
7. Be alert at all times. Obey safety signs, heed warning signs and instructions.
8. Report unsafe equipment, conditions, and actions or behavior to one's task leader or supervisor promptly.
9. Avoid back injuries by knowing one's capabilities, using proper lifting techniques, and seeking assistance when needed.
10. Employees should operate vehicles in a safe and conscientious manner.
11. All employees shall direct any questions or concerns they may have about the project HASP, job tasks, instructions or conditions to the PM or RSHEM.

7.1.3 General safety rules

1. Employees are required to practice "good housekeeping" when performing job tasks at all AECOM locations and offices. Such practices include overseeing that work areas are kept clean and organized; using approved cleaning materials for tools and equipment; proper packaging and disposal of waste materials including hazardous materials; and leaving a work area clean and orderly. This includes office work stations and occupancies.
2. One should plan work tasks before beginning work and consider any hazards that may exist and how to avoid them through proper work practices.
3. One should keep an eye out for and take care of one's "buddy" in the field.
4. Obey all warning signs (e.g., "Do Not Enter," "No Smoking," "Eye, Hearing or Respiratory Protection Required," "Permit Required Confined Space," "Authorized Personnel Only," etc.).
5. Do not jump from any elevated surface or platform, including truck beds, equipment and scaffolding.
6. Taking shortcuts leads to injury. Use appropriate ladders, platforms and stairs.
7. Do not block, deface or remove any signage, barricade or fencing without approval.
8. Keep passageways clean and clear of debris, materials, hoses, cords, and tripping obstructions. Items should be moved to low activity areas or overhead.
9. Permits may be required when performing non-routine tasks and work involving hazards. Seek advice from the SSO, CM, TL, or PM as appropriate.

10. Use only designated sanitary facilities.
11. Be alert to work going on, around or above you including contractor activities and motoring public vehicles.
12. Be familiar with project emergency procedures. Report all emergency situations to the PM immediately.
13. Read scaffolding tags before using scaffolds. Never use a red-tagged scaffold. Climbing on an incomplete scaffold (normally yellow tag) requires use of and tying off of fall protection devices.
14. Hand tools, electronic devices and equipment may not be used for any purpose other than their intended use. Damaged equipment and tools with worn part(s) shall be reported to a supervisor or task leader for repair or replacement.
15. Electric power tools must be properly grounded or double insulated. Electric power tools shall be Ground Fault Circuit Interrupter-protected when use in wet and exterior conditions.
16. Defective tools and equipment, frayed and ungrounded electrical cords and unguarded tools and machinery shall not be used. Report same to the SSO, CM, TL, or PM as appropriate.
17. Employees shall not remove floor covering, guard rails, or other working surfaces from any floor or perimeter side opening without approval by the SSO, CM, TL, or PM as appropriate.
18. Defective or unsecured ladders shall not be used.
19. Employees shall not ascend or descend a ladder without free use of both hands while facing the ladder.

7.1.4 Safety equipment rules

1. Always wear assigned safety equipment and PPE.
2. Always use protective equipment in accordance with manufacturer's instructions and AECOM training and procedures.
3. All AECOM employees, subcontractors, sub-consultants, visitors, and vendors shall wear a hard hat, high visibility vest, sturdy work boots and eye protection on construction projects. Other PPE may be required based on the nature of the work.
4. Wear clothing suitable for the work being performed. Minimum attire consists of long pants and shirt with a minimum 4-inch sleeve, tank tops are not permitted unless otherwise specified.
5. Hearing protection devices shall be used when exposed to elevated noise levels.
6. Respirator use may be required in areas where dust, gas or fumes exist. Consult the SSO, CM, TL, or PM as appropriate or the RSHEM for guidance.
7. Fall protection equipment is required for all work with a fall exposure greater than six feet on any elevated structure or aerial platform including structural steel, incomplete work platforms, scaffolding, open surface work and aerial lifts.
8. Modification or alteration of any safety equipment is prohibited as it changes the equipment's design strength and manufacturer's certifications.

9. PPE use shall be consistently enforced in accordance with rules established for the project and federal and state safety regulations.

7.1.5 Work ergonomic rules

1. Use proper methods to perform all job functions so as to minimize the risk of physical injury.
2. Take reasonable precautions when lifting heavy or large objects that could cause back injury or hernia.
3. Do not exceed one's capability and strength. Seek assistance.
4. Make suitable adjustments to one's workstation including office furniture, chair, keyboard platform, computer monitor for comfort, equipment and work.
5. Avoid routine, repetitive motion hand activities. Integrate varying motions and body parts.
6. Change work routines, (e.g., phones, typing, files). Stretch and take mini-breaks.

7.1.6 Hazardous Waste Site Rules

1. The "buddy system" will be used at all times by all field personnel. If an employee will be alone in a work area, or an alternate communication plan must be developed (see [SH&E SOP 314 – Working Alone](#)). Subcontractors working on-site with AECOM employees can help fulfill the role of a Buddy while site activities are occurring.
2. Eating, drinking, chewing gum or tobacco, smoking or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in the immediate work area and the decontamination zone. Water and Ice may be consumed in all areas to prevent heat stress but precautions must be taken to prevent contamination of the water and ice.
3. Smoking is prohibited in all work areas. Matches and lighters are not allowed in these areas.
4. Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking or any other activities.
5. Beards or other facial hair that interfere with respirator fit are prohibited, if the potential for respirator use is imminent.
6. All equipment must be decontaminated or properly discarded before leaving the site in accordance with the project work plan.
7. Avoid contact with potentially contaminated substances or materials. Do not walk through puddles, pools, mud, or handle soils without protective gloves, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on equipment or the ground. Do not place monitoring equipment on potentially contaminated surfaces (e.g., ground, etc.).
8. Field personnel will perform only those tasks which they are qualified to perform.

8.0 Air Monitoring

AECOM will be implementing a comprehensive air monitoring plan during the implementation of the IRM activities at the Garfield Avenue site (114) and proposed Carteret Avenue South location. This plan includes both real time and integrated sampling for total particulates (as a surrogate for hexavalent chromium) and total VOCs at the Exclusion Zone and the perimeter of the site and is used mainly for the protection of the public. The Exclusion Zone monitoring stations mentioned in this plan will also be used to monitor worker exposure. But if the work performed is deemed a high risk for creating dust or dust exposure, a personal air monitor can be used. The action levels for worker exposure are included in this section.

In work areas outside of the IRM activities, and therefore outside on the on-site air monitoring area, an exclusion zone and work area air monitoring system will be set up according to the AMP in each area. The SSO or FTL are responsible for following the AMP procedures when outside of the main site area.

Additional information on the air monitoring program can be found in the AMP for Ground Intrusion Activities at the Garfield Avenue Site.

8.1 Volatile Organic Vapors

A portable photo-ionization detector ("PID") with a 10.6 electron volt ("eV") lamp will be utilized to periodically monitor the levels of total volatile organic compound in the ambient air. Measurements will be taken from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions and whether there is a need to change levels of worker protection. The PID unit collects and analyzes air continuously. In order to make a conservative assessment of when different levels of respiratory protection are needed during the fieldwork, it will be assumed that the organic vapors detected by the air monitoring instruments consist of the most toxic volatile compounds expected to be found on the site. Preliminary evaluation of the risks expected at the site indicates that the most toxic volatiles that are expected to be present are VOCs (particularly Benzene, Toluene, Ethylbenzene, Xylene [BTEX]). Based on data published by the OSHA and the ACGIH, and previous experience with MGP wastes, the following PPE will be employed when the given concentrations of organic vapor are detected in the breathing zone.

VOC Action Level

As a precautionary measure, a PID with a 10.6 eV lamp will be used to monitor the breathing zone of personnel during the intrusive activities. In addition, a robust Air Monitoring Plan has been developed that details the dust and VOC monitoring and sampling/analysis that is proposed to be performed during site activities. If PID readings collected in the Exclusion Zone indicate sustained (15 minute) breathing zone vapor concentrations in excess of 5 ppm above background AECOM personnel should leave the area immediately.

Task	Instrument	Action Limit and Action
All tasks involving potential exposure to contaminated soils and/or groundwater	Photo-ionization Detector	5 ppm above back ground; Leave the area immediately or don respiratory protection as discussed in Section 9 . Over 50 ppm-level area and notify RSHEM

8.2 Dust and PM10

The DataRAM Model DR 1000 Aerosol Monitor (or equivalent) measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, as well as environmental and perimeter monitoring during intrusive work. The DataRAM has the widest measurement range of any real-time aerosol monitor - from 0.0001 mg/m³ to 400 mg/m³, or a total span of almost seven decades.

Dust and PM10 Action Level

A dust Action Level has been established for the protection of workers from potential health hazards associated with dust in and around the Exclusion Zone. The Dust Action Level based on the airborne concentration of hexavalent chromium will also apply to concrete dust/silica dust. The justification for this Action Level is provided below. Worst case concentrations of hexavalent chromium will be removed during IRM #1 and IRM #2 activities; as a result, a more conservative dust action level was calculated for use during remedial excavation during IRM #1 and IRM #2, as discussed further below.

Soil sampling at PPG sites has revealed elevated levels of hexavalent chromium ("Cr⁺⁶") were noted in soils. Air monitoring will be required during any intrusive work in Site. The Action Level ("AL") for dust in the Exclusion/Work Zone during intrusive work in this area(s) will be set at 167 µg/m³ or 0.167 mg/m³. The AL for particulates while intrusive activities are occurring in the Cr⁺⁶-impacted area(s) was derived as follows:

Cr⁺⁶ Action Level in Air in Exclusion/Work Zone:

Cr⁺⁶ PEL = 0.005 mg/m³

Divide PEL for Cr⁺⁶ by 2 as a safety factor

Modified PEL = 0.0025 mg/m³

The 95% upper confidence limit ("UCL") on the arithmetic mean for soil samples in the area was calculated to be 15,000 mg Cr⁺⁶/kg soil, or 1.5% Cr⁺⁶ in soil (represents the 95% UCL of the arithmetic mean of the concentrations found within the most impacted area of the site found in soil on PPG Sites)

Action Level (above background) is calculated by dividing the modified PEL by the expected maximum detected concentration of Cr⁺⁶ as follows:

AL = 0.0025 divided by 0.015

$$AL = 0.167 \text{ mg/m}^3 \text{ or } 167 \mu\text{g/m}^3$$

Therefore, for worker's in the Exclusion Zone, $167 \mu\text{g/m}^3$ (above background) will be set as the Action Level for total dust ("PM10") (based on Cr^{+6}) during intrusive work during remedial activities.

Task	Instrument	Action Limit and Action
All tasks with the potential to generate dust.	Particulate meter	0.167 mg/m^3 above background. Implement control measures Implement dust control

The action level is conservative and adequately protective of human health since it is based upon an assumption that the 95% UCL concentration of Cr^{+6} in soil is representative of the Cr^{+6} concentration in all dust, meaning that no other dust sources contribute to measured levels.

If the Exclusion Zone aerosol monitor indicates sustained (15 minute) breathing zone vapor dust in excess of 0.167 mg/m^3 above background or visible dust is present AECOM personnel should leave the area immediately.

The protectiveness of worker's health by using this action level will be demonstrated by reviewing hexavalent chromium concentrations in dust collected at the Exclusion Zone Air Monitoring Stations ("AMSs") (the details of the AMSs are described in the AMP). Specifically, the laboratory analytical results will be reviewed as they are received to confirm that the concentration of hexavalent chromium in dust is less than the 95% UCL of 15,000 mg/kg which was conservatively utilized to develop the action level. By confirming that the concentration of hexavalent chromium in dust is consistently below the 95% UCL, the protectiveness of the AL will have been verified. This data comparison will occur almost daily as the results are received from the laboratory, and the results and evaluations will be maintained in a site log with the HASP.

8.3 Calibration and Recordkeeping

Calibration and Recordkeeping will be conducted in accordance with the project QAPP and AECOM [SOP Q2-312-PR "Monitoring and Measurement Equipment Procedure"](#).

Air monitoring instrumentation will be bump tested or fully calibrated before each day's use in accordance with the manufacturer's instructions. A log of the calibrations and readings will be kept in the field notebook. Daily calibration information will also be recorded in the field notebook. Calibration procedures will be documented in the field records. Documentation will include the date and time of calibration, the identity of the person performing the calibration, the reference standard used, the readings taken, and any corrective action. This information will be incorporated into the appropriate reports to be submitted to NJDEP for review. In addition to the manufacturer's recommended calibration procedures and frequencies, the contractor's preventive maintenance and internal calibration schedule will be provided and kept at the site for review by the NJDEP auditor. Field instruments will be calibration checked at a minimum of twice daily, before and after use. A calibration curve will be run every six (6) to eight (8) weeks. Documentation will also include the calibration curve, as well as a log of field calibration dates and standards.

A PID is bump tested in the field as a means of verifying calibration by using a known concentration of test gas (isobutylene) will be performed before daily use to demonstrate that the instrument's response to the test gas is within acceptable limits ($\pm 10\%$ or $\pm 15\%$).

The particulate meter will be functional tested in zero/clean air following the manufacturer's instructions. The digital dust meter will be maintained in accordance with the manufacturer's instructions. Functional tests shall be recorded in a field notebook.

Detail description of equipment calibration and quality assurance/quality control ("QA/QC") procedures can be found in Section 8.1 of the AMP.

Particulate Monitors

The TSI DustTrak and DataRam Model DR 1000 Aerosol Monitors or equivalent devices will be used to continuously monitor particulate emissions at the various fence line locations. At a minimum, the monitors will be field checked daily using zero calibration air. At the beginning of each workday (prior to site intrusive activities each day) a calibration zero check will be performed on each unit at the measurement locations. A zero (or particulate-free) test sample, using the appropriate particulate filter supplied by the manufacturer for this purpose, will be placed over the sample inlet. The data output for the monitor will be observed and the response recorded in the air monitoring contractor's field logbook. Once per month, all PM10 samplers will be challenged with an unknown upscale amount of particulates in order to verify each sampler's response to upscale particulate levels. The data output for the monitor will be observed and the response recorded in a field logbook.

TVOC Monitors

The calibration of the PID analyzers will be accomplished at the beginning of each day using a cylinder of isobutylene calibration gas. The calibration gas will be used to fill Tedlar bags which will be brought to each PID. The PIDs will be zeroed in the same manner using bags filled with ultra-pure air. The instrument response to the calibration points will be checked to determine instrument performance. The data output will be observed and the response recorded in the field logbook. The field logbook will be maintained on-site throughout the duration of site activities.

8.4 Personal Air Sampling

Personal exposure assessment will be conducted only when the action levels are exceeded for VOCs/benzene and hexavalent chromium/total dust. Personal air samples will be collected in accordance with OSHA and/or NIOSH methodology and analyzed by an American Industrial Hygiene Association ("AIHA") accredited laboratory. The results of the sampling will be communicated to project personnel. The number of workers selected to wear the personal sampling pumps will be determined in advance of the field activity by AECOM's RSHEM. Personal hydrogen sulfide monitor will be performed on at-risk employees by using a clip-on disposable hydrogen sulfide detector with a low alarm range of 5 ppm.

Analytical Methods

- Benzene- 29 CFR 1910.1028 (e) - Analytical Method 12`
- Hexavalent Chromium- 29 CFR 1910.1026(d)-Analytical Method OSHA ID-215
- Dust-NIOSH Analytical Method- 0500

9.0 Personal Protective Equipment

The purpose of PPE is to provide a barrier, which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. [S3NA-208-PR Personal Protective Equipment Program](#) lists the general requirements for selection and usage of PPE. The specific PPE requirements for each work task are specified in the individual THAs.

9.1 Level D Ensemble

Level D PPE for this project shall consist of: shirts with sleeves and long trousers that are ankle length; approved hard hats, safety spectacles with side shields, steel-toe protective footwear and a high visibility vest or other high visibility outer garment when in construction area or other non-office work areas. In addition, employees are required to use the appropriate protective gloves and carry gloves with them at all times when in the construction area or other non-office work areas. As necessary hearing protection will be used.

9.2 Modified Level D Ensemble

Level D ensemble will be modified to where there is a potential for dermal (skin) exposure to the chemical contaminants of concern. Modified Level D ensemble will consist of the PPE required for Level D with the addition of the following:

- Chemical-resistant coveralls (Tyvek)
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent

9.3 Personal Protective Equipment

<u>Type</u>	<u>Material</u>	<u>Additional Information</u>
Minimum PPE		
High visibility Garment	ANSI Type II high-visibility	Must have reflective tape/be visible from all sides
Boots	Leather or rubber	ANSI approved safety toe
Safety Glasses		ANSI Approved; ≥98% ultraviolet (UV) protection
Work Gloves	Leather or Kevlar	If working with sharp objects or powered equipment.
Hard Hat		ANSI Approved; recommended wide-brim
Hearing Protection	Ear plugs and/ or muffs	In hazardous noise areas

Additional PPE:		
Protective Chemical Gloves	Inner: Disposable nitrile Outer: Nitrile	Disposable nitrile gloves
Protective Chemical Coveralls	Inner: Work Uniform Outer: Tyvek	
Protective Chemical Boots		Rubber over boots
Level C Respiratory Protection	Air Purifying Respirator ("APR") organic vapor cartridges P-100 filter dust or combination cartridge.	5 ppm of organic vapors in breathing zone
Face Shield		Safety glasses or goggles must be worn concurrently.

9.4 Respiratory Protection

Respiratory protection maybe required while engineering controls and other work practice are not effective in preventing employees from airborne contaminates. If needed, work will be stopped and the SSO will be contacted and a THA amendment will be generated to address the use of respiratory equipment.

Where respiratory protection is required to be used personnel shall be trained in the proper care, use limitation of the respiratory device and be medically qualified to wear a respirator. A respiratory fit-test is required prior to first used and annually thereafter. AECOM respiratory protection program can be found in [S3NA-519-PR](#).

9.5 Inspection of PPE

It is the responsibility of each employee to inspect their PPE for defects prior to field activities. Defective PPE must be replaced. Prior to donning PPE must be inspected, for damage or defects. Promptly remove any protective clothing that becomes ripped or torn during a particular task.

9.6 Other Safety Equipment

The following additional safety items will be made available to program staff as necessary and appropriate:

- Portable, hand-held eyewash bottles
- First aid kit
- Type A-B-C fire extinguisher
- Hearing protection
- Portable phones

10.0 Decontamination

10.1 General Requirements

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/ impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials, etc.). Specific requires for decontamination procedures can be found in [S3NA-521 Decontamination](#).

If possible, personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the Exclusion Zone.

All persons and equipment entering the Exclusion Zone shall be considered contaminated, and thus, must be properly decontaminated prior to entering the Support Zone.

Decontamination procedures may vary based on site conditions and nature of the contaminant(s). If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The applicable MSDS must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.

10.2 Decontamination Equipment

The equipment required to perform decontamination may vary based on site-specific conditions and the nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
- Hoses, buckets of water or garden sprayers for rinsing;
- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
- Metal or plastic cans or drums for the temporary storage of contaminated liquids; and
- Paper or cloth towels for drying protective clothing and equipment.

Equipment in contact with samples will be decontaminated prior to use to ensure sample integrity. Wherever possible, pre-cleaned, disposable or dedicated equipment will be utilized. All other sampling equipment used in the field investigations will be cleaned before and after sample collection using a three-part decontamination procedure. Cleaning of equipment is performed to prevent cross-

contamination between samples and to maintain a clean working environment for all personnel. Detailed 3-Step decontamination procedures are presented in the QAPP.

Under typical field conditions, the 3-step decontamination process consisting of a laboratory grade glassware detergent (i.e., Alconox®) and tap water scrub to remove visible contamination followed by a generous tap water rinse and a final rinse using distilled and deionized (ASTM Type II) water, will be used for this program. A solvent rinse and acid rinse steps of the full 8-step decontamination process will not be performed during field decontamination. If visual contamination persists, or gross contamination is suspected, additional decontamination procedures will be required (steps 4 through 8 below dependent upon the analysis required) and the 3-step decontamination procedure will be modified:

Eight-Step Decontamination Process:

The field sampling equipment cleaning and decontamination procedures are as follows:

1. Laboratory grade glassware detergent plus tap water wash to remove all visible particulate matter and residual oils and grease (Required);
2. Generous tap water rinse (Required);
3. Distilled and deionized (ASTM Type II) water rinse (Required);
4. 10% nitric acid rinse (trace metal or higher grade HNO₃ diluted with distilled and deionized (ASTM Type II) H₂O)* (As needed);
5. Distilled and deionized (ASTM Type II) water rinse* (As needed);
6. Acetone (pesticide grade) rinse** (As needed);
7. Total air dry or pure nitrogen blow out** (As needed);
8. Distilled and deionized (ASTM Type II) water rinse** (As needed);

*Only if sample is to be analyzed for metals.

**Only if sample is to be analyzed for organics.

All sampling equipment decontaminated via this procedure must be wrapped and/or sealed during storage and prior to use. If visual contamination persists, or gross contamination is suspected, additional decontamination procedures will be required.

In the field, decontamination should be carried out over a container and the residual liquid material must be properly disposed. Decontamination wastes must be disposed in accordance with current NJDEP policy (see Chapter 2 of the *Field Sampling Procedure Manual* (August 2005), Section 2.4.5.7, *Disposal of Development, Purge, Pump Test and Decontamination Water*). Where possible, only dedicated and disposable materials will be used for sample collection to minimize the need for on-site full decontamination.

Decontamination of drilling equipment will be performed by the drilling subcontractor. AECOM will provide the drilling subcontractors with a copy of all the applicable POP(s). Subcontractors will be overseen to ensure that decontamination is completed in accordance with POP PPG 014 and NJDEP *Field Sampling Procedures Manual* (August 2005).

10.3 Personal/Equipment Decontamination

All equipment leaving the Exclusion Zone shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE, support devices, (e.g., hoses, cylinders, etc.), and various handheld tools.

All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the Exclusion Zone. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

Personnel decontamination should consist of the following glove removal procedure:

- Grasp the cuff of the dominant hand and pull glove over the bulk of the hand, leaving the fingers inside the glove.
- Use the dominant hand to grasp the cuff of the non-dominant hand and pull the glove completely off (inside-out) and place inside of the dominant hand glove.
- Once removed, employee should only touch the inside material of the dominant hand glove.
- Thoroughly wash hands.

For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination. Before heavy equipment and trucks are taken offsite, the Site Supervisor and/or SSO will visually inspect them for signs of contamination. If contamination is present, the equipment must be decontaminated.

For smaller equipment, use the following steps for decontamination:

1. Remove majority of visible gross contamination in Exclusion Zone.
2. Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment.
3. Rinse equipment.
4. Visually inspect for remaining contamination.
5. Follow appropriate personal decontamination steps outlined above.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. Equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

AECOM employees will follow the decontamination procedures implemented on the site by the PPG contractor if when exiting the Exclusion Zone.

11.0 Site Control

11.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from site hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community.

Controlled work areas will be established at each work location, and if required, will be established directly prior to the work being conducted. Controlled work areas will be established during the daily safety meetings. If the site layout changes, the new areas and their potential hazards will be discussed immediately after the changes are made.

11.2 Controlled Work Areas

Each HAZWOPER controlled work area will consist of the following three zones:

- Exclusion Zone: Contaminated work area.
- Contamination Reduction Zone: Decontamination area.
- Support Zone: Uncontaminated or “clean area” where personnel should not be exposed to hazardous conditions.

Each zone will be periodically monitored in accordance with the air monitoring requirements established in this HASP. The Exclusion Zone and the Contamination Reduction Zone are considered work areas. The Support Zone is accessible to the public, (e.g., vendors, inspectors).

11.2.1 Exclusion Zone

The Exclusion Zone is the area where primary activities occur, such as sampling, remediation operations, installation of wells, cleanup work, etc. This area must be clearly marked with hazard tape, barricades or cones, or enclosed by fences or ropes. Only personnel involved in work activities, and meeting the requirements specified in the applicable THA and this HASP will be allowed in an Exclusion Zone.

The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with site activities.

- **Drilling.** Determine the mast height of the drill rig. This height will be cleared, if practical, in all directions from the bore-hole location and designated as the Exclusion Zone. The cleared area will be sufficient to accommodate movement of necessary equipment and the stockpiling of spoils piles. Vehicles and other hard barriers should be used where applicable to protect employees and public.
- **Hand Augering/Vacuum Excavation and Clearance.** A distance of 10 feet will be cleared in all directions from the sampling location in order to accommodate additional sampling equipment. Vehicles and other hard barriers should be used where applicable to protect employees and public.

- AECOM typically establishes the Exclusion Zone; however for Garfield Avenue Group remedial activities, the PPG Contractor is responsible for establishing the Exclusion Zone around the work area or temporary stockpile areas and where contamination is present or suspected.

All personnel should be alert to prevent unauthorized, accidental entrance into controlled-access areas (the Exclusion Zone and Contamination Reduction Zone). If such an entry should occur, the trespasser should be immediately escorted outside the area, or all HAZWOPER-related work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated or containerized as waste prior to leaving (through the Contamination Reduction Zone only).

11.2.2 Contamination Reduction Zone

The Contamination Reduction Zone is the transition area between the contaminated area and the clean area. Decontamination is the main focus in this area. The decontamination of workers and equipment limits the physical transfer of hazardous substances into the clean area. This area must also be clearly marked with hazard tape and access limited to personnel involved in decontamination.

Vehicles, equipment and personnel will exit the Exclusion Zone through the Contamination Reduction Zone before entering the support area. All heavy equipment used in the Exclusion Zone shall be decontaminated on the decon pad using a pressure washer prior to entering the support zone.

11.2.3 Support Zone

The Support Zone is an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located. The Support Zone shall have minimal potential for significant exposure to contaminants (i.e., background levels).

Employees will establish a Support Zone (if necessary) at the site before the commencement of site activities. The Support Zone would also serve as the entry point for controlling site access.

11.2.4 Site Access Control

Security at Site 114 is maintained by PPG. All personnel entering Site 114 must sign in/out with the Security Officer on duty and then report to the AECOM Field Office to check in with the CM and/or SSO.

11.2.5 Parking and Staging Areas

Parking at Site 114 will be restricted to areas designated by PPG's contractor. At other sites where vehicles parked on the public streets will be marked with cones both in front of and behind the vehicle.

12.0 Medical Monitoring and Training Requirements

All AECOM Contractor/Subcontractors employee subject to this HASP shall provide copies of documentation indicating that the requirements for training, medical surveillance, and respirator use are current. Copies of these documents shall be made available to AECOM or AECOM's client upon request.

12.1 Medical Monitoring

All personnel performing activities covered by this HASP must be active participants in a medical monitoring program that complies with 29 CFR 1910.120(f). Each individual must have completed an annual surveillance examination and/or an initial baseline examination within the last year prior to performing any work on the site covered by this HASP. The AECOM medical monitoring includes the medical evaluation criteria for respirator use as found in 29 CFR 1910.134 (c) (1) (ii).

12.2 Health and Safety Training

12.2.1 HAZWOPER

All personnel performing activities covered by this HASP must have completed the appropriate training requirements specified in 29 CFR 1910.120 (e). Each individual must have completed an annual 8-hour refresher training course and/or initial 40-hour training course within the last year prior to performing any work on the sites covered by this HASP.

12.2.2 Hexavalent Chromium

As required by [29 CFR 1910.1026\(l\)](#) personnel exposed to or have a potential to be exposed to hexavalent chrome will be trained in the provisions of the hexavalent chromium standard, medical monitoring requirements, health hazards of hexavalent chrome and methods used to control/eliminate exposure to hexavalent chromium.

12.2.3 Treatment Chemical Training

Chemical specific training will be required for personnel involved with the pilot scale treatment studies for groundwater and saturated soils. The training will cover: safe handling procedures, protective garments to be used, health hazards and emergency procedures.

12.2.4 Pre-Entry Briefing

Prior to the commencement of project activities, a pre-entry briefing will be conducted by the AECOM SSO to review the specific requirements of HASP, applicable site rules, PPE requirements, MSDSs etc. Attendance at the pre-entry meeting is mandatory for all personnel covered by this HASP and must be documented on the tailgate meeting attendance form provided in **Appendix C**. All documentation should be maintained in the project file.

12.2.5 Tailgate Meetings

Tailgate safety meetings will held at the beginning of each task or work operation and at least daily thereafter, according to the various circumstances involved or when necessary to clear working procedures. Attendance at the daily tailgate meeting is mandatory for site personnel and must be

documented on the tailgate meeting attendance form provided in **Appendix C**. All documentation should be maintained in the project file.

Meetings will cover relevant health and safety issues, site activities, changes in site conditions, and a review of topics covered in the pre-entry briefing as they apply to daily activities. As part of the tailgate safety meeting, employee feedback (comments, questions, health or safety concerns) are welcomed. Issues addressed in the safety meetings will be documented and shall include the date, attendees, subjects discussed and names of individual(s) who conducted the meeting.

12.2.6 Contractors Briefing

AECOM employees working on the 114 site shall attend the PPG contractor's pre-entry briefing/daily tailgate meeting, as a means of orientating themselves to site condition, health and safety requirements and hazards controls measures.

13.0 Emergency Response

OSHA defines emergency response as any "response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance.

AECOM personnel shall not participate in any emergency response where there are potential safety or health hazards (i.e., fire, explosion, or chemical exposure). AECOM response actions will be limited to evacuation and medical/first aid as described within this section below. As such this section is written to comply with the requirements of 29 CFR 1910.38 (a).

The basic elements of an emergency evacuation plan include:

- Employee training;
- Alarm systems;
- Escape routes;
- Escape procedures;
- Critical operations or equipment;
- Rescue and medical duty assignments;
- Designation of responsible parties;
- Emergency reporting procedures; and
- Methods to account for all employees after evacuation.

13.1 Employee Training

Employees must be instructed in the site-specific aspects of emergency evacuation. On-site refresher or update training is required anytime escape routes or procedures are modified or personnel assignments are changed.

13.2 Alarm System/Emergency Signals

An emergency communication system must be in effect at all sites. The simplest and most and effective emergency communication system in many situations will be direct verbal communications. Each site must be assessed at the time of initial site activity and periodically as the work progresses. Verbal communications must be supplemented anytime voices cannot be clearly perceived above ambient noise levels (i.e., noise from heavy equipment; drilling rigs, backhoes, etc.) and anytime a clear line-of-sight cannot be easily maintained amongst all AECOM personnel because of distance, terrain or other obstructions.

Verbal communications will be adequate to warn employees of hazards associated with the immediate work area. The property is un-occupied and AECOM will not have access to facility phones. Therefore,

AECOM will bring a portable phone to the site to ensure that communications with local emergency responders is maintained, when necessary.

13.3 Escape Routes and Procedures

The escape route from the site and an emergency muster point will be determined and provided to all workers during the project mobilization.

Prior to mobilizing to a new project area, the SSO or his designee will confirm that the escape routes are clear and lead to a safe area.

13.4 Employee Accounting Method

The AECOMs on site team leader/SSO is responsible for identifying AECOM personnel on-site at all times. AECOM Contractors/Subcontractors will notify the SSO when they enter and leave the site. The team leader/SSO will account for all AECOM personnel following an evacuation. The daily Tailgate Meeting form can be used as an attendance sheet to account for employees or a separate sign/out sheet can be maintained.

13.5 Critical Operations

There are no critical operations that would require AECOM employees to remain behind or enter an area during an emergency.

13.6 Injuries and Illnesses

The phone numbers of the police and fire departments, ambulance service, local hospital, and AECOM representatives are provided in the emergency reference sheet **Table 13-1**. This sheet will be posted in the site vehicle.

13.6.1 First Aid

Minor injuries will be treated on site using materials from the first aid kit or other local sources. All cuts and abrasions will be cleaned with potable water and a clean dressing applied. The injured employee will be evaluated at the end of the work day and the following day when the employee arrives at the project site to determine whether the wound has started the healing process. The wound will be protected from contamination during the project activities.

13.6.2 Professional Treatment

In the event of a non-critical injury, and once preliminary reporting been completed, if the injured employee desires/needs to speak with a medical professional to consult on the nature of their injury and treatment options, employees should contact the RSH&E manager who will contact WorkCare. Once contacted, WorkCare will make direct contact with the employee.

Once the injury has been reported, seek treatment (i.e. injuries of the First Aid variety) at the identified non-critical care facility indicated on the THA.

If the injured employee can be moved from the accident area, he or she will be brought to the Contamination Reduction Zone where their PPE will be removed. If the person is suffering from a back or neck injury the person will not be moved and the requirements for decontamination do not apply. The SSO must familiarize the responding emergency personnel about the nature of the site and the injury. If

the responder feels that the PPE can be cut away from the injured person's body, this will be done on-site. If this not feasible, decontamination will be performed after the injured person has been stabilized.

13.7 Incident Response Procedures

13.7.1 Fire

During the incipient phase of the fire, personnel who have been trained and are willing to do so shall deploy a portable fire extinguisher or other effective means for extinguishing a fire (water, soil, blanket etc.), to stop the incipient fire from growing larger. If the fire cannot be prevented from growing larger or extinguished within 30 seconds, the person shall flee the area. Regardless of the effort used to extinguish the incipient phase of the fire, the local fire department shall be notified by calling 911 to report the fire.

- Call the fire department.
- Evacuate the affected area or initiate evacuation by sounding the alarm or verbally warning others. Do not return to burning or smoked-filled areas.
- Report to the designated assembly area.

Dispatch a person to greet the fire department and lead them to the scene.

13.7.2 Medical Emergency Response

The term "medical emergency" means different things in different contexts. In regards to a person, a medical emergency is any life-threatening condition that requires immediate medical intervention to restore breathing, control bleeding, restore circulation, or prevent shock. In regards to incidents on the job, a medical emergency is also an event in which two or more people receive injuries as the result of single incident.

The immediate response to either type of medical emergency is as follows:

- Take control of the situation.
- Ensure personal safety and the safety of others.
- Assist and evaluate the victim(s). Do not try to move the victim(s).
- Direct someone to call 911.
- Dispatch a person to greet the fire department or ambulance and lead the emergency personnel to the scene.
- Do not attempt to perform any type of technical rescue.

13.7.3 Release of Oil or Hazardous Materials

"Emergency response" or "responding to emergencies" means a response effort by employees from outside the immediate release area or by other designated responders (i.e. mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses. Responses to release of hazardous substances where there is no potential safety of health hazard (i.e. fire, explosion, or chemical exposure) are not considered to be emergency responses.

Based on the above paragraph AECOM personnel will not respond to emergencies. Nevertheless, personnel may respond to release of hazardous substances where there is no potential safety of health hazard (i.e. fire, explosion, or chemical exposure).

The response for a release of potentially hazardous material entails the following:

- Determine the nature of the substance released.
- Eliminate all sources of ignition.
- Isolate the affected area or initiate area evacuation.
- Contain the flow of the material from the source if this can be done safely.
- Following the procedures and using the protective equipment as indicated by the MSDS, contain the release to the smallest area possible, and initiate cleanup.
- Dispose of all residues in accordance with the MSDS.

When on-site efforts cannot mitigate the hazard in a timely manner or the material poses a fire or explosion hazard or is a threat public safety, the site and surrounding area shall be evacuated and the Fire Department shall be immediately notified.

Release of oil or hazardous material must be reported to the AECOM PM and RSHEM, with the PM providing notification to the client representative. At this time a determination will be made by the PM to notify the NJDEP and the National Response Center. After initial response actions have been completed an incident investigation will be performed to determine the root causes of the incident and corrective actions, and lessons learned shall be shared to prevent future reoccurrence.

13.7.4 Electrical Strike

Personnel in the vicinity of the incident shall not touch or come near downed power lines. If a machine (crane or other equipment) becomes energized by an electrical utility, all personnel surrounding the machine shall leave the area immediately.

If the machine is energized, the operator should remain on the machine and avoid moving so as not to change their body position until the electric power has been turned off. The operator may choose to move the machine to break contact with the electric power. The operator should follow the manufacturer's procedure to determine if the machine is electrically charged before attempting to dismount the machine.

If persons are exiting the area of an energized machine, it is advised that they should shuffle their feet while walking away or hop away from the machine until they reach a safe area. Gradient electric current could travel up one leg and down the other if feet are apart (from different voltage potential in the soil).

- Call 911 and the electric utility company.
- Barricade the area to prevent personnel from entering the incident area.
- Medical attention cannot be started until the power is shut off.

13.7.5 Fiber Optic Strike

- Do not look into the cut ends of the cable. This can cause severe eye damage.
- Stop machine operation.
- Contact the utility owner immediately and report the condition.

13.7.6 Natural Gas and Petroleum Liquid

- Turn off equipment, if it can be done safely
- Abandon all equipment and get a safe distance away.
- Avoid open flames or anything that might start a fire. Do not start motor vehicles or electrical equipment. Remove all ignition sources (cigarettes, cell phones, or anything that could create a spark or static electricity).
- Evacuate the area and keep people out.
- Do not make contact with escaping gas or liquid.
- Do not operate any pipeline valves.
- Call 911.
- Do not try to put out a fire. If it's burning, let it burn.
- Contact the facility operator immediately to report conditions.

13.7.7 Water/Sewer

- Evacuate the area immediately and keep people out. Leaking water can fill a trench quickly making escape extremely difficult.
- Do not close valves in order to stop flooding. Closing the wrong valves may affect fire flow and /or possible contamination of portable systems.
- Be careful of damaged high-pressure water lines because even the slightest scratch or vibration can cause pipelines to break.
- Move carefully around trenches with wet walls. Wet soil can easily cave in and cause suffocation.
- Avoid contact with wastewater. Do not wade in or work around wastewater.
- Sewer gas is flammable; avoid open flames or anything that might start a fire.
- Contact the facility operator immediately to report the condition.

13.8 Incident Reporting and Investigation

Any incident (other than minor first aid treatment) resulting in injury, illness or property damage requires an Incident investigation and report. The investigation should be conducted as soon as emergency conditions are under control. The purpose of the investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided. An AECOM Incident Investigation Form is presented in **Appendix E** of this HASP. The injured AECOM employee's supervisor, the AECOM PM, and the RSHM should be notified immediately of the injury.

13.9 Emergency Equipment/Facilities

All emergency alerting and response equipment shall be available at the interface of the support and Contamination Reduction Zone. At a minimum, this shall include the following:

- Air Horn
- First Aid Kit
- Fire Extinguisher (10 lb 2A:10B:10C)

- Site Telephone or cell phone
- Eye Wash (delivering a minimum of 0.4 gallons per minute ("gpm") for 15 minutes)
- Spill control supplies (absorbent pads, Speedy Dri, spill booms)

13.10 Occupational Clinic

Once employee report the injury to the SSO or PM, they should seek treatment for non-critical injuries; i.e. injuries of the First Aid variety at the occupational care clinic identified below.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

A map and written directions to the Occupational Care Clinic must be developed for each site location. The route to the clinic shall be verified by the health and safety officer prior to the start of activities, and be familiar to all site personnel.

13.11 Hospital

The hospital in the Jersey City area that provides emergency care is identified below. If emergency medical service is called the medical responders will determine the appropriate hospital for treatment.

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

A map and written directions to the hospital has been developed for each site location and is provided as **Appendix D**. The route to the hospital shall be verified by the health and safety officer prior to the start of activities, and be familiar to all site personnel.

13.12 Emergency Contacts

Emergency contact information is presented in **Table 13-1**.

Table 13-1 EMERGENCY CONTACTS

<i>Emergency Coordinators / Key Personnel</i>			
<u>Name</u>	<u>Title</u>	<u>Telephone Number</u>	<u>Cellular Phone</u>
Chris Martell	AECOM Project Manager	978-564-3633	732-529-5910
Craig MacPhee	AECOM Project Engineer	978-905-2299	978-758-6174
Scott Mikaelian	AECOM Program Manager	732-564-3624	732-757-9425
Ed Bradshaw	AECOM Site 114 Supervisor/Construction Manager	(Use Cell Phone Number)	914-879-1759
Mark Hayden	AECOM Carteret South Site Supervisor/ Construction Manager	978-905-2238	978-888-3168

Emergency Coordinators / Key Personnel			
Rich Feinberg	AECOM Field Operations Manager	732-564-3610	732-233-4552
Ron Kantor	AECOM Site 114 Safety Officer	732-564-3912	908-625-2763
Christine Basinski	AECOM Carteret South Field Operations Manager	732-564-3603	732-259-9401
Michael Grasso	District Health & Safety Manager	607-282-0175	607-282-0175
Philip Platcow	Regional Health & Safety Manager	617-371-4461	617-899-5403
Incident Reporting	Corporate Safety Administrator	800-348-5046	
Organization / Agency			
<u>Name</u>			<u>Telephone Number</u>
Police Department			911
Fire Department			911
Ambulance Service (<i>EMT will determine appropriate hospital for treatment</i>)			911
Work Care (Consulting Physicians)			888-449-7787
Poison Control Center			800-222-1222
Underground Utilities or New Jersey One call			811 or 800-272-1000
Animal Control			201 547-4888
Housing Code Enforcement			201-547-4821/4824
Pollution Emergency			800-292-4706
Emergency Chemical Information – INFOTRAC			800-535-5053
New Jersey Department of Environmental Protection National Response Center Any such report shall include, but not be limited to: a. The location, the quantity, and the type of substance, material, or waste. b. The date and the cause of the discharge, spillage, uncontrolled loss, seepage, or filtration. c. The name and address of the owner of the ship, boat, barge, or other vessel, terminal, establishment, vehicle, trailer, or machine. d. The name and address of the person making the report and relationship to the owner			(877) 927-6337 (800) 424-8802

Appendix A

Health and Safety Plan Acceptance Form



Health and Safety Plan Acceptance Form

May 2012 Program HASP for PPG Hudson County Chromium Sites

I have reviewed a copy of the Health and Safety Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name: _____

Signature: _____

Date: _____

Representing: _____

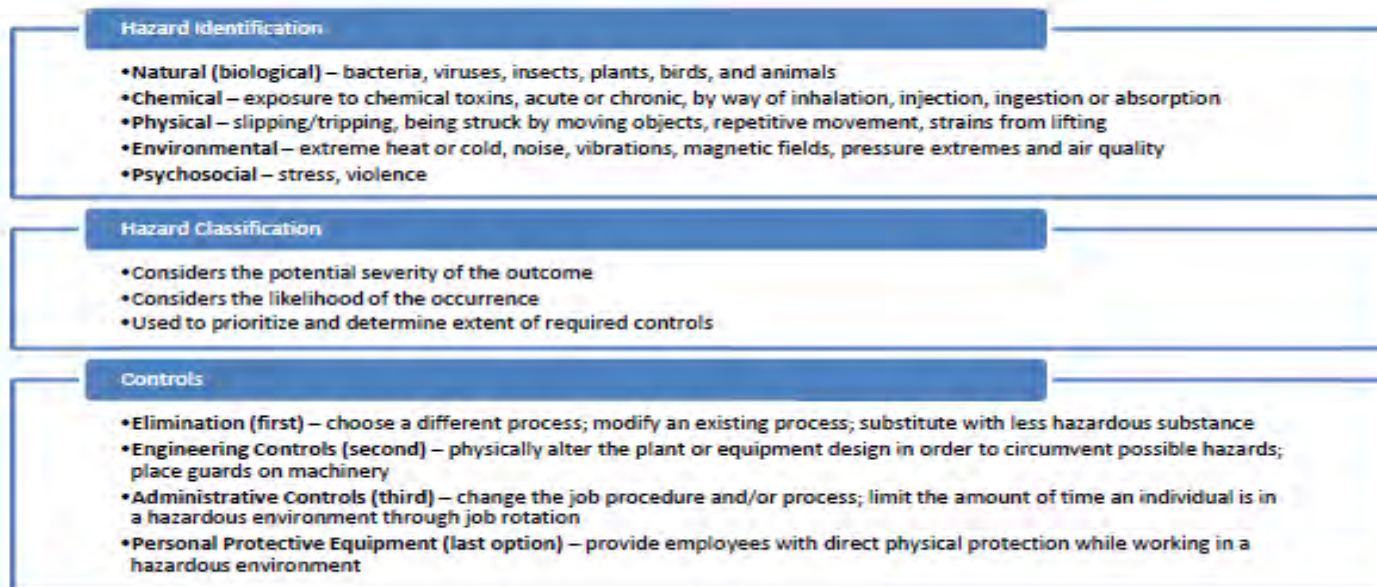
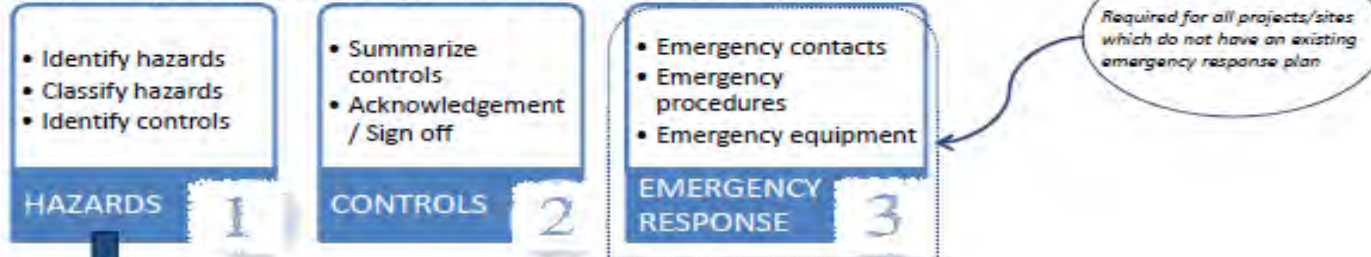
Appendix B

Task Hazard Analysis Form

S3NA-209-FM TASK HAZARD ANALYSIS

This THA (worksheets 1 & 2) must be completed for all field work.

***you may need to change the security settings in your task bar to enable the macros in the forms*



S3NA-209-FM TASK HAZARD ANALYSIS

	Project Name:		Project Number:		Client:	
	Supervisor:		Project Manager:		Location:	
	THA Developed By:				Date:	
TASK HAZARD ANALYSIS	Task Name:				Regularity of Task: One-time ☐ Routine ☐	
Job Event Sequence (List the major steps of the individual task)	Hazards (List primary hazards)	Hazard Classification (before controls)			Controls (List controls that AECOM will implement)	
		Severity	Likelihood	Risk Level		
1				0		
2				0		
3				0		
4				0		
5				0		
6				0		
7				0		
8				0		
9				0		
10				0		
11				0		
12				0		
13				0		
14				0		
15				0		
16				0		
17				0		

Hazard Classification Guidelines		
Severity 1. Remote: potential for injury, property damage/\$ loss, or env damage 2. Potential for minor first aid injury, property damage/\$ loss, or environmental damage 3. Potential for moderate personnel injuries, including medical treatment, property damage/\$ loss, environmental damage, or negative public impact 4. Potential for a serious injury, major property damage/\$ loss, serious impact to the environment, and public health 5. Catastrophic damage to people, property/equipment, environment, or public health	Likelihood of Occurrence 1. Very unlikely 2. Unlikely 3. Likely 4. Very likely 5. Certain	Hazard Classification Matrix  Risk Level = Likelihood x Severity

S3NA-209-FM TASK HAZARD ANALYSIS

AECOM	Project Name:		Project Number:		Client:	
	Supervisor:		Project Manager:		Location:	
	THA Developed By:				Date:	
EMERGENCY RESPONSE PLAN	Task Name:		Regularity of Task:		☐ One-time ☐ Routine ☐	
Check-in Procedures						
Check-in Times	Check-in Person	Phone Number		Cell Phone Number		
Alternate:						
Emergency Coordinators / Key Personnel						
Name	Title	Phone Number		Cell Phone Number		
	On-site First Aid Attendant					
	Project Manager					
	Site Supervisor					
	Regional SH&E Manager					
	Incident Reporting Line (BY THE END OF THE SHIFT)	1.800.348.5046				
	Client Contact					
Emergency Agencies / Public Utilities						
Name	Type	Details		Phone Number		
	Police					
	Fire					
	Ambulance					
	Nearest Hospital / Clinic					
	Poison Control Center					
	Pollution / Environmental					
Emergency Equipment & Supplies		Other Emergency Plan Details				
☐ First Aid Kit - Type:						
☐ Blankets / Survival:						
☐ Fire Extinguishers Type:						
☐ Communication Device						
☐ Vehicle Safety Equipment						
☐ Eye Wash						
☐ Spill Kit						
☐ Other:						

Appendix C

Tailgate Meeting Form

S3NA-210-FM Tailgate Safety Meeting Log

This sign-in log documents the topics of the tailgate safety briefing and individual attendance at the briefing. Personnel who perform work operations onsite are required to attend each safety briefing and acknowledge their ability to ask questions and receipt of such briefings daily. Please provide a brief narrative of the following topics as applicable to the Project.

Name of Meeting Leader

Signature

PROJECT NAME & LOCATION

PROJECT NO.

DATE/TIME

WEATHER CONDITIONS

TOPIC

Discussion – check one

Today's Scope of Work (All tasks) ☐ yes ☐ n/a

Schedule / New Work / Scope Changes ☐ yes ☐ n/a

Reviewed Procedures, THA, etc. ☐ yes ☐ n/a

Emergency Action Plan & Procedures ☐ yes ☐ n/a

Communications Protocol ☐ yes ☐ n/a

Required PPE ☐ yes ☐ n/a

Required Monitoring / Instruments ☐ yes ☐ n/a

Site Control / Work Zones / Security ☐ yes ☐ n/a

Access / Egress / Slips, Trips, & Falls ☐ yes ☐ n/a

Smoking, Eating, & Drinking ☐ yes ☐ n/a

Washroom / Facilities Location ☐ yes ☐ n/a

Heat/Cold Stress ☐ yes ☐ n/a

Exclusion Areas Barricades / Cones ☐ yes ☐ n/a

Required Permits, Passes, Keys, etc. ☐ yes ☐ n/a

Decon Procedures / IDW Mgmt. ☐ yes ☐ n/a

Eqpmt. Inspections/Safety Checklists ☐ yes ☐ n/a

COMMENTS/OTHER

Tailgate Meeting Attendees

Print Name

Signature

SIX QUESTIONS FOR SUCCESS – As your final preparedness take two minutes to think through and answer these questions:

1. What are we about to do?
2. What equipment are we going to use?
3. Have I/we been trained to use this equipment?
4. Have I/we been trained to do this job?
5. How can I/we be hurt?
6. How can I/we prevent this incident?

*If you and your team aren't prepared to do the assigned work, **STOP WORK**, and take time to properly prepare.*

END OF DAY SIGN-OFF:

Site Safety Officer Signature

- ☐ No Incidents Occurred
- ☐ Number of Near Misses/Observations Reported
- ☐ All Incidents Reported the Incident Reporting Line

LESSONS LEARNED/COMMENTS/OTHER

Appendix D

Site History and Hospital Routes

Emergency Information and Hazard Assessment

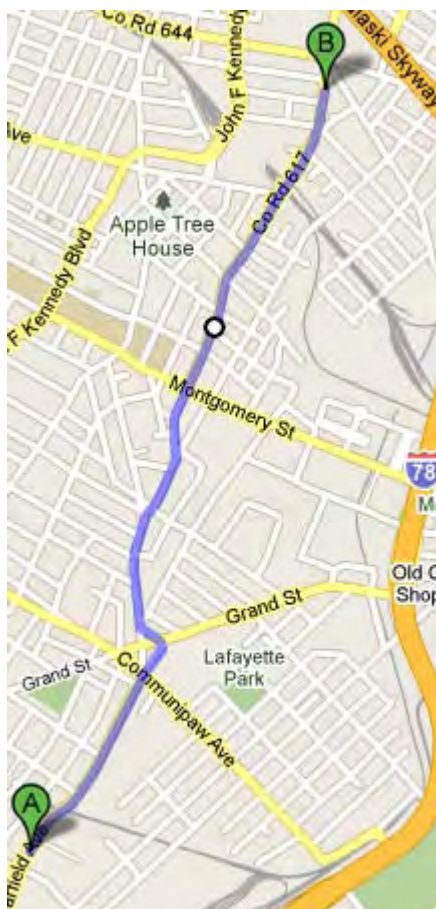
PPG Site 114, Garfield Avenue
Jersey City, New Jersey

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

Driving distance from 880 Garfield Ave is approximately 2.8 miles;
driving time is approximately 7 minutes.





880 Garfield Ave
Jersey City, NJ 07305



- Head **northeast** on **Garfield Ave** toward **Dakota Ave**  0.5 mi
- Turn **left** to stay on **Garfield Ave**  108 ft
- Turn **left** at **Co Rd 619/Ivy Pl**  289 ft
- Turn **right** at **Co Rd 617/Summit Ave**  0.4 mi
- Slight **left** to stay on **Co Rd 617/Summit Ave**  0.9 mi

Destination will be on the right



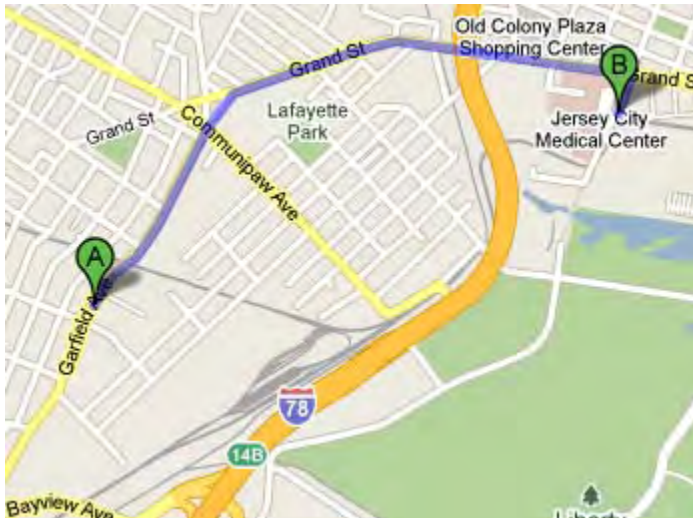
574 Summit Ave
Jersey City, NJ 07306



HOSPITAL

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

Driving distance is approximately 1.6 miles; driving time is approximately 5 minutes



- A** 880 Garfield Ave
Jersey City, NJ 07305
1. Head **northeast** on **Garfield Ave** toward **Dakota Ave** 0.6 mi
 2. Slight **right** at Co Rd 622/Grand St
Continue to follow Grand St 0.9 mi
 3. Turn **right** at **Jersey Ave** 479 ft
- B** Jersey City Medical Center
101 Jersey Avenue
Jersey City, NJ 07302

Site History:

Site 114 - Chromate Production Facility

Site 114 is located at 70 Carteret Avenue in Jersey City, NJ. The western half of Site 114 was the location of a chromate production facility from 1924 to 1963. Products produced at the plant included aluminum hydrate, sodium chromate, sodium bichromate, sodium sulfate, vanadium pentoxide and potassium bichromate. In 1964, the chromate chemical production facility was dismantled.

The residue remaining after the leaching of the roast constituted the only waste produced at the chromate plant. This waste is referred to as “chromate ore processing residue” or COPR. Some COPR was recycled through the process, but the majority was stockpiled on the southeast corner of Site 114 and on adjacent PPG Site 137, or used as fill material to close the Morris Canal. In addition, some material was transported to other Hudson County sites and was used as fill for other purposes.

Site 114 - Manufactured Gas Plant (“MGP”)

Site 114 is located at 70 Carteret Avenue in Jersey City, NJ. The northeastern portion of Site 114 was the location of a manufactured gas plant (“MGP”) that operated from 1886 to the mid-1930s. The MGP used the coal gas process, the water gas process and the carbureted water gas process. The most likely wastes generated at the MGP included: ash, clinker, iron oxide sponge, coke, tar, pitch, drip oil, ammonium sulfate, sulfur, and ammonia liquor.

Hazard Assessment:

Site activities include construction management and environmental investigation and action activities. These activities include:

- Construction oversight
- Health and Safety oversight
- Engineering oversight
- Implementing the air monitoring plan
- Assisting in waste management/records management
- Environmental services
 - Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
 - Physical characterization and sampling of soil samples from soil boring activities;
 - Soil boring installation also includes the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at soil boring locations;
 - Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
 - Conduct an air monitoring program for particulates, volatile organic compounds (VOCs) and other potential contaminants during all investigation activities.
 - Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
 - Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
 - Oversight and direction of subcontractor installation and abandonment of temporary and permanent groundwater monitoring wells, including development of groundwater monitoring wells;

- Gauging, purging and sampling of groundwater monitoring wells;
- Geophysical and hydrologic testing of wells;
- Management of Investigative Derived Waste (“IDW”);
- Oversight and direction for surveying services;
- Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of Chromate Chemical Production Waste (“CCPW”) impacts on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
- Oversight of the installation of interim remedial measures (“IRM”) and continued quarterly inspection and maintenance of all installed IRMs.
- Physical interior and exterior property inspection for the purpose of property acquisition.
- Conduct site walks and property inspections accompanied with the owner prior to implementing an environmental investigation on the property.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,
- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,
- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Chromium and chromium byproducts

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;

PCBs – associated with historic site operations

Emergency Information and Hazard Assessment

PPG Site 132, Garfield Avenue
Jersey City, New Jersey

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

Driving distance from 824 Garfield Ave. is approximately 2.8 miles; driving time is approximately 9 minutes.



A 824 Garfield Ave
Jersey City, NJ 07305

1. Head **north** on **Garfield Ave** toward **Carteret Ave** 0.7 mi
2. Turn **left** to stay on **Garfield Ave** 108 ft
3. Turn **left** at **County Rd 619/Ivy Pl** 289 ft
4. Turn **right** at **County Rd 617/Summit Ave** 0.4 mi
5. Slight **left** to stay on **County Rd 617/Summit Ave** 0.9 mi
Destination will be on the right

B 574 Summit Ave
Jersey City, NJ 07306

Emergency Information and Hazard Assessment

PPG Site 132, Garfield Avenue
Jersey City, New Jersey

HOSPITAL

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

Driving distance is approximately 1.7 miles; driving time is approximately 4 minutes



Site History

Site 132

Site 132 is located at 91 Carteret Avenue in Jersey City, NJ. On Site 132 (Town & Country Linen), an Interim Remedial Measures ("IRM") [pavement cover and fencing] were installed between 1990 and 1992. A Remedial Investigation Workplan was submitted to New Jersey Department of Environmental Protection ("NJDEP") in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in soil at levels up to 20,900 milligrams per kilogram ("mg/kg") of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 85 parts per billion ("ppb") for total chromium. The IRMs (pavement cover and fencing) are inspected on a quarterly basis. Site 132 is proposed to become part of the PPG Carteret South Project.

Hazard Assessment:

Site activities include construction management and environmental investigation and action activities. These activities include:

- Construction oversight

- Health and Safety oversight
- Engineering oversight
- Implementing the air monitoring plan
- Assisting in waste management/records management
- Environmental services
 - Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
 - Physical characterization and sampling of soil samples from soil boring activities;
 - Soil boring installation also includes the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at soil boring locations;
 - Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
 - Conduct an air monitoring program for particulates, volatile organic compounds (VOCs) and other potential contaminants during all investigation activities.
 - Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
 - Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
 - Oversight and direction of subcontractor installation and abandonment of temporary and permanent groundwater monitoring wells, including development of groundwater monitoring wells;
 - Gauging, purging and sampling of groundwater monitoring wells;
 - Geophysical and hydrologic testing of wells;
 - Management of Investigative Derived Waste (“IDW”);
 - Oversight and direction for surveying services;
 - Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of Chromate Chemical Production Waste (“CCPW”) impacts on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
 - Oversight of the installation of interim remedial measures (“IRM”) and continued quarterly inspection and maintenance of all installed IRMs.
 - Physical interior and exterior property inspection for the purpose of property acquisition.
 - Conduct site walks and property inspections accompanied with the owner prior to implementing an environmental investigation on the property.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,
- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,

- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Chromium and chromium byproducts

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;

PCBs – associated with historic site operations

Emergency Information and Hazard Assessment

PPG Site133, Halladay Street
Jersey City, New Jersey

HOSPITAL

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

Driving distance is approximately 1.9 miles; driving time is approximately 5 minutes



A 22 Halladay St
Jersey City, NJ 07304

1. Head **southwest** on **Halladay St** toward **Caven Point Ave** 266 ft
2. Turn **right** at **Caven Point Ave** 384 ft
3. Turn **right** at **Garfield Ave** 0.8 mi
4. Slight **right** at **County Rd 622/Grand St** Continue to follow Grand St 0.9 mi
5. Turn **right** at **Jersey Ave** 486 ft
Destination will be on the right

B 101 Jersey Ave
Jersey City, NJ 07302

Emergency Information and Hazard Assessment

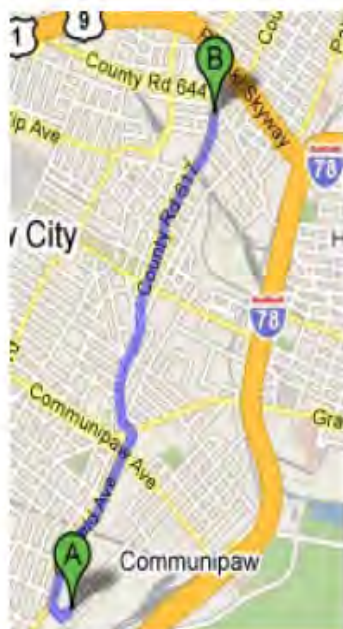
PPG Site133, Halladay Street
Jersey City, New Jersey

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

Driving distance from 1 Burma Rd. is approximately 2.3 miles;
driving time is approximately 7 minutes.



A 22 Halladay St
Jersey City, NJ 07304

1. Head **southwest** on **Halladay St** toward **Caven Point Ave** 266 ft
 2. Turn **right** at **Caven Point Ave** 384 ft
 3. Turn **right** at **Garfield Ave** 0.8 mi
 4. Turn **left** to stay on **Garfield Ave** 108 ft
 5. Turn **left** at **County Rd 619/Ivy Pl** 289 ft
 6. Turn **right** at **County Rd 617/Summit Ave** 0.4 mi
 7. Slight **left** to stay on **County Rd 617/Summit Ave** 0.9 mi
- Destination will be on the right

B 574 Summit Ave
Jersey City, NJ 07306

Site History

Site 133

Site 133 includes 15 Halladay Street and 2-72 Halladay Street in Jersey City, NJ. On Site 133 (Ross Wax), an IRM [interior wall and floor coverings and exterior pavement] were installed in 1991. A Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 11,900 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 7,000 ppb total chromium in the adjacent right-of-way. The interior and exterior IRMs at Site 133 are inspected on a quarterly basis. 15 Halladay was part of the due diligence investigation conducted in early 2012.

Hazard Assessment:

Site activities include construction management and environmental investigation and action activities. These activities include:

- Construction oversight
- Health and Safety oversight
- Engineering oversight
- Implementing the air monitoring plan
- Assisting in waste management/records management
- Environmental services
 - Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
 - Physical characterization and sampling of soil samples from soil boring activities;
 - Soil boring installation also includes the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at soil boring locations;
 - Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
 - Conduct an air monitoring program for particulates, volatile organic compounds (VOCs) and other potential contaminants during all investigation activities.
 - Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
 - Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
 - Oversight and direction of subcontractor installation and abandonment of temporary and permanent groundwater monitoring wells, including development of groundwater monitoring wells;
 - Gauging, purging and sampling of groundwater monitoring wells;
 - Geophysical and hydrologic testing of wells;
 - Management of Investigative Derived Waste ("IDW");
 - Oversight and direction for surveying services;
 - Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of Chromate Chemical Production Waste ("CCPW") impacts on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
 - Oversight of the installation of interim remedial measures ("IRM") and continued quarterly inspection and maintenance of all installed IRMs.
 - Physical interior and exterior property inspection for the purpose of property acquisition.
 - Conduct site walks and property inspections accompanied with the owner prior to implementing an environmental investigation on the property.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,

- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,
- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Chromium and chromium byproducts

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;

PCBs – associated with historic site operations

Emergency Information and Hazard Assessment

PPG Site 135, Pacific Avenue
Jersey City, New Jersey

HOSPITAL

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

Driving distance is approximately 1.5 miles; driving time is approximately 5 minutes



A 51 Pacific Ave
Jersey City, NJ 07304

1. Head **northeast** on **Pacific Ave** toward **Carteret Ave**  1.2 mi
2. Turn **right** at **County Rd 622/Grand St**  0.3 mi
Continue to follow Grand St
3. Turn **right** at **Jersey Ave**  486 ft
Destination will be on the right

B 101 Jersey Ave
Jersey City, NJ 07302

Emergency Information and Hazard Assessment

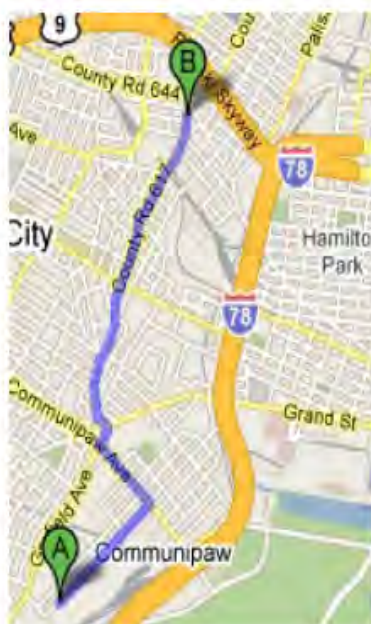
PPG Site 135, Pacific Avenue
Jersey City, New Jersey

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

Driving distance from 51 Pacific Ave. is approximately 2.4 miles;
driving time is approximately 7 minutes.



51 Pacific Ave
Jersey City, NJ 07304

- Head **northeast** on **Pacific Ave** toward **Carteret Ave** 0.6 mi
- Turn **left** at the 1st cross street onto **Communipaw Ave/County Rd 612** 0.3 mi
- Turn **right** at **Garfield Ave** 344 ft
- Take the 1st **left** to stay on **Garfield Ave** 108 ft
- Turn **left** at **County Rd 619/Ivy Pl** 289 ft
- Turn **right** at **County Rd 617/Summit Ave** 0.4 mi
- Slight **left** to stay on **County Rd 617/Summit Ave** 0.9 mi

Destination will be on the right

574 Summit Ave
Jersey City, NJ 07306

Site History

Site 135

Site 135 is located from 51-99 Pacific Avenue in Jersey City, NJ. On Site 135 (Vitarroz), a Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 20 mg/kg of hexavalent chromium. On Site 135, hexavalent chromium was detected at 20.1 mg/kg in only one sample (PPG-135-MW1C). Total chromium was detected in site groundwater at levels up to 114 ppb for total chromium.

Hazard Assessment:

Site activities include construction management and environmental investigation and action activities. These activities include:

- Construction oversight
- Health and Safety oversight
- Engineering oversight
- Implementing the air monitoring plan
- Assisting in waste management/records management
- Environmental services
 - Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
 - Physical characterization and sampling of soil samples from soil boring activities;
 - Soil boring installation also includes the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at soil boring locations;
 - Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
 - Conduct an air monitoring program for particulates, volatile organic compounds (VOCs) and other potential contaminants during all investigation activities.
 - Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
 - Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
 - Oversight and direction of subcontractor installation and abandonment of temporary and permanent groundwater monitoring wells, including development of groundwater monitoring wells;
 - Gauging, purging and sampling of groundwater monitoring wells;
 - Geophysical and hydrologic testing of wells;
 - Management of Investigative Derived Waste ("IDW");
 - Oversight and direction for surveying services;
 - Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of Chromate Chemical Production Waste ("CCPW") impacts on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
 - Oversight of the installation of interim remedial measures ("IRM") and continued quarterly inspection and maintenance of all installed IRMs.
 - Physical interior and exterior property inspection for the purpose of property acquisition.
 - Conduct site walks and property inspections accompanied with the owner prior to implementing an environmental investigation on the property.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,

- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,
- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Chromium and chromium byproducts

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;

PCBs – associated with historic site operations

Emergency Information and Hazard Assessment

PPG Site137, Halladay Street
Jersey City, New Jersey

HOSPITAL

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

Driving distance is approximately 1.9 miles; driving time is approximately 5 minutes



A 25 Halladay St
Jersey City, NJ 07304

1. Head **southwest** on **Halladay St** toward **Caven Point Ave** 338 ft
2. Turn **right** at **Caven Point Ave** 384 ft
3. Turn **right** at **Garfield Ave** 0.8 mi
4. Slight **right** at **County Rd 622/Grand St** Continue to follow Grand St 0.9 mi
5. Turn **right** at **Jersey Ave** 486 ft
Destination will be on the right

B 101 Jersey Ave
Jersey City, NJ 07302

Emergency Information and Hazard Assessment

PPG Site 137, Halladay Street
Jersey City, New Jersey

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

Driving distance from 45 Halladay St. is approximately 2.3 miles;
driving time is approximately 7 minutes.



A 25 Halladay St
Jersey City, NJ 07304

1. Head **southwest** on **Halladay St** toward **Caven Point Ave** 338 ft
 2. Turn **right** at **Caven Point Ave** 384 ft
 3. Turn **right** at **Garfield Ave** 0.8 mi
 4. Turn **left** to stay on **Garfield Ave** 108 ft
 5. Turn **left** at **County Rd 619/Ivy Pl** 289 ft
 6. Turn **right** at **County Rd 617/Summit Ave** 0.4 mi
 7. Slight **left** to stay on **County Rd 617/Summit Ave** 0.9 mi
- Destination will be on the right

B 574 Summit Ave
Jersey City, NJ 07306

Site History

Site 137

Site 137 is located at 25 Halladay Street and 45 Halladay Street in Jersey City, NJ. On Site 137 (Rudolf Bass) at 45 Halladay Street, IRM [interior wall and floor coverings; and exterior pavement] were installed between 1990 and 1992. A Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 29,300 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 19,000 ppb for total chromium.

On Site 137 (Rudolf Bass) at 25 Halladay Street, a Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. The property has a building on it and is presently being used for light industrial purposes. Hexavalent chromium was detected in site soil at levels up

to 26,000 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater at levels up to 5,300 ppb for total chromium. Interim remedial measures were implemented at Site 137 and engineering controls have been installed within the building interior and exterior to address observed chromium impacted surfaces. The IRMs are inspected on a quarterly basis. 25 Halladay was part of the due diligence investigation conducted in early 2012.

Hazard Assessment:

Site activities include construction management and environmental investigation and action activities. These activities include:

- Construction oversight
- Health and Safety oversight
- Engineering oversight
- Implementing the air monitoring plan
- Assisting in waste management/records management
- Environmental services
 - Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
 - Physical characterization and sampling of soil samples from soil boring activities;
 - Soil boring installation also includes the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at soil boring locations;
 - Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
 - Conduct an air monitoring program for particulates, volatile organic compounds (VOCs) and other potential contaminants during all investigation activities.
 - Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
 - Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
 - Oversight and direction of subcontractor installation and abandonment of temporary and permanent groundwater monitoring wells, including development of groundwater monitoring wells;
 - Gauging, purging and sampling of groundwater monitoring wells;
 - Geophysical and hydrologic testing of wells;
 - Management of Investigative Derived Waste ("IDW");
 - Oversight and direction for surveying services;
 - Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of Chromate Chemical Production Waste ("CCPW") impacts on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
 - Oversight of the installation of interim remedial measures ("IRM") and continued quarterly inspection and maintenance of all installed IRMs.

- Physical interior and exterior property inspection for the purpose of property acquisition.
- Conduct site walks and property inspections accompanied with the owner prior to implementing an environmental investigation on the property.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,
- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,
- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Chromium and chromium byproducts

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;

PCBs – associated with historic site operations

Emergency Information and Hazard Assessment

PPG Site 143, Garfield Avenue
Jersey City, New Jersey

HOSPITAL

Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

Driving distance is approximately 1.7 miles; driving time is approximately 4 minutes



A 846 Garfield Ave
Jersey City, NJ 07305

1. Head **north** on **Garfield Ave** toward **Carteret Ave** 0.6 mi
2. Slight **right** at **County Rd 622/Grand St**
Continue to follow Grand St 0.9 mi
3. Turn **right** at **Jersey Ave**
Destination will be on the right 486 ft

B 101 Jersey Ave
Jersey City, NJ 07302

Emergency Information and Hazard Assessment

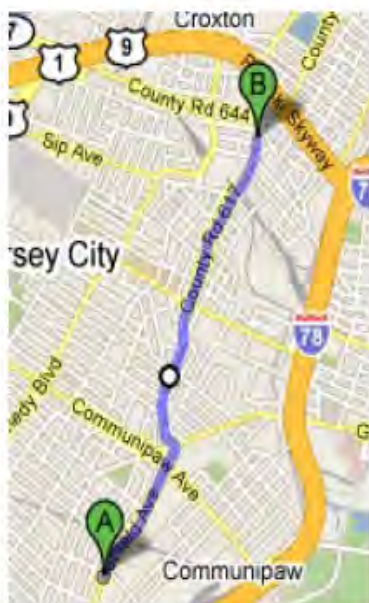
PPG Site 143, Garfield Avenue
Jersey City, New Jersey

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

Driving distance from 846 Garfield Ave. is approximately 2.0 miles; driving time is approximately 6 minutes.



A
846 Garfield Ave
Jersey City, NJ 07305

1. Head **north** on **Garfield Ave** toward **Carteret Ave** 0.6 mi
2. Turn **left** to stay on **Garfield Ave** 108 ft
3. Turn **left** at **County Rd 619/Ivy Pl** 289 ft
4. Turn **right** at **County Rd 617/Summit Ave** 0.4 mi
5. Slight **left** to stay on **County Rd 617/Summit Ave** 0.9 mi
Destination will be on the right

B
574 Summit Ave
Jersey City, NJ 07306

Site History

Site 143

Site 143 is located at 846 Garfield Avenue in Jersey City, NJ. On Site 143 (Talarico Auto), an IRM (exterior covering) was installed between 1990 and 1992. A Remedial Investigation Workplan was submitted to NJDEP in 2006, and remedial investigation fieldwork was completed in 2007. Hexavalent chromium was detected in site soil at levels up to 1,530 mg/kg of hexavalent chromium. Total chromium was detected in site groundwater in the adjacent right of way at levels up to 25,000 ppb for total chromium. Site 143 was part of the due diligence investigation conducted in late 2011.

Hazard Assessment:

Site activities include construction management and environmental investigation and action activities. These activities include:

- Construction oversight
- Health and Safety oversight
- Engineering oversight
- Implementing the air monitoring plan
- Assisting in waste management/records management
- Environmental services
 - Oversight of the installation of soil borings, via direct-push and conventional drilling methods;
 - Physical characterization and sampling of soil samples from soil boring activities;
 - Soil boring installation also includes the oversight of non-mechanical excavation for utility clearance via soft dig (vactron/air knife) of at least the upper five (5) feet at soil boring locations;
 - Collection of environmental samples from soil, groundwater, air, surface water, waste, concrete and other matrices;
 - Conduct an air monitoring program for particulates, volatile organic compounds (VOCs) and other potential contaminants during all investigation activities.
 - Oversight of environmental test pits and environmental trenching which includes excavation, stock piling and backfilling material.
 - Conduct in-situ pilot tests and oversight of joint pilot tests conducted by other contracted consultants.
 - Oversight and direction of subcontractor installation and abandonment of temporary and permanent groundwater monitoring wells, including development of groundwater monitoring wells;
 - Gauging, purging and sampling of groundwater monitoring wells;
 - Geophysical and hydrologic testing of wells;
 - Management of Investigative Derived Waste ("IDW");
 - Oversight and direction for surveying services;
 - Physical interior and exterior property inspection by AECOM accompanied with the resident/owner looking for visual evidence of Chromate Chemical Production Waste ("CCPW") impacts on the exterior of any structures as well as the interior of ground floor and basement or crawl space, if present.
 - Oversight of the installation of interim remedial measures ("IRM") and continued quarterly inspection and maintenance of all installed IRMs.
 - Physical interior and exterior property inspection for the purpose of property acquisition.
 - Conduct site walks and property inspections accompanied with the owner prior to implementing an environmental investigation on the property.

Physical Hazards

The primary physical hazards which may be encountered may include:

- Struck by motor vehicles, construction equipment or material handled,
- Slips trips and falls on the same level,
- Falls from elevations,
- Caught in/between,
- Underground and overhead utilities,
- Electrical hazards,
- Biological hazards,
- Noise Exposure, and
- Heat stress and cold stress.

Contaminates of Concern

The primary contaminant of concern is:

- Chromium and chromium byproducts

The secondary contaminants of concern include:

- Various metals (Vanadium, Antimony, Nickel, Arsenic) – associated with chromium production and historic fill;
- VOCs – associated with historic site and MGP facility operations;
- SVOCs – associated with historic site and MGP facility operations;
- PAHs – associated with historic fill;
- Pesticides – associated with historic site operations and fill;

PCBs – associated with historic site operations



Appendix E

Supervisor's Accident Investigation Report Form

S3NA-004-FM1

SUPERVISOR'S REPORT OF INCIDENT

1. SEEK IMMEDIATE MEDICAL ATTENTION IF NECESSARY
2. EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY.
3. REPORT THE INCIDENT TO THE APPROPRIATE INCIDENT REPORTING LINE.

(800) 348-5046

ORGANIZATION INFORMATION

REGION: ☐ CAN-EAST ☐ CAN-CENTRAL ☐ CAN-WEST
☐ MID-ATLANTIC ☐ MIDWEST ☐ NORTHEAST ☐ South ☐ WEST

DISTRICT:**PROJECT
NUMBER:**

BUSINESS LINE: ☐ AECOM CORP ☐ CONSTRUCTION SERVICES ☐ ENERGY&POWER ☐
 ENVIRONMENT ☐ PDD ☐ TRANSPORTATION ☐ WATER

CLIENT NAME:**PROJECT NAME:**

ADMINISTRATIVE

EMPLOYEE NAME:**EMPLOYEE NUMBER:****WORK PHONE:****CELL PHONE:****EMPLOYEE STATUS** ☐ FULL TIME ☐ PART TIME☐ SUB ☐ TEMP AGENCY ☐ THIRD PARTY**HOME OFFICE ADDRESS:****JOB TITLE:**

DESCRIPTION OF EVENT

TYPE OF OCCURRENCE: ☐ INJURY/ILLNESS ☐ PROPERTY DAMAGE ☐ ENV DAMAGE/SPILL ☐
 REGULATORY INSPECTION

☐ MOTOR VEHICLE ACCIDENT ☐ BOATING INCIDENT ☐ NOV/CITATION ☐ REPUTATIONAL (AECOM,
 CLIENT, OTHER)

DATE OF INCIDENT:**TIME OF INCIDENT:****DATE REPORTED TO SUPERVISOR:****TIME REPORTED TO
SUPERVISOR:****INCIDENT ADDRESS/LOCATION:****CITY:****STATE/PROVINCE/TERRITORY:****ZIP/POSTAL CODE:**

WERE THERE ANY SUBCONTRACTORS, WITNESSES OR OTHER PERSONS INVOLVED: ☐ Yes ☐ No

IF YES, PLEASE PROVIDE DETAILS TO INCLUDE NAMES AND CONTACT INFORMATION

S3NA-004-FM1

SUPERVISOR'S REPORT OF INCIDENT

PERSONAL INJURY

TYPE OF INJURY: ☐ FIRST AID (TREATED ON-SITE) ☐ MEDICAL AID (TREATED BY PROFESSIONAL) ☐ FATALITY

DESCRIBE THE INJURY AND BODY PART AFFECTED:

WAS A DOCTOR OR HOSPITAL VISITED? ☐ YES ☐ NO

IF YES, WHEN:

MEDICAL RECEIVED:

DOCTOR/HOSPITAL NAME:

PROVIDER ADDRESS:

PHONE NUMBER:

PROPERTY DAMAGE (COMPLETE FOR PROPERTY DAMAGE ONLY)

TYPE OF DAMAGE: ☐ AECOM PROPERTY ☐ MOTOR VEHICLE (COMPLETE MVA REPORT PAGE 3)

☐ SPILL OR RELEASE OF A HAZARDOUS SUBSTANCE ☐ MAJOR STRUCTURAL FAILURE ☐ CLIENT, SUBCONTRACTOR, OTHER:

DESCRIBE THE SPECIFIC DAMAGE, STRUCTURAL FAILURE OR HAZARDOUS RELEASE:

RANK THE SEVERITY OF THE DAMAGE: ☐ MINOR ☐ SERIOUS ☐ MAJOR

WHERE CAN THE PROPERTY BE SEEN?

PROPERTY OWNER NAME:

CONTACT INFORMATION:

IS THERE ANY POTENTIAL FOR CIVIL, CRIMINAL OR REGULATORY LIABILITY AGAINST AECOM OR AN EMPLOYEE?

☐ YES ☐ NO

IF YES, DISCUSS WITH AECOM REGIONAL COUNSEL BEFORE PROCEEDING WITH ANY FURTHER REPORTING.

INDICATE WHO HAS BEEN NOTIFIED OF THE EVENT (E.G., OWNER/OPERATOR, STATE (US) OR GOVERNING BODY OF LABOR, ETC?)

EMPLOYEE DESCRIPTION OF INCIDENT:

What, when, where, why, how? Attached notes/diagrams as required and list any machinery or equipment involved.

ON-SITE/CORRECTIVE ACTIONS

INCIDENT IMMEDIATELY REPORTED ON-SITE TO:

S3NA-004-FM1 SUPERVISOR'S REPORT OF INCIDENT			
WHAT CORRECTIVE ACTIONS WERE IMMEDIATELY IMPLEMENTED ON-SITE?			
WHAT LONG-TERM OR PERMANENT CORRECTIVE ACTIONS ARE RECOMMENDED?			
ACKNOWLEDGEMENTS			
EMPLOYEE PRINTED NAME AND PHONE		SIGNATURE AND DATE	
SUPERVISOR REVIEW OF INCIDENT:			
SUPERVISORS PRINTED NAME AND PHONE		SIGNATURE AND DATE	
MANAGER COMMENTS:			
MANAGER PRINTED NAME AND PHONE		SIGNATURE AND DATE	
FOR REGIONAL SH&E MANAGER USE ONLY:			
CORRECTIVE ACTIONS REQUIRING IMPLEMENTATION BY SH&E MANAGER:		RATIONALE:	
NAME AND SIGNATURE:		DATE:	
RECORDABILITY DETERMINATION ☐ FIRST AID ☐ RECORDABLE ☐ RECORDABILITY UNDETERMINED ☐ NON WORK ☐ PROPERTY DAMAGE ☐ GENERAL LIABILITY ☐ VANDALISM COMMENTS:			

Appendix F

AECOM SH&E SOPs

S3NA-209-PR Project Hazard Assessment and Planning

1.0 Purpose and Scope

- 1.1 AECOM and its employees must assess all projects and sites for anticipated hazards and plan to mitigate those hazards through a series of controls. This procedure establishes the requirements and provides the tools for this process of pre-work planning and risk assessment.
- 1.2 The objective is to enhance SH&E performance, to reduce losses due to injury, illness, property damage, or environmental impairment incident, and maintain regulatory compliance.
- 1.3 This procedure applies to all AECOM North America based employees and operations.

2.0 Terms and Definitions

- 2.1 **Task Hazard Analysis (THA):** A THA (*S3NA-209-FM Task Hazard Analysis*) is a technique for evaluating the component parts of any work method or procedure for the purpose of:
 - 2.1.1 Identifying the SH&E hazards and risks connected with the work;
 - 2.1.2 Identifying and implementing control methods to eliminate, nullify, or reduce to a minimum the consequences of such hazards and risks; and,
 - 2.1.3 Evaluating the effectiveness of risk control measures and making modifications as needed.
- 2.2 **Plan:** A comprehensive document which outlines at length, in a report-style format, all of the operational controls necessary to mitigate the anticipated hazards for a project's sites and activities. AECOM will use two established planning templates:
 - 2.2.1 Health and Safety Plan (HASP) for work involving environmental contaminants (e.g., HAZWOPER), or
 - 2.2.2 Safe Work Plan (SWP) for all other SH&E planning documentation.
- 2.3 **High Risk Classification:** Any task where the identified hazard, if further controls are not implemented, has a combined severity and probability that is either catastrophic or very likely, or some combination thereof (but where the result is not minor or rare). (Refer to *S3NA-209-WI Hazard Identification, Classification and Controls* for further details.) The following may be classified as High Risk; consult the SH&E Department for clarification:
 - 2.3.1 Confined space,
 - 2.3.2 HAZWOPER,
 - 2.3.3 Contaminated sites,
 - 2.3.4 Radiation,
 - 2.3.5 Lead,
 - 2.3.6 Asbestos,
 - 2.3.7 AECOM camp or construction sites,
 - 2.3.8 Competent person requirements,
 - 2.3.9 Sites with potential for client system failures,
 - 2.3.10 Significant physical hazards (e.g., fall, water, equipment, etc.),
 - 2.3.11 Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO) Ops
 - 2.3.12 Potential for significant environmental incident, or
 - 2.3.13 Sites with medical surveillance requirements.

3.0 Attachments

- 3.1 S3NA-209-FM Task Hazard Analysis
- 3.2 S3NA-209-WI Hazard Identification, Classification and Controls
- 3.3 S3NA-209-TP1 Safe Work Plan
- 3.4 S3NA-209-TP2 Health and Safety Plan Template
- 3.5 S3NA-209-TP2a HASP Assistant
- 3.6 S3NA (US)-209-TP2b HASP Chemical Guidelines

4.0 Procedure

4.1 Roles & Responsibilities

4.1.1 SH&E Department responsibilities include the following:

- Assisting project management personnel to identify any necessary project-specific SH&E planning documentation required for all new and ongoing projects.
- Assisting in the preparation of necessary SH&E planning documentation.
- Reviewing and approving all SH&E planning documentation prior to its implementation for field activities.

4.1.2 Project Manager (or their designee) responsibilities include the following:

- Confirming the completion of SH&E planning documentation (THA, SWP or HASP), as required, that addresses the full range of project activities, safety risks and that all requirements and procedures are implemented and enforced during the field activities.
- Confirming SH&E requirements and Standard Operating Procedures are implemented successfully, including but not limited to:
 - Subcontractor evaluations
 - SH&E Training
 - Personal Protective Equipment
 - First aid and emergency response
 - Client requirements
- Contacting the SH&E Department to discuss SH&E planning documentation needs/ requirements at the start of each new project involving AECOM and at designated intervals (not to exceed one year) or when changes occur to the work operations or work location/ conditions, when work activities are modified/ changed, or when additional tasks are added to the work scope.
- Confirming that all SH&E planning documentation (draft or final) has been reviewed and approved by the **SH&E Department** prior to its use by AECOM personnel, or prior to release to outside agencies or organizations.
- Making appropriate resources available to protect the health and safety of AECOM employees, the environment and to comply with occupational health and safety, and environmental legislation and for the effective implementation of this procedure.

4.1.3 Employee responsibilities include the following:

- Participating in hazard identification training at the commencement of their employment with AECOM or prior to commencing field preparations.
- Reviewing and understanding the potential hazards and controls of the project before work commences.
- Complying with all required controls as identified in the THA and/or associated safety plans.

4.2 Procedure

4.2.1 All projects must have a completed Task Hazard Analysis at a minimum. In addition, all field projects must have an Emergency Response Plan. These two documents may be all a project needs for administrative safety requirements, depending on the hazards identified.

4.2.2 The table below helps illustrate the further planning documentation which may be required, depending on the hazards identified in the THA.

Task Hazard Analysis	- Most basic requirement - All sites and tasks including walk-through site visits	- Prepared by employees/supervisors - Confirmed by Project Manager or designee
Safe Work Plan (SWP)	- High risk activities - Complex projects with multiple stakeholders, long-duration - AECOM controlled sites - Non-HAZWOPER	SH&E Department review and guidance required
Health & Safety Plan (HASP)	- HAZWOPER regulated sites and all other sites with potential chemical exposures - Client directed	- Only for sites with potential chemical exposures and Hazardous Waste Operations and Emergency Response (HAZWOPER) - SH&E Department review and guidance required

4.3 Task Hazard Analysis (THA)

4.3.1 A THA must be completed for all (routine and non-routine) tasks and sites.

4.3.2 A THA must be completed prior to the commencement of work so that all controls can be planned, equipment purchased/inspected, and staff adequately trained for the hazards.

4.3.3 The THA must identify all known and potential physical hazards as well as potential occupational exposures for noise, biological, or chemical contaminants, and environmental issues.

4.3.4 The assessment must include the identification and implementation of control measures to prevent worker injury, exposure and contamination.

4.3.5 Hazard identification and risk assessment must be ongoing. This requires the project team to consider the timing and frequency of the THA reviews, as affected by the following types of issues:

- The need to determine whether existing risk controls are effective and adequate,
- The need to respond to new hazards,
- The need to respond to changes that AECOM itself has made,
- The need to respond to feedback from monitoring activities, incident investigation, emergency situations or the results of testing of emergency procedures,
- Changes in legislation,
- External factors, e.g. emerging occupational health issues,
- Advances in control technologies,
- Changing diversity in the workforce, including contractors, or
- Changes proposed by corrective and preventive action.

4.3.6 THAs will be prepared by the supervisor and employee(s) directly responsible for the work.

4.3.7 Final drafts shall be submitted for review and approved by the **Project Manager** prior to commencing work activities.

4.3.8 AECOM subcontractors will prepare their own THA and submit them to the **Project Manager** for review and acceptance prior to the start of subcontracted work activities. These reviews are not approvals, and do not relieve the subcontractor for being responsible for their own safety on the project site.

- 4.3.9 The **Project Manager** shall maintain all approved/signed THA copies (including revisions) in the project files and make them available during project audits and for use during the training of new project personnel.
- 4.3.10 THAs shall be used to facilitate project SH&E tailgate meetings. Comments and suggestions relative to the completed THA shall be encouraged from attendees and incorporated into revised documents. Any modifications must be reviewed as corrective measures to confirm that no new hazards are created.
- 4.3.11 THAs that have been found to be inadequate or incomplete should be suitably annotated by the project management team to be used as lessons learned.
- 4.3.12 The THA will be reviewed by all personnel involved in the task, as well as any visitors or additional or new crews brought on to perform the work. This is a minimum of a one-time review and signature with supplement reviews conducted on a pre-determined basis by the **Project Manager** or their designee.
- 4.4 **Planning Documents**
- 4.4.1 An SH&E plan (in addition to the THA) may be required in the following circumstances:
- Tasks with high risk classification designations,
 - Tasks with medium risk classification designations, where circumstances warrant, and/or
 - Complex AECOM controlled projects where it is necessary to communicate to numerous stakeholders and clearly define all controls including emergency response, incident reporting, inspections, security requirements, or other details.
- 4.4.2 The planning document shall be titled a Safe Work Plan UNLESS it involves Hazardous Waste Operations and Emergency Response (HAZWOPER) requirements, then it will be called a Health and Safety Plan (HASP) and will clearly address the specific requirements associated with the hazardous waste exposures.
- 4.4.3 Specific plan needs will vary for each project. In some cases it may be acceptable to utilize general (non-site/non-project-specific) SH&E procedural documentation prepared for the type of work activities being performed, while in others project/site/activity-specific documentation is required to be developed as part of the project planning process. The specific operational needs of individual projects will be determined as part of the initial coordination between the **Project Manager** and the **SH&E Department**.
- 4.4.4 The following requirements apply to all AECOM SH&E planning documentation:
- Preparation of the SH&E documentation can be performed by a member of the project team or the **SH&E Department**.
 - All SH&E documentation (including draft versions of documents) will be approved by the **SH&E Department** prior to release for outside agency review (e.g., clients, regulatory agencies, etc) and prior to its field implementation.
 - All changes to approved SH&E documentation require concurrence from a designated member of the **SH&E Department**. This includes those made in response to changing field conditions or operational requirements and those made in response to regulator/client comments. Any written responses made to regulator/client comments also must be reviewed and approved by the **SH&E Department**.
 - The SH&E documentation for any project lasting twelve (12) months or longer will be reviewed at periodic intervals determined by the **SH&E Department**, but at least annually. The SH&E Representative will review the changes and determine whether modifications are required to the existing SH&E planning documentation. This confirms that the documentation continues to reflect the current project scope and knowledge of site conditions, and that any revised regulatory requirements are properly addressed. The **Project Manager** will provide a master copy of the SH&E documentation to be maintained on site for reference by personnel, together with copies of any required SH&E-related records or operational documentation. The master copy must be current in all respects, and will include any changes or modifications made as work progresses.
 - **Project Managers** will confirm that ALL plans and THAs have been reviewed with project personnel prior to implementation of field work. Sign-off and concurrence is mandatory and to be kept in the project records.

5.0 Records

- 5.1 Completed THAs, SWPs, and HASPs will be filed in their appropriate project file.

6.0 References

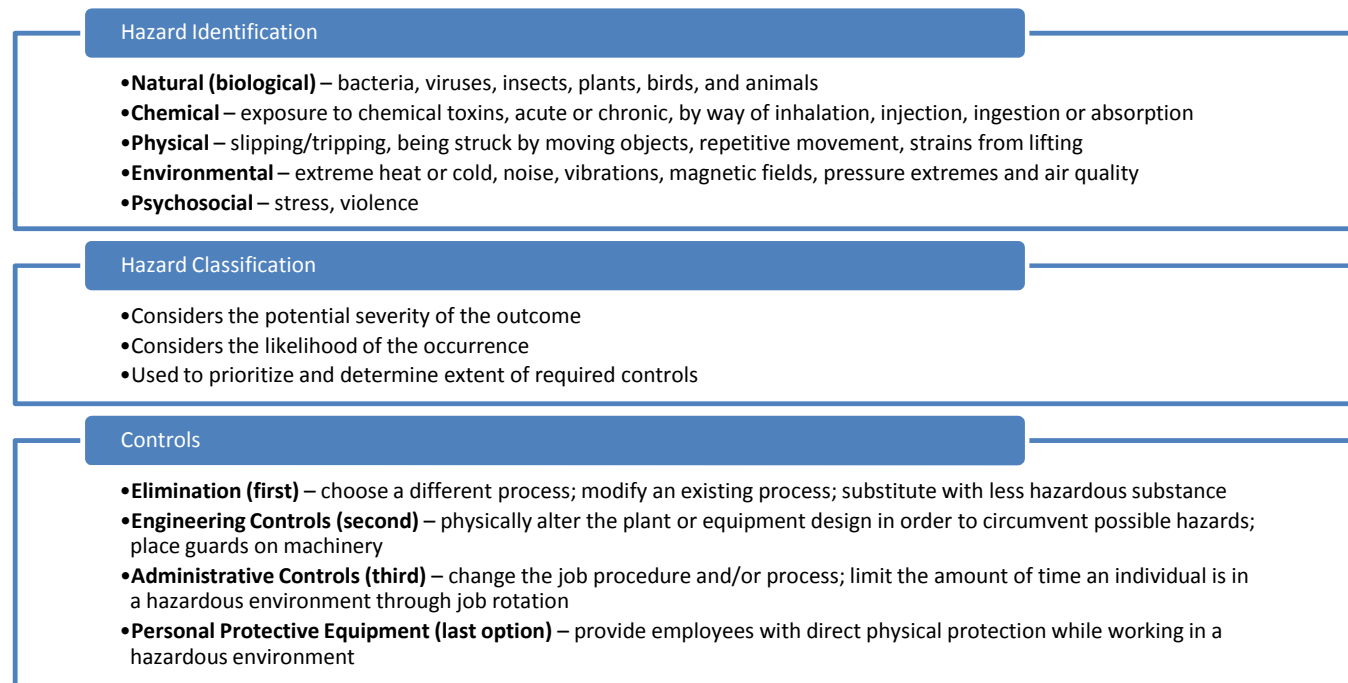
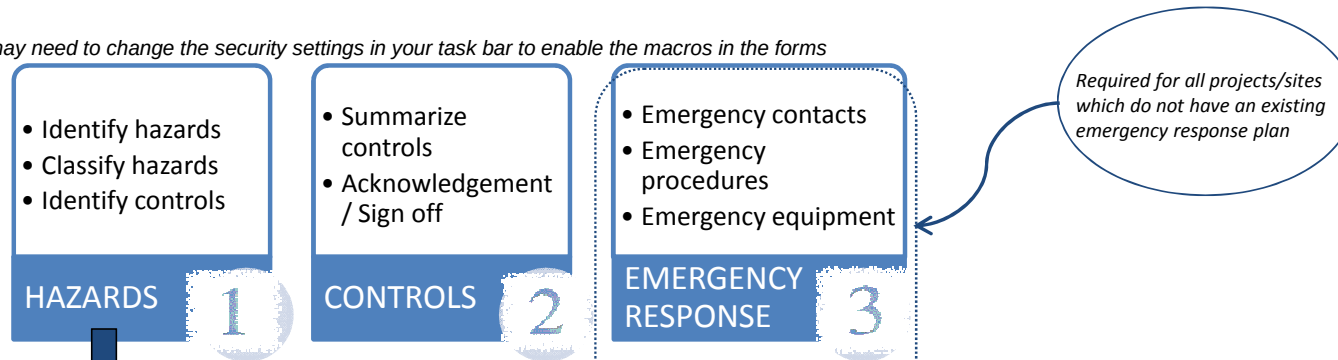
- 6.1 None



S3NA-209-FM TASK HAZARD ANALYSIS

This THA (worksheets 1 & 2) must be completed for all field work.

**you may need to change the security settings in your task bar to enable the macros in the forms



S3NA-209-FM TASK HAZARD ANALYSIS

	Project Name:		Project Number:		Client:																																														
	Supervisor:		Project Manager:		Location:																																														
	THA Developed By:				Date:																																														
TASK HAZARD ANALYSIS	Task Name:			Regularity of Task: One-time ☐ Routine ☐																																															
Job Event Sequence (List the major steps of the individual task)	Hazards (List primary hazards)	Hazard Classification (before controls)				Controls (List controls that AECOM will implement)																																													
		Severity	Likelihood	Risk Level	Hazard Classification																																														
1				0																																															
2				0																																															
3				0																																															
4				0																																															
5				0																																															
6				0																																															
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15				0																																															
16				0																																															
17				0																																															
Hazard Classification Guidelines																																																			
Severity 1 Remote potential for injury, property damage/\$ loss, or env damage 2 Potential for minor first aid injury, property damage/\$ loss, or environmental damage 3 Potential for moderate personnel injuries, including medical treatment, property damage/\$ loss, environmental damage, or negative public impact 4 Potential for a serious injury, major property damage/\$ loss, serious impact to the environment, and public health 5 Catastrophic damage to people, property/equipment, environment, or public health		Likelihood of Occurrence 1 Very unlikely 2 Unlikely 3 Likely 4 Very likely 5 Certain		Hazard Classification Matrix <table border="1" style="display: inline-table; margin-right: 20px;"> <tr><th colspan="5">Severity</th></tr> <tr><th>Likelihood</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr> <tr><td>1</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>2</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr> <tr><td>3</td><td>3</td><td>6</td><td>9</td><td>12</td><td>15</td></tr> <tr><td>4</td><td>4</td><td>8</td><td>12</td><td>16</td><td>20</td></tr> <tr><td>5</td><td>5</td><td>10</td><td>15</td><td>20</td><td>25</td></tr> </table> <table border="1" style="display: inline-table;"> <tr><th>Risk Level</th></tr> <tr><td>Low</td></tr> <tr><td>Medium</td></tr> <tr><td>High</td></tr> </table> Risk Level = Likelihood x Severity			Severity					Likelihood	1	2	3	4	5	1	1	2	3	4	5	2	2	4	6	8	10	3	3	6	9	12	15	4	4	8	12	16	20	5	5	10	15	20	25	Risk Level	Low	Medium	High
Severity																																																			
Likelihood	1	2	3	4	5																																														
1	1	2	3	4	5																																														
2	2	4	6	8	10																																														
3	3	6	9	12	15																																														
4	4	8	12	16	20																																														
5	5	10	15	20	25																																														
Risk Level																																																			
Low																																																			
Medium																																																			
High																																																			

S3NA-209-FM TASK HAZARD ANALYSIS

	Project Name:		Project Number:		Client:			
	Supervisor:		Project Manager:		Location:			
	THA Developed By:				Date:			
SUMMARY OF CONTROLS	Task Name:				Regularity of Task: One-time ☐ Routine ☐			
Personal Protective Equipment (<i>check all that apply</i>)	Air Monitoring (reference HASP monitoring plan)							
☐ CSA/ANSI Safety-Toed Boots (Leather or Rubber)	☐ No air monitoring required ☐ Air monitoring required (<i>see procedures below</i>)							
☐ CSA/ANSI Safety Glasses or Goggles	Parameter		Location/Monitoring Interval		Response/Action Levels		Response Activity	
☐ CSA/ANSI-approved Hard Hat								
☐ CSA/ANSI Type II/III Reflective Traffic Safety Vest								
☐								
☐								
☐								
☐								
☐								
☐								
☐								
Required Training (associated with this THA)	Key SOPs (associated with this THA)				Client & Other Requirements			
1								
2								
3								
4								
5								
6								
Acknowledgement / Signatures								
Project Manager / Supervisor (signature):				Date:				
Name	Signature	Company	Date	Name	Signature	Company	Date	

S3NA-209-FM TASK HAZARD ANALYSIS

	Project Name:		Project Number:		Client:		
	Supervisor:		Project Manager:		Location:		
	THA Developed By:				Date:		
	EMERGENCY RESPONSE PLAN		Task Name:		Regularity of Task: One-time ☐ Routine ☐		
Check-in Procedures							
Check-in Times		Check-in Person		Phone Number		Cell Phone Number	
Alternate:							
Emergency Coordinators / Key Personnel							
Name		Title		Phone Number		Cell Phone Number	
		On-site First Aid Attendant					
		Project Manager					
		Site Supervisor					
		Regional SH&E Manager					
		Incident Reporting Line (BY THE END OF THE SHIFT)		1.800.348.5046			
		Client Contact					
Emergency Agencies / Public Utilities							
Name		Type		Details		Phone Number	
		Police					
		Fire					
		Ambulance					
		Nearest Hospital / Clinic					
		Poison Control Center					
		Pollution / Environmental					
Emergency Equipment & Supplies				Other Emergency Plan Details			
☐ First Aid Kit - Type:		☐ Eye Wash					
☐ Blankets / Survival:		☐ Spill Kit					
☐ Fire Extinguishers Type:		☐ Other:					
☐ Communication Device							
☐ Vehicle Safety Equipment							

S3NA-209-WI Hazard Identification, Classification & Controls

The following information is intended to guide staff in completing the Task Hazard Analysis.

1.0 Hazard Identification

- 1.1 Hazards occurring in the workplace may be:
 - 1.1.1 Natural (biological) – bacteria, viruses, insects, plants, birds, and animals
 - 1.1.2 Chemical – exposure to chemical toxins, acute or chronic, by way of inhalation, ingestion or absorption
 - 1.1.3 Physical – slipping/tripping, being struck by moving objects, repetitive movement, strains from lifting
 - 1.1.4 Environmental – extreme heat or cold, noise, vibrations, magnetic fields, pressure extremes and air quality
 - 1.1.5 Psychosocial – stress, violence
- 1.2 When identifying hazards, remember to consider the following:
 - 1.2.1 Routine and non-routine activities;
 - 1.2.2 Activities of all persons having access to the workplace (including contractors and visitors);
 - 1.2.3 Human behavior, capabilities and other human factors;
 - 1.2.4 Identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of AECOM;
 - 1.2.5 Hazards created in the vicinity of the workplace by work-related activities under the control of AECOM;
 - 1.2.6 Infrastructure, equipment and materials at the workplace, whether provided by AECOM or others;
 - 1.2.7 Changes or proposed changes within AECOM;
 - 1.2.8 Modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities;
 - 1.2.9 Any applicable legal obligations relating to risk assessment and implementation of necessary controls;
 - 1.2.10 The design of work areas, processes, installations, machinery/equipment, operating procedures and work organization, including their adaptation to human capabilities.
- 1.3 It is often useful to break the job or task down into a sequence of steps (“Job Event Sequence”) to help identify the primary hazards which may be encountered when you complete a job task. The “events” identified should be only as detailed as required to identify the primary hazards (e.g., drive to worksite; inspect bridge decking; take water samples, etc.)

2.0 Hazard Classification

Once identified, all hazards should be classified based on both their potential outcome and the probability of its occurrence as follows:

2.1 Severity

- 2.1.1 Insignificant – no injuries, low environmental/financial impact = 1
- 2.1.2 Minor – first aid required, some environmental/financial impact = 2
- 2.1.3 Moderate – medical treatment required, contained environmental impact, high cost = 3
- 2.1.4 Major – serious injury, severe environmental damage, major cost = 4
- 2.1.5 Catastrophic – death, environmental disaster, extensive damage, extended downtime for company or site, huge cost = 5
- 2.1.6 Likely – Likelihood of incident occurring sometime during the work activity = 4
- 2.1.7 Very Likely – Likelihood of incident happening often during course of the work activity = 5

- 2.2 High Hazard – Practice or condition whose sum of severity and probability is greater than or equal to 8.
- 2.3 Medium Hazard – Practice or condition whose sum of severity and probability is equal to either 6 or 7.
- 2.4 Low Hazard – Practice or condition whose sum of severity and probability is less than or equal to 5.
- 2.5 Inputs to the hazard classification can include, but are not be limited to, information or data on the following:
 - 2.5.1 Details of location(s) where work is carried out,
 - 2.5.2 The proximity and scope for hazardous interaction between activities in the workplace,
 - 2.5.3 Security arrangements,
 - 2.5.4 The human capabilities, behavior, competence, training and experience of those who normally and/or occasionally carry out hazardous tasks,
 - 2.5.5 Toxicological data, epidemiological data and other health related information,
 - 2.5.6 The proximity of other personnel (e.g. cleaners, visitors, contractors, the public) who might be affected by hazardous work,
 - 2.5.7 Details of any work instructions, systems of work and/or permit-to-work procedures, prepared for hazardous tasks,
 - 2.5.8 Manufacturers' or suppliers' instructions for operation and maintenance of equipment and facilities,
 - 2.5.9 The availability and use of control measures (e.g. for ventilation, guarding, personal protective equipment (PPE), etc.),
 - 2.5.10 Abnormal conditions (e.g. the potential interruption of utility services such as electricity and water, or other process failures),
 - 2.5.11 Environmental conditions affecting the workplace,
 - 2.5.12 The potential for failure of plant and machinery components and safety devices or for their degradation from exposure to the elements or process materials,
 - 2.5.13 Details of access to, and adequacy/condition of emergency procedures, emergency escape plans, emergency equipment, emergency escape routes (including signage), emergency communication facilities, and external emergency support, etc.,
 - 2.5.14 Monitoring data related to incidents associated with specific work activities,
 - 2.5.15 The findings of any existing assessments relating to hazardous work activity,
 - 2.5.16 Details of previous unsafe acts either by the individuals performing the activity or by others (e.g. adjacent personnel, visitors, contractors, etc.),
 - 2.5.17 The potential for a failure to induce associated failures or disabling of control measures,
 - 2.5.18 The duration and frequency at which tasks are carried out,
 - 2.5.19 The accuracy and reliability of the data available for the risk assessment,
 - 2.5.20 Any legal and other requirements which prescribe how the risk assessment has to be performed or what constitutes an acceptable risk, e.g. sampling methods to determine exposure,
 - 2.5.21 Use of specific risk assessment methods, or permissible exposure levels.
- 2.6 Considering all of the hazards associated with the job task, provide an overall classification for the job/task in the Task Hazard Analysis. This classification can be used as a guideline for prioritizing and determining the level and number of controls required.
- 2.7 In considering the hazard, there are numerous tools to help you classify the risk of an incident. The hazard classification matrix, below, is one such tool:

Hazard classification matrix

Severity	Probability					
		Very Likely	Likely	Possibly	Rarely	Unlikely
		5	4	3	2	1
Catastrophic (death, environmental disaster, extensive damage, extended downtime for company or site, huge cost)	5	10	9	8	7	6
Major (serious injury, severe environmental damage, major cost)	4	9	8	7	6	5
Moderate (medical treatment required, contained environmental impact, high cost)	3	8	7	6	5	4
Minor (First aid required, some environmental/financial impact)	2	7	6	5	4	3
Insignificant (no injuries, low environmental/financial impact)	1	6	5	4	3	2

Probability: How likely is it to happen?

Very Likely	Likelihood of incident happening often during course of the work activity
Likely	Likelihood of incident occurring sometime during the work activity
Possibly	Possibility of incident occurring sometime during the work activity
Rarely	Incident will rarely occur during the work activity
Unlikely	Incident will probably not occur during the work activity

Hazard Classification:

	HIGH
	MED
	LOW

3.0 Hazard Control

Once identified and classified, all hazards must have an effective means of control which can be accomplished by using one or more of the following means of control:

3.1 Elimination/Removal (first)

- 3.1.1 Choose a different process
- 3.1.2 Modify an existing process
- 3.1.3 Substitute with less hazardous substance

3.2 Engineering Controls (second)

- 3.2.1 Physically alter the plant or equipment design in order to circumvent possible hazards
- 3.2.2 Place guards on machinery
- 3.2.3 Construct catwalks to divert traffic from hazardous areas

3.3 Administrative Controls (third)

- 3.3.1 Affect the job procedure and/or process in order to reduce hazards

3.3.2 Implement rules to change unsafe behaviors

3.3.3 Limit the amount of time an individual is in a hazardous environment through job rotation

3.4 Personal Protective Equipment (fourth)

3.4.1 Provide employees with direct physical protection while working in a hazardous environment

3.5 All identified hazards must have an effective means of control to minimize the potential for an incident; however, hazards with higher classifications should be addressed first and will undoubtedly require a variety of the types of controls mentioned above.

S3NA-209-TP1 Safe Work Plan

[PROJECT NAME]

[PROJECT LOCATION]

Prepared for:

[Client]
[Address]
[City, State, Zip]

Prepared by:

AECOM
Safety, Health, and Environmental Department
[Address]
[City, State, Zip]

[Month XX, 20XX]

Project No.: [00000.00]

Safe Work Plan Expiration Date:

[insert date 1 year from approval date]

Safe Work Plan

Project Name

Project Location

By signing below, I acknowledge that I have reviewed and hereby approve the Safe Work Plan for the [insert project name]. This procedure has been written for the exclusive use of AECOM, its employees, and its subcontractors.

Prepared by:

[Preparers Name]
[Preparers Title]
[Preparers Phone Number]

Date

Reviewed by:

[Safety Prof Name]
[Safety Prof Title]
[Safety Prof Phone Number]

Date

Accepted by:

[Proj Mgr Name]
Project Manager
[Proj Mgr Phone Number]

Date

EXECUTIVE SUMMARY

The purpose of this Safe Work Plan (SWP) is to address health and safety concerns related to AECOM-managed activities at the [site name] site, located at [site address] in [city, state]. The specific roles, responsibilities, authority, and requirements as they pertain to the safety of employees and the scope of services are discussed herein. The document is intended to identify known potential hazards and to facilitate communication and control measures to prevent injury or harm. Additionally, provisions to control the potential for environmental impact from these activities are included where applicable.

[Insert brief scope of services and responsible party]

AECOM will be...

Subcontractor X will be...

Subcontractor Y will be...

The primary physical hazards that may be encountered include:

[list PRIMARY physical hazards]

The chemical hazards that may be encountered include:

[list anticipated chemical hazards]

All staff are bound by the provisions of this SWP and are required to participate in a preliminary project safety meeting to familiarize them with the anticipated hazards and respective onsite controls. The discussion will cover the entire SWP subject matter, putting emphasis on critical elements of the plan; such as the emergency response procedures, personal protective equipment, site control strategies, and monitoring requirements. In addition, daily tailgate safety meetings will be held to discuss the anticipated scope of work, required controls, incident reporting, and any lessons learned or concerns from the previous day; to identify new hazards and controls; and to review the results of inspections.

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Attachment B	Standard Operating Procedures
Attachment C	Client Required Health and Safety Guidelines

1.0 INTRODUCTION

This Safe Work Plan (SWP) addresses the requirements for AECOM and subcontractor personnel to conduct field activities to support the [Project Name, Scope of Work, and Location].

The requirements of this SWP apply to AECOM-managed operations only. No change to this SWP that could affect the health or safety of personnel, the community, or the environment may be made without prior approval of the AECOM Project Manager (PM) and the Safety, Health, and Environmental (SH&E) Professional.

1.1 Classification of Activities

- 1.1.1 The work activities addressed in this SWP are [describe the planned services] and do not meet the requirements for characterization as hazardous waste operations or emergency response (HAZWOPER) activities as defined in *S3NA-509-PR Hazardous Waste Operations and Emergency Response*.

1.2 Regulatory Requirements

- 1.2.1 This SWP meets the requirements and follows the OH&S legislative requirements in Canada and the guidelines established by the Federal Occupational Safety and Health Administration (OSHA):
- Code of Federal Regulation Title 29, Part 1910 (29 CFR Part 1910), Occupational Safety and Health Standards
 - Code of Federal Regulation Title 29, Part 1926 (29 CFR Part 1926), Safety and Health Regulations for Construction
 - [insert state or other requirements]
- 1.2.2 The requirements specified in this SWP also conform to AECOM's Corporate SH&E Program requirements as specified in AECOM's North America Operations SH&E Manual. Individual Standard Operating Procedures (SOPs) from this manual that are applicable to the work activities planned during this project may be found in Attachment B.
- ### 1.3 Project Safety and Health Organization
- 1.3.1 Project Manager [Insert Name, if available]
- 1.3.2 The Project Manager (PM) has overall management authority and responsibility for all site operations, including safety. The PM will provide the **site supervisor** with work plans, staff, and budgetary resources that are appropriate to meet the safety needs of the project operations.
- 1.3.3 Site Supervisor [Insert Name, if available]
- 1.3.4 The site supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans. The **PM** may act as the **site supervisor** while on site.
- 1.3.4.1 RESPONSIBILITIES
- The site supervisor is responsible for:
- Discussing deviations from the work plan with the SSO and PM.
 - Discussing safety issues with the PM, SSO, and field personnel.
 - Assisting the SSO with the development and implementation of corrective actions for site safety deficiencies.
 - Assisting the SSO with the implementation of this SWP and with ensuring compliance.
 - Assisting the SSO with inspections of the site for compliance with this SWP and applicable SOPs.

1.3.4.2 Authority

The site supervisor has authority to:

- Verify that all operations are in compliance with the requirements of this SWP and halt any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspend individuals from field activities for infractions against the SWP pending consideration by the SSO, the Safety Professional, and the PM.

1.3.5 Employees

1.3.5.1 Employee Responsibilities

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the policies and procedures specified in the SWP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to health and safety management relating to omissions and modifications in the SWP or other safety policies.
- Notifying the SSO, in writing, of unsafe conditions and acts.

1.3.5.2 Employee Authority

The safety and health authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work authority when the employee feels that the work is unsafe (including subcontractors or team contractors), or where specified safety precautions are not adequate or fully understood.
- The right to refuse to work on any site or operation where the safety procedures specified in this SWP or other safety policies are not being followed.
- The right to contact the SSO or the Safety Professional at any time to discuss potential concerns.
- The right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions.

2.0 SITE DESCRIPTION AND PLANNED WORK OPERATIONS

2.1 General Description

The [site name] site is located at [site address]. [Insert description. This should include any *significant* physical features of the site (i.e., terrain, buildings, size, location, bodies of water etc.)].

2.2 Planned Work Operations

[Provide a verbal description of the overall objective for what is being done for the job and what is supposed to be accomplished. This does not have to actually spell out the steps for the job, as that will be covered in the bullets below.]

- [Provide a bulleted list of the tasks that will be accomplished throughout the job]

3.0 HAZARD ASSESSMENT

3.1 Physical Hazards

[Discuss the specifics of hazards that will/may be encountered, like haz noise, heavy equip. etc... Limit the discussion to the scope and magnitude of the hazard on this job, don't discuss hazard control.]

See SWP Description and Assistance document for examples

3.2 Wildlife, Plant and Insect Hazards

Below is a series of tasks typically encountered on projects. While the text below may be used to describe your work, it must be elaborated on and sufficient detail included making it site specific.

See SWP Description and Assistance document for examples

3.3 Radiological Hazards

[Discuss any on-site radioactive materials that are environmental contaminants (ignore RAM in devices, etc. that we bring to site)].

3.4 Ultraviolet Hazards

[The 2009 historical UV Index for the (Insert City here) area showed that worker's UV exposures were in the HIGH category beginning in March and lasting until November with worker's exposures in the EXTREME category from July through August. In 2009, (City Name) had 44 days in the HIGH category, 133 days in the VERY HIGH category, and 0 days in the EXTREME category. Workers performing field work outdoors may be susceptible to sunburn if not properly protected with sunscreen or protective clothing and hats. Skin can burn in minutes when the UV Index is VERY HIGH.] Protective measures are advisable.

3.5 Weather Hazards

The Site Safety Officer will be attentive to daily weather forecasts for the project area each morning. Predicted weather conditions of potential field impact are to be included in safety briefings and the Task Hazard Analysis (THA) for that day. Weather changes should initiate a review and updates (THA) as necessary.

Severe weather can occur with little warning. Employees will be vigilant for the potentials for storms, lightning, high winds, and flash flood events.

3.6 Other Hazards

[Address anything not already covered that might be significant, like UXO. Don't provide control procedures here (that's for Section 5.0), just discuss what's there and what it can do].

3.7 Hazard Analysis

Task Hazard Analyses (THAs) have been completed for all tasks identified in the Scope of Work (Attachment A):

[List all Tasks which have been addressed in THAs]

Unanticipated Work Activities/Conditions

As a result of unanticipated work activities or changing conditions, additional THAs may be required. All additional THAs will be reviewed and approved by the SH&E Professional.

3.8 Task-Specific SH&E Procedures

Personnel may be exposed to a variety of chemical, physical, and radiological hazards resulting from task or equipment-specific activities. The controls for many of these hazards are discussed in SOPs found in the **Series 300 to 500** of the North America SH&E SOPs.

SOP#	TITLE	SOP#	TITLE
S3NA 300 Series Field (Common)		S3NA 500 Series Industrial Hygiene	
☐ S3NA-301-PR	Confined Spaces	☐ S3NA-501-PR	Asbestos
☐ S3NA-302-PR	Electrical, General	☐ S3NA-502-PR	Benzene
☐ S3NA-303-PR	Excavation and Trenching	☐ S3NA-503-PR	Blood borne Pathogen Program
☐ S3NA-304-PR	Fall Protection	☐ S3NA-504-PR	Cadmium
☐ S3NA-305-PR	Hand and Power Tools	☐ S3NA-505-PR	Cold Stress Prevention
☐ S3NA-306-PR	Highway and Road Work	☐ S3NA-506-PR	Compressed Gases
☐ S3NA-307-PR	Housekeeping, Worksite	☐ S3NA-507-PR	Hazardous Materials Communication / WHMIS
☐ S3NA-308-PR	Manual Lifting, Field	☐ S3NA-508-PR	Hazardous Materials Handling and Shipping
☐ S3NA-309-PR	Mobile or Heavy Equipment	☐ S3NA-509-PR	Hazardous Waste Operations and Emergency Response Activities
☐ S3NA-310-PR	Rigging, Hoisting, Cranes and Lifting Devices	☐ S3NA-510-PR	Hearing Conservation Program
☐ S3NA-311-PR	Scaffolding	☐ S3NA-511-PR	Heat Stress Prevention
☐ S3NA-312-PR	Ladders and Stairways	☐ S3NA-512-PR	Laboratory Safety
☐ S3NA-313-PR	Wildlife, Plants and Insects	☐ S3NA-513-PR	Lead
☐ S3NA-314-PR	Working Alone & Remote Travel	☐ S3NA-514-PR	Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO)
☐ S3NA-315-PR	Water, Working Around	☐ S3NA-515-PR	Nanotechnology
S3NA 400 Series Field (Uncommon)		☐ S3NA-516-PR	Radiation Safety Programs
☐ S3NA-401-PR	Aircraft Charters	☐ S3NA-517-PR	Radiation, Non-Ionizing
☐ S3NA-402-PR	All Terrain Vehicles (ATVs)	☐ S3NA-518-PR	Radiation, Gauge Source program
☐ S3NA-403-PR	Avalanches	☐ S3NA-519-PR	Respiratory Protection Program
☐ S4NA(US)-404-PR	Commercial Motor Vehicles	☐ S3NA-520-PR	Spill Response, Incidental
☐ S3NA-405-PR	Drilling and Boring		
☐ S3NA-406-PR	Electrical Lines, Overhead		
☐ S3NA-407-PR	Electro-fishing		
☐ S3NA-408-PR	Elevated Work Platforms and Aerial Lifts		
☐ S3NA-409-PR	Forklifts (operation of)		
☐ S3NA-410-PR	Hazardous Energy Control		
☐ S3NA-411-PR	Machine Guarding		
☐ S3NA-412-PR	Powder-Actuated Tools		
☐ S4NA(US)-413-PR1	Process Safety Management		
☐ S4NA(US)-414-PR	Railway Sites		
☐ S4NA(US)-415-PR	RCRA Regulated Facilities		
☐ S3NA-416-PR	Tunnel and Underground Work		
☐ S3NA-417-PR	Utilities, Underground		
☐ S3NA-418-PR	Welding, Cutting and Other Hot Work		
☐ S3NA-419-PR	Water, Marine Operations, Boating		
☐ S3-NA420-PR	Water, Underwater Diving		

4.0 HEALTH AND SAFETY REQUIREMENTS

4.1 Site-Specific Safety Training

All AECOM personnel performing activities at the site will be trained in accordance with *S3NA-003-PR SH&E Training*. All personnel are required to remain current in all of their required training and evaluate their need for additional training when there is a change in work. In addition to the general health and safety training programs, personnel will be required to complete any supplemental task specific training developed for the tasks to be performed. Administration and compliance with the requirements for additional task-specific training will be the responsibility of the project or lead manager. Any additional required training that is completed will be documented and tracked in the project files.

4.2 Competent Person Training Requirements

In order to complete the planned scope of work, an (OSHA or OH&S conformance) competent person must be designated to perform the required daily on site inspections of operations and/or equipment. The competent person may be an AECOM (if responsible for supervising that activity) or the subcontractor's employee. Designated competent person(s) for this project are shown in Table 4-2:

Table 4-2: Task-Specific Competent Persons

Employee Name	Organization	Area of Competency
		[insert other requirements or delete rows]

Note: The training requirements for competent persons are specified in the indicated SOPs and/or *S3NA-202-PR Competent Person Designation*. By identifying an employee as a "competent person", that person has now been authorized to take prompt corrective measures to eliminate hazards.

4.3 Tailgate Meetings

Prior to the commencement of daily project activities, a tailgate meeting will be conducted by the SSO to review the specific requirements of this SWP, applicable THA. Attendance at the daily tailgate meeting is mandatory for all employees at the site covered by this SWP and must be documented on the attendance form. All safety training documentation is to be maintained in the project file by the SSO.

4.4 Hazard Communication

Hazardous materials that may be encountered as existing on-site environmental or physical/health contaminants during the work activities are addressed in this SWP and their properties, hazards, and associated required controls will be communicated to all affected staff and subcontractors.

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item's Material Safety Data Sheet (MSDS) to the SSO for review and filing (the SSO will maintain copies of all MSDS on site). MSDS may not be available for locally obtained products, in which case some alternate form of product hazard documentation will be acceptable in accordance with the requirements of *S3NA-507-PR Hazardous Materials Communication/WHMIS*.

All personnel shall be briefed on the hazards of any chemical product they use, and shall be aware of and have access to all MSDS.

All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

Attachment B provides copies of MSDS for those items planned to be brought on site at the time this SWP is prepared. This information will be updated as required during site operations.

4.5 Confined Space Entry

The SSO/site supervisor shall identify all potential confined spaces in accordance with *S3NA-301-PR Confined Spaces*. In addition; the SSO/site supervisor will inform all employees of the location of onsite confined spaces and their associated security controls and procedures.

4.6 Hazardous, Solid, or Municipal Waste

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable federal, state, provincial, territorial and/or local regulations. Consult the Regional SH&E Manager for further guidance.

4.7 General Safety Rules

All site personnel shall conduct themselves in a safe manner and maintain a working environment that is free of additional hazards, in adherence to *S3NA-001-PR Safe Work Standards and Rules* and *S3NA-103-PR General Housekeeping*.

4.8 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.9 Smoking, Eating, or Drinking

Smoking, eating and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any AECOM site. Smoking, eating or drinking must be in an approved area.

4.9.1 Heat and Cold Stress

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress.

Heat stress can be a significant field site hazard, particularly for nonacclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties. Work-rest cycles will be determined and the appropriate measures taken to prevent heat stress as outlined in SH&E 616 *Heat Stress Prevention Program*.

4.9.1.1 Responding to Heat-Related Illness

The guidance below will be used in identifying and treating heat-related illness.

Table 4.7.3 Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • If an air-conditioned spot is available, this is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (<i>avoid drafts or sudden chilling</i>). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (<i>Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing</i>). • If the victim is conscious, it may be helpful to give him/her sips of water. • Transport victim to a medical facility ASAP.
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool/shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his/her back w/the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide onsite treatment of the victim and proper transport to a medical facility.

4.10 Personal Protective Equipment

The purpose of personal protective equipment (PPE) is to provide a barrier that which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. *S3NA-208-PR Personal Protective Equipment Program* lists the general requirements for selection and usage of PPE. Table 7-1 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual THAs.

By signing this SWP the employee agree having been trained in the use, limitations, care and maintenance of the protective equipment to be used by the employee at this project. If training has not been provided, request same of the PM/SSO for the proper training before signing.

Table: 4-8 Personal Protective Equipment

Type	Material	Additional Information
Minimum PPE		
Safety Vest	ANSI Type II high-visibility	Must have reflective tape/be visible from all sides
Boots	Leather	ANSI approved safety toe
Safety Glasses		ANSI Approved; ≥98% UV protection
Hard Hat		ANSI Approved; recommended wide-brim
Work Uniform		No shorts/cutoff jeans or sleeveless shirts
Additional PPE: [list all applicable information or delete not applicable rows]		
Hearing Protection	Ear plugs and/ or muffs	In hazardous noise areas
Leather Gloves		If working with sharp objects or powered equipment.
Protective Chemical Gloves	Inner: Outer:	
Protective Chemical Coveralls	Inner: Outer:	
Protective Chemical Boots		
Face Shield		Safety glasses or goggles must be worn concurrently.
Apron		
Sunscreen	SPF 30 or higher	
Welding Equipment		
Cooling Vest		
Cold Weather Gear	Hard hat liner, hand warmers, insulated gloves	

4.10.1 Personal Hygiene

The following personal hygiene requirements will be observed:

Water Supply: A water supply meeting the following requirements will be utilized:

Potable Water - An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from nonpotable water sources.

Nonpotable Water - Nonpotable water may be used for hand washing and cleaning activities. Nonpotable water will not be used for drinking purposes. All containers of nonpotable water will be marked with a label stating:

***Nonpotable Water
Not Intended for Drinking Water Consumption***

Toilet Facilities: A minimum of one toilet will be provided for every 20 personnel on site, with separate toilets maintained for each sex except where there are less than 5 total personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities on-site facilities are not required.

Washing Facilities: Employees will be provided washing facilities (e.g., buckets with water and Alconox) at each work location. The use of water and hand soap (or similar substance) will be required by all employees following exit from the Exclusion Zone, prior to breaks, and at the end of daily work activities.

4.11 Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on site can serve as "buddies" for AECOM personnel. Under no circumstances will any employee be present alone in a controlled work area. For areas not in controlled work areas, the procedures outlined in *S3NA-314-PR Working Alone Remote Travel* will be followed at all times.

4.12 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe and to assist in correcting these conditions as outlined in *S3NA-002-PR Stop Work Authority*. Whenever the SSO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the SSO is authorized and required to stop work, which shall be immediately binding on all affected AECOM employees and subcontractors.

Upon issuing the stop work order, the SSO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the Safety Professional has concurred that workplace conditions meet acceptable safety standards.

4.13 Client Specific Safety Requirements

The client has specified no additional health and safety requirements.

or

Client-specific health and safety guidelines are included in Attachment C of this SWP. All site activities must be performed in accordance with client-specific requirements and procedures.

[Or insert additional client-specific requirements]

Emergency Coordinators / Key Personnel			
Name	Title/Workstation	Telephone Number	Mobile Phone
[insert]	Client Contact	[insert]	[insert]
[insert]	Project Manager	[insert]	[insert]
[insert]	Site Supervisor	[insert]	[insert]
[insert]	Site Safety Officer	[insert]	[insert]
	Regional SH&E Manager		
[insert]	SH&E Professional	[insert]	[insert]
Incident Reporting	Incident Reporting Line	1-800-348-5046	
[insert]	Emergency Coordinator (EC)	[insert]	[insert]
	TDG/DOT/IATA Shipper	(303) 804-2312	(303) 588-5829
Organization / Agency			
Name		Telephone Number	
Police Department:		911	
Fire Department:		911	
State Police:		911	
Ambulance Service (<i>EMT will determine appropriate hospital for treatment</i>):		911	
[insert nearest hospital name]			
[insert hospital address, city, state, zip]			
Hospital Route: See Figure 4-1			
Poison Control Center:		(800) 222-1222	
Pollution Emergency:		(800) 292-4706	
National Response Center:		(800) 424-8802	
Chem-Tel:		(800) 255-3924	
Title 3 Hotline:		(800) 424-9346	
Public Utilities			
Name		Telephone Number	
National Utility Locate System:		811	

Figure 4-1: Hospital Route Map

[Insert a map showing the route from your project location to the nearest emergency treatment hospital]

Attachment A
Task Hazard Analyses

[Insert appropriate THAs]

Attachment B
Standard Operating Procedures

[Insert applicable SOPs]

Attachment C
Client Specific Health and Safety Guidelines

[Insert additional client-specific requirements]

[Contract Name or Client Name]

Contract No. [insert]

Task/Delivery Order No. [insert]



S3NA-209-TP2 HEALTH AND SAFETY PLAN

[PROJECT NAME]
[SITE NAME]
[SITE ADDRESS]
[CITY, STATE] [SITE ZIP]

Prepared for:

[Client Name]

[Client Address]

[Client City, State/Province Zip]

Prepared by:

AECOM

[Office Address]

[Office City, State/Province Zip]

Health and Safety Plan Expiration Date: [insert expiration date which is 1 year from the approval date on the next page– Month, day, year]

Project No: [insert project number]

Project Health and Safety Plan

approval page

This project Health and Safety Plan (HASP) was prepared for employees performing a specific, limited scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present on the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards, which may be encountered during the completion of this project, adherence to the requirements of the HASP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve the HASP for the [site name] site. This HASP has been written for the exclusive use of AECOM, its employees, and subcontractors. The plan is written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Prepared by:

[Preparer name, certs]
[Preparer title]
[Preparer phone number]

Date

Concurrence by:

[Safety Prof. name, certs]
[Safety Prof. title]
[Safety Prof. phone number]

Date

Approved by:

[Proj. mgr. name, certs]
Project Manager
[Proj. mgr. phone number]

Date

Executive Summary

The purpose of this Health and Safety Plan (HASP) is to address health and safety concerns related to AECOM managed activities at the [site name] site, located at [site address] in [city, state]. The specific roles, responsibilities, authority, and requirements as they pertain to the safety of employees and the scope of services are discussed herein. The document is intended to identify known potential hazards and facilitate communication and control measures to prevent injury or harm. Additionally, provisions to control the potential for environmental impact from these activities are included where applicable.

[insert brief scope of services and responsible party]

AECOM will be...

Subcontractor X will be...

Subcontractor Y will be...

The primary physical hazards which may be encountered include:

[list PRIMARY physical hazards]

The chemical hazards which may be encountered include:

[list anticipated chemical hazards]

All staff are bound by the provisions of this HASP and are required to participate in a preliminary project safety meeting to familiarize them with the anticipated hazards and respective onsite controls. The discussion will cover the entire HASP subject matter, putting emphasis on critical elements of the plan; such as the emergency response procedures, personal protective equipment, site control strategies, and monitoring requirements. In addition, daily tailgate safety meetings will be held to discuss: the anticipated scope of work, required controls, identify new hazards and controls, incident reporting, review the results of inspections, any lessons learned or concerns from the previous day.

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ATTACHMENTS

Attachment A	Task Hazard Analyses
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Attachment E	Client-Specific SH&E Guidelines and Subcontractors SH&E information

1.0 Introduction

This Health and Safety Plan (HASP) (including Attachments A-[xx]) provides a general description of the levels of personal protection and safe operating guidelines expected of each employee or subcontractor associated with the environmental services being conducted at the [site name] site, located at [site address] in [city, state/province]. This HASP also identifies chemical and physical hazards known to be associated with the AECOM-managed activities addressed in this document.

HASP Supplements will be generated as necessary to address any additional activities or changes in site conditions, which may occur during field operations.

1.1 General

1.1.1 The provisions of this HASP are mandatory for all AECOM personnel engaged in fieldwork associated with the environmental services being conducted at the subject site. A copy of this HASP, any applicable HASP Supplements and the AECOM's North America Safety, Health, and Environmental (SH&E) Procedures and Manual shall be accessible on site and available for review at all times. Record keeping will be maintained in accordance with this HASP and the applicable Standard Operating Procedures (SOPs). In the event of a conflict between this HASP, the SOPs and federal, provincial, state, and local regulations, workers shall follow the most stringent/protective requirements. Concurrence with the provisions of this HASP is mandatory for all personnel at the site covered by this HASP and must be signed on the acknowledgement page.

1.2 Project Policy Statement

AECOM is committed to protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by our activities. We are also committed to protecting and preserving the natural environment in which we operate. The safety of persons and property is of vital importance to the success of this project and accident prevention measures shall be taken toward the avoidance of needless waste and loss. It shall be the policy of this project that all operations be conducted safely. Onsite supervisors are responsible for those they supervise by maintaining a safe and healthy working environment in their areas of responsibility, and by fairly and uniformly enforcing safety and health rules and requirements for all project personnel. Subcontractors shall comply with the requirements of this HASP, provisions contained within the contract document and all applicable rules, requirements and health, safety and environmental regulations. All practical measures shall be taken to promote safety and maintain a safe place to work. Contractors are wholly responsible for the prevention of accidents on work under their direction and shall be responsible for thorough safety and loss control programs and the execution of their own safety plans for the protection of workers.

1.3 References

This HASP conforms to the regulatory requirements and guidelines established in the following documents:

- Title 29, Part 1910 of the Code of Federal Regulations (29 CFR 1910), Occupational Safety and Health Standards (with special attention to Section 120, Hazardous Waste Operations and Emergency Response).
- Title 29, Part 1926 of the Code of Federal Regulations (29 CFR 1926), Safety and Health Regulations for Construction.
- National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, 1985.
- In Canada there is no direct federal or provincial counterpart to HAZWOPER; however, as due diligence and in compliance with applicable provincial duty of care/general duty clauses, staff working in Canada will comply with S3NA-509-PR Hazardous Waste Operations and Emergency Response Activities.
- [Insert state or other requirements]

2.0 Site Information and Scope of Work

AECOM will conduct environmental services at the [site name] site. Work will be performed in accordance with the applicable Statement of Work (SOW) and associated Project Work Plan developed for project site. Deviations from the listed SOW will require that a Safety Professional review and changes made to this HASP, to ensure adequate protection of personnel and other property.

The following is a summary of relevant data concerning the project site, and the work procedures to be performed. The Project Work Plan prepared by AECOM as a companion document to this HASP provides more detail concerning both site history and planned work operations.

2.1 Site Information

This section provides a general description and historical information associated with the site.

2.1.1 General Description

The [site name] site is located at [site address]. [Insert description. This should include any *significant* physical features of the site (i.e., terrain, buildings, size, location, bodies of water etc.)].

2.1.2 Site Background/History

[Insert site background/history information. This should include all applicable activities and processes that have previously occurred on site, as well as current operations.]

2.1.3 Previous Investigations

[Insert previous highest concentration investigation results in the applicable work area. This should list any known investigations and the results of the investigations. Contaminants with their concentrations (soil in mg/kg and/or groundwater in ug/l) should be listed in tabular format (2-1), if available. This should be the most recent site data available.]

Table 2-1: Previous Investigation Data

Contaminants	Soil (mg/kg)	Groundwater (ug/l)
(insert Highest Contaminants)		
(insert second Highest Contaminants)		
(Insert third highest Contaminants)		

2.2 Scope of Work

[Provide a verbal description of the overall objective for what is being done for the job and what is supposed to be accomplished. This does not have to actually spell out the steps for the job, as that will be covered in 2.2.1]

(See HASP Description and Assistance document for examples)

2.2.1 Additional Work Operations

The following additional tasks will also be performed as necessary in support of planned site activities:

(Operations at the site may require additional tasks not identified in this section or addressed in Attachment A THAs. Before performing any task not covered in this HASP a THA must be prepared, and approved by the Safety Professional.)

3.0 Hazard Assessment (Safety)

3.1 Physical Hazards

[Discuss the specifics of hazards that will/may be encountered, like haz noise, heavy equip. etc.. Limit the discussion to the scope and magnitude of the hazard on this job, don't discuss hazard control.]

(See HASP Description and Assistance document for examples)

3.2 Wildlife, Plant and Insect Hazards

Below is a series of tasks typically encountered on projects. While the text below may be used to describe your work, it must be elaborated on and sufficient detail included making it site specific.

(See HASP Description and Assistance document for examples)

3.3 Radiological Hazards

[Discuss any on-site radioactive materials that are environmental contaminants (ignore RAM in devices, etc. that we bring to site.)]

3.4 Ultraviolet Hazards

[The 2009 historical UV Index for the [Insert City here] area showed that worker's UV exposures were in the HIGH category beginning in March and lasting until November with worker's exposures in the EXTREME category from July through August. In 2009, [City Name] had 44 days in the HIGH category, 133 days in the VERY HIGH category, and 0 days in the EXTREME category. Workers performing field work outdoors may be susceptible to sunburn if not properly protected with sunscreen or protective clothing and hats. Skin can burn in minutes when the UV Index is VERY HIGH. Protective measures are advisable.]

3.5 Weather Hazards

The Site Safety Officer will be attentive to daily weather forecasts for the project area each morning. Predicted weather conditions of potential field impact are to be included in safety briefings and the Task Hazard Analysis (THA) for that day. Weather changes should initiate a review and updates (THA) as necessary.

Severe weather can occur with little warning. Employees will be vigilant for the potentials for storms, lightning, high winds, and flash flood events.

3.6 Other Hazards

[Address anything not already covered that might be significant, like UXO. Don't provide control procedures here (that's for Section 5.0), just discuss what's there and what it can do].

3.7 Hazard Analysis

Task Hazard Analyses (THAs) have been completed for all tasks identified in the Scope of Work (Attachment A):

[List all Tasks which have been addressed in THAs]

3.7.1 Unanticipated Work Activities/Conditions

As a result of unanticipated work activities or changing conditions, additional THAs may be required. All additional THAs will be reviewed and approved by the SH&E Professional.

3.8 Task Specific SH&E Procedures

As discussed in Section 5.0, personnel may be exposed to a variety of chemical, physical, and radiological hazards resulting from task or equipment-specific activities. The controls for many of these hazards are discussed in SOPs found in the **Series 300 to 500** North America SH&E SOPs.

SOP#	TITLE	SOP#	TITLE
S3NA 300 Series Field(Common)		S3NA 500 Series Industrial Hygiene	
☐ S3NA-301-PR	Confined Spaces	☐ S3NA-501-PR	Asbestos
☐ S3NA-302-PR	Electrical, General	☐ S3NA-502-PR	Benzene
☐ S3NA-303-PR	Excavation and Trenching	☐ S3NA-503-PR	Blood borne Pathogen Program
☐ S3NA-304-PR	Fall Protection	☐ S3NA-504-PR	Cadmium
☐ S3NA-305-PR	Hand and Power Tools	☐ S3NA-505-PR	Cold Stress Prevention
☐ S3NA-306-PR	Highway and Road Work	☐ S3NA-506-PR	Compressed Gases
☐ S3NA-307-PR	Housekeeping, Worksite	☐ S3NA-507-PR	Hazardous Materials Communication / WHMIS
☐ S3NA-308-PR	Manual Lifting, Field	☐ S3NA-508-PR	Hazardous Materials Handling and Shipping
☐ S3NA-309-PR	Mobile or Heavy Equipment	☐ S3NA-509-PR	Hazardous Waste Operations and Emergency Response Activities
☐ S3NA-310-PR	Rigging, Hoisting, Cranes and Lifting Devices	☐ S3NA-510-PR	Hearing Conservation Program
☐ S3NA-311-PR	Scaffolding	☐ S3NA-511-PR	Heat Stress Prevention
☐ S3NA-312-PR	Ladders and Stairways	☐ S3NA-512-PR	Laboratory Safety
☐ S3NA-313-PR	Wildlife, Plants and Insects	☐ S3NA-513-PR	Lead
☐ S3NA-314-PR	Working Alone & Remote Travel	☐ S3NA-514-PR	Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO)
☐ S3NA-315-PR	Water, Working Around	☐ S3NA-515-PR	Nanotechnology
		☐ S3NA-516-PR	Radiation Safety Programs
S3NA 400 Series Field (Uncommon)		☐ S3NA-517-PR	Radiation, Non-Ionizing
☐ S3NA-401-PR	Aircraft Charters	☐ S3NA-518-PR	Radiation, Gauge Source program
☐ S3NA-402-PR	All Terrain Vehicles (ATVs)	☐ S3NA-519-PR	Respiratory Protection Program
☐ S3NA-403-PR	Avalanches	☐ S3NA-520-PR	Spill Response, Incidental
☐ S4NA(US)-404-PR	Commercial Motor Vehicles		
☐ S3NA-405-PR	Drilling and Boring		
☐ S3NA-406-PR	Electrical Lines, Overhead		
☐ S3NA-407-PR	Electro-fishing		
☐ S3NA-408-PR	Elevated Work Platforms and Aerial Lifts		
☐ S3NA-409-PR	Forklifts (operation of)		
☐ S3NA-410-PR	Hazardous Energy Control		
☐ S3NA-411-PR	Machine Guarding		
☐ S3NA-412-PR	Powder-Actuated Tools		
☐ S4NA(US)-413-PR1	Process Safety Management		
☐ S4NA(US)-414-PR	Railway Sites		
☐ S4NA(US)-415-PR	RCRA Regulated Facilities		
☐ S3NA-416-PR	Tunnel and Underground Work		
☐ S3NA-417-PR	Utilities, Underground		
☐ S3NA-418-PR	Welding, Cutting and Other Hot Work		
☐ S3NA-419-PR	Water, Marine Operations, Boating		
☐ S3NA-420-PR	Water, Underwater Diving		

4.0 SH&E Requirements (Safety)

4.1 HAZWOPER Qualifications

Personnel performing work at the job site must be qualified as HAZWOPER workers (unless otherwise noted in specific THAs or by the SSO), and must meet the medical monitoring and training requirements specified in the AECOM's North America SH&E Standard Operating Procedures.

If site monitoring procedures indicate that a possible exposure has occurred above the OSHA permissible exposure limit (PEL), employees may be required to receive supplemental medical testing to document any symptoms that may be specific to the particular materials present.

4.2 Site-Specific Safety Training

All AECOM personnel performing activities at the site will be trained in accordance with *S3NA-003-PR SH&E Training*. All personnel are required to remain current in all of their required training and evaluate their need for additional training when there is a change in work. In addition to the general health and safety training programs, personnel will be required to complete any supplemental task specific training developed for the tasks to be performed. Administration and compliance with the requirements for additional task-specific training will be the responsibility of the project or lead manager. Any additional required training that is completed will be documented and tracked in the project files.

4.2.1 Competent Person Training Requirements

In order to complete the planned scope of work, an (OSHA conformance) competent person must be designated to perform the required daily on site inspections of operations and/or equipment. The competent person may be an AECOM (if responsible for supervising that activity) or the subcontractor's employee. Designated competent person(s) for this project are shown in Table 4-2:

Table 4.2.1-2: Task-Specific Competent Persons

Employee Name	Organization	Area of Competency
		[insert other requirements or delete rows]

Note: The training requirements for competent persons are specified in the indicated SOPs and/or *S3NA-202-PR Competent Person Designation*. By identifying an employee as a "competent person", that person has now been authorized to take prompt corrective measures to eliminate hazards.

4.3 Tailgate Meetings

Prior to the commencement of daily project activities, a tailgate meeting will be conducted by the SSO to review the specific requirements of this HASP, applicable THA. Attendance at the daily tailgate meeting is mandatory for all employees at the site covered by this HASP and must be documented on the attendance form. All safety training documentation is to be maintained in the project file by the SSO.

4.4 Hazard Communication

Hazardous materials that may be encountered as existing on-site environmental or physical/health contaminants during the work activities are addressed in this HASP and their properties, hazards and associated required controls will be communicated to all affected staff and subcontractors.

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item's Material Safety Data Sheet (MSDS) to the SSO for review and filing (the SSO will maintain copies of all MSDS on site). MSDS may not be available for locally-obtained products, in which case some alternate form of product hazard documentation will be acceptable in accordance with the requirements of *S3NA-507-PR Hazardous Materials Communication/WHMIS*.

All personnel shall be briefed on the hazards of any chemical product they use, and shall be aware of and have access to all MSDS.

All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

Attachment B provides copies of MSDS for those items planned to be brought on site at the time this HASP is prepared. This information will be updated as required during site operations.

4.5 Confined Space Entry

The SSO/site supervisor shall identify all potential confined spaces in accordance with *S3NA-301-PR Confined Spaces*. In addition; the SSO/site supervisor will inform all employees of the location of onsite confined spaces, and their associated security controls and procedures.

4.6 Hazardous, Solid, or Municipal Waste

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable Federal, State, Provincial, Territorial and/or local regulations. Consult the Regional SH&E Manager for further guidance.

4.7 General Safety Rules

All site personnel shall conduct themselves in a safe manner and maintain a working environment that is free of additional hazards, in adherence to *S3NA-001-PR Safe Work Standards and Rules* and *S3NA-103-PR General Housekeeping*.

4.7.1 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.7.2 Smoking, Eating, or Drinking

Smoking, eating and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any AECOM site. Smoking, eating or drinking must be in an approved area.

4.7.3 Personal Hygiene

The following personal hygiene requirements will be observed:

Water Supply: A water supply meeting the following requirements will be utilized:

Potable Water - An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.

Non-Potable Water - Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating:

***Non-Potable Water
Not Intended for Drinking Water Consumption***

Toilet Facilities: A minimum of one toilet will be provided for every 20 personnel on site, with separate toilets maintained for each sex except where there are less than 5 total personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities on-site facilities are not required.

Washing Facilities: Employees will be provided washing facilities (e.g., buckets with water and Alconox) at each work location. The use of water and hand soap (or similar substance) will be required by all employees following exit from the Exclusion Zone, prior to breaks, and at the end of daily work activities.

4.7.4 Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on site can serve as "buddies" for AECOM personnel. Under no circumstances will any employee be present alone in a controlled work area. For areas not in controlled work areas, the procedures outlined in *S3NA-314-PR Working Alone Remote Travel* will be followed at all times.

4.8 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe and to assist in correcting these conditions as outlined in *S3NA-002-PR Stop Work Authority*. Whenever the SSO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the SSO is authorized and required to stop work, which shall be immediately binding on all affected AECOM employees and subcontractors.

Upon issuing the stop work order, the SSO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the Safety Professional has concurred that workplace conditions meet acceptable safety standards.

4.9 Client Specific Safety Requirements

The client has specified no additional health and safety requirements.

or

Client-specific health and safety guidelines are included in Attachment E of this HASP. All site activities must be performed in accordance with client-specific requirements and procedures.

[or insert additional client-specific requirements]

5.0 Exposure Monitoring Procedures (Health)

5.1 Contaminant Exposure Hazards

The following is a discussion of the hazards presented to worker personnel during this project from on-site chemical and radiological hazards known, suspected or anticipated to be present on site.

Exposure symptoms and applicable first aid information for each suspected site contaminant identified in the Scope of Work are located in the following subsections.

[insert chemical/chem. group-specific discussions for what is at your site]

-
-
-
-

5.1.1 [insert contaminant]

[insert contaminant information]

5.1.2 [insert contaminant]

[insert contaminant information]

5.1.3 [insert contaminant]

[insert contaminant information]

5.2 Route of Entry Assessment of Exposure Hazards

Inhalation: [Discuss the possible hazards from inhalation based on what's there and what's being done]. [discuss any general things being done to protect, like RPP, monitoring, etc.].

Skin Contact: [Discuss the possible hazards from skin contact (irritation and absorption) based on what's there and what's being done – don't forget the eyes, etc.]. [Discuss any general things being done to protect, like PPE, decon, etc.].

Ingestion: [Discuss the possibility of ingestion exposure based on what's there and what's being done.]. Protection against exposure via ingestion can be accomplished by performance of proper decontamination procedures when exiting contaminated work areas.

Monitoring procedures will be employed during site characterization activities to assess employee exposure to chemical and physical hazards. Monitoring will consist primarily of onsite determination of various parameters (e.g., airborne contaminant concentrations and heat stress effects), but may be supplemented by more sophisticated monitoring techniques, if necessary.

5.3 Real-Time Exposure Measurement

Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be conducted as specified in each THA as work is performed.

Table 5-1 specifies the real-time monitoring equipment, which will be used for this project. [Delete instruments from the table that are not applicable to the project.]

Table 5-1: Monitoring Parameters and Equipment

INSTRUMENT	MANUFACTURER/MODEL*	SUBSTANCES DETECTED
Photo Ionization Detector (PID)	RAE Systems mini-RAE Photovac Microtip HNu Model Hnu (min. 10.2 eV bulb)	Petroleum hydrocarbons Organic Solvents
Flame Ionization Detector (FID)	Foxboro	Petroleum hydrocarbons Organic Solvents
Combustible Gas Indicator (CGI) May be combined with individual or multi-gas detectors.		Explosively
Individual Gas Detectors		Oxygen (O ₂) Carbon Monoxide (CO) Hydrogen Sulfide (H ₂ S) Cyanide Gases (CN ⁻)
Particulate Monitor	MIE Model PDM-3 mini-RAM	Aerosols, mist, dust, and fumes
Colorimetric Detector Tubes	Sensidyne Draeger	Benzene 0.5–10 ppm [list additional]
[insert additional]		

*Or similar unit, as approved by the SH&E Professional

5.4 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone.

If ambient levels are measured which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigative actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of SSO or the Safety Professional.

Reasons to upgrade:

- Known or suspected presence of dermal hazards.
- Occurrence or likely occurrence of gas, vapor, or dust emission.
- Change in work task that will increase the exposure or potential exposure to hazardous materials.

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally suspected.
- Change in site conditions that decrease the potential hazard.
- Change in work task that will reduce exposure to hazardous materials.

5.4.1 Monitoring Procedures

[Contact an SH&E Professional for guidance. This section must be approved by the Regional SH&E/District SH&EM prior to the start of field work.]

5.4.1.1 Monitoring Equipment Calibration

All instruments used will be calibrated at the beginning and end of each work shift, in accordance with the manufacturer's recommendations. If the owner's manual is not available, the personnel operating the equipment will contact the applicable office representative, rental agency or manufacturer for technical guidance for proper calibration. If equipment cannot be pre-calibrated to specifications, site operations requiring monitoring for worker exposure or off-site migration of contaminants will be postponed or temporarily ceased until this requirement is completed.

5.4.1.2 Personal Sampling

Should site activities warrant performing personal sampling (breathing zone) to better assess chemical exposures experienced by AECOM employees, the SSO, under the direction of a Certified Industrial Hygienist (CIH), Certified Safety Professional (CSP) will be responsible for specifying the monitoring required. Within five working days after the receipt of monitoring results, the CIH or CSP will notify each employee, in writing, of the results that represent that employee's exposure. Copies of air sampling results will be maintained in the SSO project files.

If the site activities warrant, the subcontractor will ensure its employees' exposures are quantified via the use of appropriate sampling techniques. The subcontractor shall notify the employees sampled in accordance with health and safety regulations, and provide the results to the SSO for use in determining the potential for other employees' exposure.

5.5 Heat and Cold Stress

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress.

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties. Work-rest cycles will be determined and the appropriate measures taken to prevent heat stress as outlined in *S3NA-511-PR Heat Stress Prevention Program*.

5.5.1 Responding to Heat-Related Illness

The guidance below will be used in identifying and treating heat-related illness.

Table 5.5.1: Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • If an air-conditioned spot is available, this is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (<i>avoid drafts or sudden chilling</i>). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (<i>Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing</i>). • If the victim is conscious, it may be helpful to give him/her sips of water. • Transport victim to a medical facility ASAP.

Type of Heat-Related Illness	Description	First Aid
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool/shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his/her back w/the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide onsite treatment of the victim and proper transport to a medical facility.

6.0 Environmental Program (Environment)

6.1 Environmental Compliance and Management

This project and the individual tasks will comply with all federal, state, provincial, and local environmental requirements.

[Give a brief description of the environmental compliance and management requirements for the project site.]

6.1.1 Air Emissions

[Discuss any operations where air emissions may negatively impact the surrounding environment, air emission permits, etc. and discuss associated control of emissions in Section 6.]

6.1.2 Hazardous Waste Management

[Discuss any operations involving the storage, treatment, or disposal of hazardous waste at the project site, RCRA Part B permits or equivalent, 90-day storage procedures, etc. and discuss controls in Section 6.]

6.1.3 Storm Water Pollution Prevention

[Discuss any operations that may generate/discharge stormwater from the project site, NPDES/general construction stormwater discharge permits, etc. and discuss BMPs and other controls in Section 6.]

6.1.4 Wetlands Protection

[Use the FWS online wetlands mapper (<http://www.fws.gov/wetlands/Data/mapper.html>) to determine if any wetlands exists on your project site, are adjacent to your project, or may be negatively impacted by your project, do you need a regulatory permit, discuss wetlands protection measures/controls in Section 6, etc.] – suggest adding the map as a figure to the HASP or keeping it in the project files as the official risk assessment/determination process.

6.1.5 Critical Habitat Protection

[Use the FWS online critical habitat mapper tool (<http://criticalhabitat.fws.gov/>) to determine if any plant or animal critical habitats exists on, adjacent to, or may be otherwise impacted by your project, do you need a regulatory permit, discuss critical habitat protection/control measures in Section 6, etc.] – suggest adding the map as a figure to the HASP or keeping it in the project files as the official risk assessment/determination process.

6.1.6 Environmental Protection

[Discuss any environmental protection controls you will implement on your project such as sediment control, stormwater infiltration control, measures to mitigate impacts on wetlands, critical habitat protection, endangered species protection, etc.]

6.1.7 [add here anything else]

[specify if necessary]

7.0 Personal Protective Equipment

7.1 Personal Protective Equipment

The purpose of personal protective equipment (PPE) is to provide a barrier, which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. *S3NA-208-PR Personal Protective Equipment Program* lists the general requirements for selection and usage of PPE. Table 7-1 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual THAs.

By signing this HASP the employee agree having been trained in the use, limitations, care and maintenance of the protective equipment to be used by the employee at this project. If training has not been provided, request same of the PM/SSO for the proper training before signing.

Table 7-1: Personal Protective Equipment

<u>TYPE</u>	<u>MATERIAL</u>	<u>ADDITIONAL INFORMATION</u>
Minimum PPE		
Safety Vest	ANSI Type II high-visibility	Must have reflective tape/be visible from all sides.
Boots	Leather	ANSI approved safety toe.
Safety Glasses		ANSI Approved; ≥98% UV protection.
Hard Hat		ANSI Approved; recommended wide-brim.
Work Uniform		No shorts/cutoff jeans or sleeveless shirts.
Additional PPE: [list all applicable information or delete not applicable rows]		
Hearing Protection	Ear plugs and/ or muffs	In hazardous noise areas.
Leather Gloves		If working with sharp objects or powered equipment.
Protective Chemical Gloves	Inner: Outer:	
Protective Chemical Coveralls	Inner: Outer:	
Protective Chemical Boots		
Level C Respiratory Protection	MSA (Full Face or equivalent) equipped with GMA/P100	
Level B Respiratory Protection	Self Contained Breathing Apparatus (SCBA), Airline with 5 minute escape pack.	Grade "D" Certified Air (Certificate Required). Obtain certificate of analysis from compressed gas vendor.
Face Shield		Safety glasses or goggles must be worn concurrently.
Apron		
Sunscreen	SPF 30 or higher	
Welding Equipment		
Cooling Vest		
Cold Weather Gear	Hard hat liner, hand warmers, insulated gloves	
Fall Protection		
Insert		
Insert		

7.2 PPE Doffing and Donning (UTILIZATION) Information

The following information is to provide field personnel with helpful hints that, when applied, make donning and doffing of PPE a more safe and manageable task:

- Never cut disposable booties from your feet with basic utility knives. This has resulted in workers cutting through the bootie and the underlying sturdy leather work boot, resulting in significant cuts to the legs/ankles. Recommend using a pair of scissors or a package/letter opener (cut above and parallel with the work boot) to start a cut in the edge of the bootie, then proceed by manually tearing the material down to the sole of the bootie for easy removal.
- When applying duct tape to PPE interfaces (wrist, lower leg, around respirator, etc.) and zippers, leave approximately one inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small handle to grab while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Have a “buddy” check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.
- Never perform personal decontamination with a pressure washer.

7.3 Decontamination

7.3.1 General Requirements

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials, etc).

All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the Exclusion Zone (EZ).

All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the SZ.

Decontamination procedures may vary based on site conditions and nature of the contaminant(s). If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The applicable Material Safety Data Sheet (MSDS) must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.

7.3.2 Decontamination Equipment

The equipment required to perform decontamination may vary based on site-specific conditions and the nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
- Hoses, buckets of water or garden sprayers for rinsing;
- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
- Metal or plastic cans or drums for the temporary storage of contaminated liquids; and
- Paper or cloth towels for drying protective clothing and equipment.

7.3.3 Personal/Equipment Decontamination

All equipment leaving the EZ shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE, support devices (e.g., hoses, cylinders, etc.), and various handheld tools.

All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

[The SH&E Professional will outline the personal decontamination steps here in bullet format.]

For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination.

For smaller equipment, use the following steps for decontamination:

- Remove majority of visible gross contamination in EZ.
- Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment.
- Rinse equipment.
- Visually inspect for remaining contamination.
- Follow appropriate personal decontamination steps outlined above.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ). Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

[The SH&E Professional, in coordination with the Corporate Radiation Safety Officer, must specify the applicable radiological decontamination procedures along with the applicable removable monitoring limits in CPM, as applicable to the project]

8.0 Project Health and Safety Organization

8.1 Project Manager [insert Name, if available]

The Project Manager (PM) has overall management authority and responsibility for all site operations, including safety. The PM will provide the site supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations.

8.2 Site Supervisor [insert Name, if available]

The site supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans. The PM may act as the site supervisor while on site.

8.2.1 Responsibilities

The site supervisor is responsible to:

- Discuss deviations from the work plan with the SSO and PM.
- Discuss safety issues with the PM, SSO, and field personnel.
- Assist the SSO with the development and implementation of corrective actions for site safety deficiencies.
- Assist the SSO with the implementation of this HASP and ensuring compliance.
- Assist the SSO with inspections of the site for compliance with this HASP and applicable SOPs.

8.2.2 Authority

The site supervisor has authority to:

- Verify that all operations are in compliance with the requirements of this HASP, and halt any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspend individuals from field activities for infractions against the HASP pending consideration by the SSO, the Safety Professional, and the PM.

8.2.3 Qualifications

In addition to being Hazardous Waste Operations and Emergency Response (HAZWOPER)-qualified (see Section 4.1), the Site Supervisor is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 CFR 1910.120 (e)(4).

8.3 Site Safety Officer [insert Name, if available]

8.3.1 Responsibilities

The SSO is responsible to:

- Update the site-specific HASP to reflect changes in site conditions or the scope of work. HASP updates must be reviewed and approved by the Safety Professional.
- Be aware of changes in AECOM Safety Policy.
- Monitor the lost time incidence rate for this project and work toward improving it.
- Inspect the site for compliance with this HASP and the SOPs using the appropriate audit inspection checklist provided by an AECOM Safety Professional.
- Work with the site supervisor and PM to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contact the Safety Professional for technical advice regarding safety issues.

- Provide a means for employees to communicate safety issues to management in a discreet manner (i.e., suggestion box, etc.).
- Determine emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Check that all site personnel and visitors have received the proper training and medical clearance prior to entering the site.
- Establish any necessary controlled work areas (as designated in this HASP or other safety documentation).
- Present tailgate safety meetings and maintain attendance logs and records.
- Discuss potential health and safety hazards with the Site Supervisor, the Safety Professional, and the PM.
- Select an alternate SSO by name and inform him/her of their duties, in the event that the SSO must leave or is absent from the site.

8.3.2 Authority

The SSO has authority to:

- Verify that all operations are in compliance with the requirements of this HASP.
- Issue a "Stop Work Order" under the conditions set forth in this HASP.
- Temporarily suspend individuals from field activities for infractions against the HASP pending consideration by the Safety Professional and the PM.

8.3.3 Qualifications

In addition to being HAZWOPER-qualified, the SSO is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 CFR 1910.120 (e)(4).

8.4 Employees

8.4.1 Employee Responsibilities

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the policies and procedures specified in the HASP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to health and safety management relating to omissions and modifications in the HASP or other safety policies.
- Notifying the SSO, in writing, of unsafe conditions and acts.

8.4.2 Employee Authority

The health and safety authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work authority when the employee feels that the work is unsafe (including subcontractors or team contractors), or where specified safety precautions are not adequate or fully understood.
- The right to refuse to work on any site or operation where the safety procedures specified in this HASP or other safety policies are not being followed.
- The right to contact the SSO or the Safety Professional at any time to discuss potential concerns.
- The right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions.

8.5 Safety Professional [Insert Name, if available]

8.5.1 The Safety Professional is the member of the AECOM Safety, Health and Environmental Department assigned to provide guidance and technical support for the project. Duties include the following:

- Approving this HASP and any required changes.
- Approving the designated Site Safety Officer (SSO).
- Reviewing all personal exposure monitoring results.
- Investigating any reported unsafe acts or conditions.

8.6 Subcontractors

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in *S3NA-213-PR Subcontractors*. Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE and all required training.

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior to the start of onsite activities, if required.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM PM or the Site Supervisor prior to beginning work operations. The Site Supervisor or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

8.7 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the site will be briefed by the PM on the hazards present at that location. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training and personal protective equipment which are required for entry to any controlled work area; visitors must comply with these requirements at all times.

8.7.1 Visitor Access

Visitors to any HAZWOPER controlled-work area must comply with the health and safety requirements of this HASP, and demonstrate an acceptable need for entry into the work area. All visitors desiring to enter any controlled work area must observe the following procedures:

- A written confirmation must be received by AECOM documenting that each of the visitors has received the proper training and medical monitoring required by this HASP. Verbal confirmation can be considered acceptable provided such confirmation is made by an officer or other authorized representative of the visitor's organization.
- Each visitor will be briefed on the hazards associated with the site activities being performed and acknowledge receipt of this briefing by signing the appropriate tailgate safety briefing form.
- All visitors must be escorted by an AECOM employee.

If the site visitor requires entry to any EZ, but does not comply with the above requirements, all work activities within the EZ must be suspended. Until these requirements have been met, entry will not be permitted.

Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

9.0 Site Control

9.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from site hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community.

Controlled work areas will be established at each work location, and if required, will be established directly prior to the work being conducted. Diagrams designating specific controlled work areas will be drawn on site maps, posted in the support vehicle or trailer and discussed during the daily safety meetings. If the site layout changes, the new areas and their potential hazards will be discussed immediately after the changes are made. General examples of zone layouts have been developed for drilling and earth moving activities [(e.g., excavating, trenching, etc.) – **post these diagrams as appropriate**] and are attached to this section.

9.2 Controlled Work Areas

Each HAZWOPER controlled work area will consist of the following three zones:

- Exclusion Zone: Contaminated work area.
- Contamination Reduction Zone: Decontamination area.
- Support Zone: Uncontaminated or “clean area” where personnel should not be exposed to hazardous conditions.

Each zone will be periodically monitored in accordance with the air monitoring requirements established in this HASP. The Exclusion Zone and the Contamination Reduction Zone are considered work areas. The Support Zone is accessible to the public (e.g., vendors, inspectors).

9.2.1 Exclusion Zone

The Exclusion Zone is the area where primary activities occur, such as sampling, remediation operations, installation of wells, cleanup work, etc. This area must be clearly marked with hazard tape, barricades or cones, or enclosed by fences or ropes. Only personnel involved in work activities, and meeting the requirements specified in the applicable THA and this HASP will be allowed in an Exclusion Zone.

The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with sample collection activities.

(See HASP Description and Assistance document for minimum distances examples)

All personnel should be alert to prevent unauthorized, accidental entrance into controlled-access areas (the EZ and CRZ). If such an entry should occur, the trespasser should be immediately escorted outside the area, or all HAZWOPER-related work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated or containerized as waste prior to leaving (through the CRZ only).

9.2.2 Contamination Reduction Zone

The Contamination Reduction Zone is the transition area between the contaminated area and the clean area. Decontamination is the main focus in this area. The decontamination of workers and equipment limits the physical transfer of hazardous substances into the clean area. This area must also be clearly marked with hazard tape and access limited to personnel involved in decontamination.

9.2.3 Support Zone

The Support Zone is an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located. The Support Zone shall have minimal potential for significant exposure to contaminants (i.e., background levels).

Employees will establish a Support Zone (if necessary) at the site before the commencement of site activities. The Support Zone would also serve as the entry point for controlling site access.

9.3 Site Access Documentation

If implemented by the PM, all personnel entering the site shall complete the “Site Entry/Exit Log” located at the site trailer or primary site support vehicle.

9.4 Site Security

9.4.1 Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards.
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the site.
- Prevent theft.
- Avoid interference with safe working procedures.

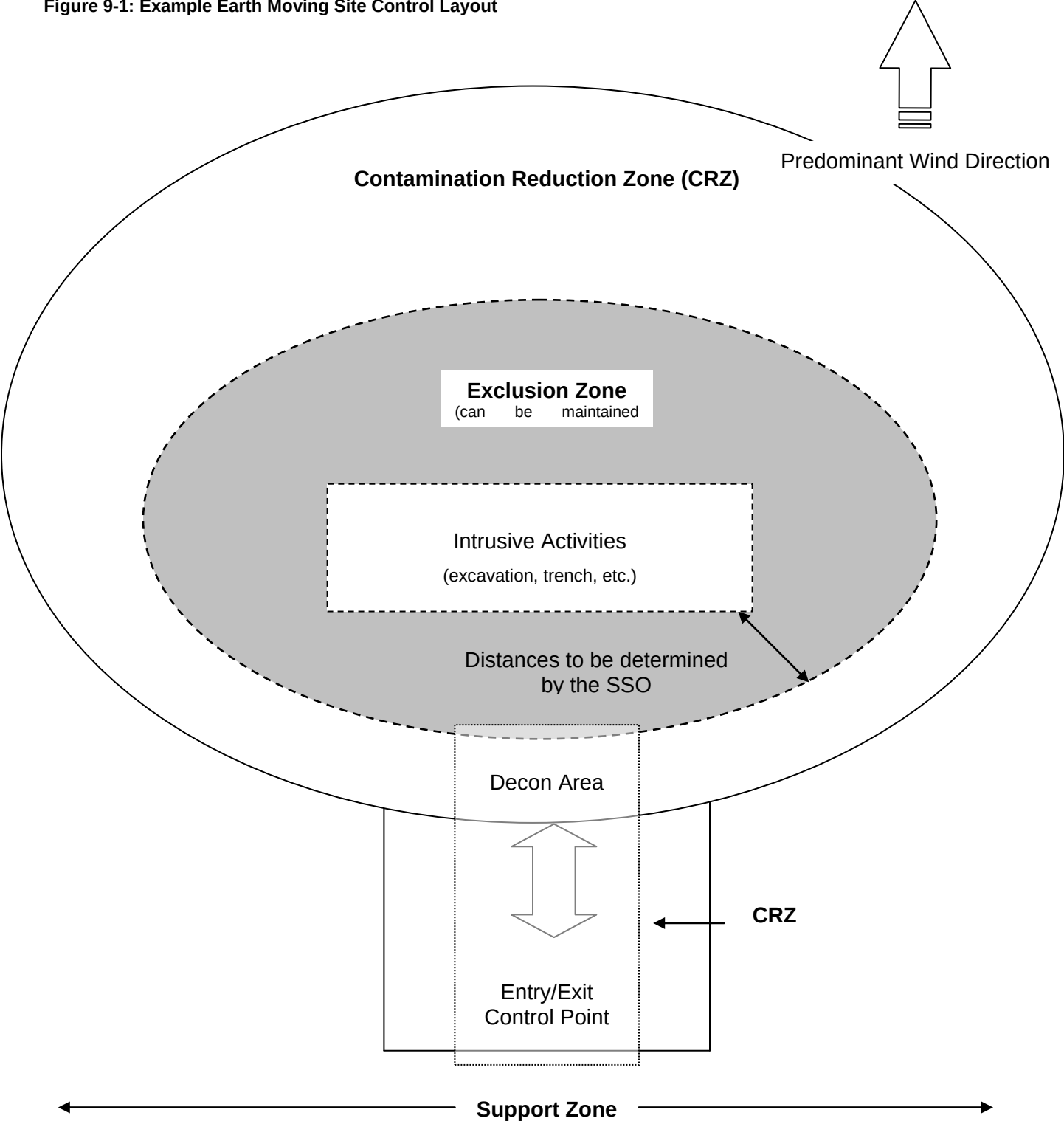
9.4.2 To maintain site security during working hours:

- Maintain security in the Support Zone and at access control points.
- Establish an identification system to identify authorized persons and limitations to their approved activities.
- Assign responsibility for enforcing authority for entry and exit requirements.
- When feasible, install fencing or other physical barrier around the site.
- If the site is not fenced, post signs around the perimeter and whenever possible, use guards to patrol the perimeter. Guards must be fully apprised of the hazards involved and trained in emergency procedures.
- Have the PM approve all visitors to the site. Make sure they have valid purpose for entering the site. Have trained site personnel accompany visitors at all times and provide them with the appropriate protective equipment.

9.4.3 To maintain site security during off-duty hours:

- If possible, assign trained, in-house technicians for site surveillance. They will be familiar with the site, the nature of the work, the site's hazards, and respiratory protection techniques.
- If necessary, use security guards to patrol the site boundary. Such personnel may be less expensive than trained technicians, but will be more difficult to train in safety procedures and will be less confident in reacting to problems around hazardous substances.
- Enlist public enforcement agencies, such as the local police department, if the site presents a significant risk to local health and safety.
- Secure the equipment.

Figure 9-1: Example Earth Moving Site Control Layout



10.0 Emergency Response Planning

10.1 Emergency Action Plan

Although the potential for an emergency to occur is remote, an emergency action plan has been prepared for this project should such critical situations arise. The only significant type of onsite emergency that may occur is physical injury or illness to a member of the AECOM team. The Emergency Action Plan (EAP) will be reviewed by all personnel prior to the start of field activities. A test of the EAP will be performed within the first three (3) days of the project field operations. This test will be evaluated and documented in the project records.

10.1.1 Three major categories of emergencies could occur during site operations:

- Illnesses and physical injuries (including injury-causing chemical exposure)
- Catastrophic events (fire, explosion, earthquake, or chemical)
- Workplace Violence, Bomb Threat
- Safety equipment problems

10.1.2 Emergency Coordinator

The duties of the Emergency Coordinator (EC) include:

- Implement the EAP based on the identified emergency condition.
- Notify the appropriate project and SH&E Department personnel of the emergency (Table 9-3).
- Verify emergency evacuation routes and muster points are accessible.
- Conduct routine EAP drills and evaluate compliance with the EAP.

10.1.3 Site-Specific Emergency Procedures

Prior to the start of site operations, the EC will complete Table 9-1 with any site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

Table 10-1: Emergency Planning

Emergency	Evacuation Route	Muster Location
Chemical Spill	Upwind [insert distance]	[insert location]
Fire/Explosion	[insert directions]	[insert location]
Tornado	[insert directions]	[insert location]
Lightning	[insert directions]	Vehicle
[insert additional]		
Additional Information		
Communication Procedures	[insert communication procedures, means of alerting personnel, etc.]	
CPR/First Aid Trained Personnel	[insert names]	
Site-Specific Spill	[insert spill response procedures for specific chemicals if required]	

Response Procedures	

10.1.4 Spill Containment Procedure

Work activities may involve the use of hazardous materials (i.e. fuels, solvents) or work involving drums or other containers. Where these activities exist, a site-specific Spill Reporting Card [project team must develop the spill reporting card] will be developed (Attachment D). Procedures outlined below will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.

At least one spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e. speedy dri) shall be available at each work site (more as needed).

- All hazardous commodities in use (i.e. fuels) shall be properly labeled.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.
- Drums/containers will be secured and handled in a manner which minimizes spillage and reduces the risk of musculoskeletal injuries.

10.1.5 Safety Accident/Incident Reporting

All accidents and incidents that occur on-site during any field activity will be promptly reported to the SSO and the immediate supervisor.

If any AECOM employee is injured and requires medical treatment, the Site Supervisor will report the incident in accordance with AECOM's incident reporting procedures. A copy of the final Supervisor's Report of Incident will be provided to the SH&E Professional before the end of the following shift.

If any employee of a subcontractor is injured, documentation of the incident will be accomplished in accordance with the subcontractor's procedures; however, copies of all documentation (which at a minimum must include the OSHA Form 301 or equivalent) must be provided to the SSO within 24 hours after the accident has occurred.

All accidents/incidents will be investigated. Copies of all subcontractor accident investigations will be provided to the SSO within five (5) days of the accident/incident.

10.1.6 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the sequence identified in the *Site-Specific Spill Reporting Card*. In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, your applicable regulatory permit, and/or client-specific reporting procedures. In order to support the Site Supervisor and expedite the decision to report to a state regulatory agency, a site-specific Spill Reporting Card will be developed (Attachment D). **If reporting to a US state or Federal regulatory agency is required, AECOM has 15 minutes from the time of the spill/release to officially report it.**

Chemical-specific Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Reportable Quantities for the known chemicals onsite are shown in Table 10.1.

Table 10.1: CERCLA Reportable Quantities

Hazardous Substance	Regulatory Synonyms	Final RQ (lbs)
Benzene	N/A	10
Trichloroethylene	Trichloroethene, TCE	100
Tetrachloroethylene	Perchloroethylene, PCE	100
[insert additional rows as required]		

[CERCLA RQs can be found at:

[http://www.epa.gov/superfund/programs/er/triggers/haztrigs/302table01.pdf.](http://www.epa.gov/superfund/programs/er/triggers/haztrigs/302table01.pdf)]

Table 10.1: Emergency Contacts

Emergency Coordinators / Key Personnel			
<u>Name</u>	<u>Title/Workstation</u>	<u>Telephone Number</u>	<u>Mobile Phone</u>
[insert]	Client Contact		
[insert]	Account/Client Manager		
[insert]	Project Manager		
[insert]	Site Supervisor		
[insert]	Site Safety Officer		
[insert]	Regional SH&E Manager		
[insert]	District SH&E Manager		
Incident Reporting	Incident Reporting Line	(800) 348-5046	
[insert]	Emergency Coordinator (EC)		
[insert]	Secondary EC		
Insert	TDG/IATA Shipping Expert		
Organization / Agency			
<u>Name</u>	<u>Telephone Number</u>		
Police Department (local)	911 [or insert here]		
Fire Department (local)	911 [or insert here]		
Ambulance Service (<i>EMT will determine appropriate hospital for treatment</i>)	911 [or insert here]		
-Emergency Hospital (<i>Use by site personnel is only for non-emergency cases</i>)			
[insert clinic Name]			
[insert clinic address]			
[insert clinic city, state, zip]			
Emergency Hospital Route: See Figure 9-1			
Poison Control Center	(800) 222-1222		
Pollution Emergency	(800) 292-4706		
National Response Center	(800) 424-8802		
INFOTRAC(insert account number)	(800) 355-5053		
Title 3 Hotline	(800) 424-9346		
Public Utilities			
<u>Name</u>	<u>Telephone Number</u>		
Call Before You Dig	811		

Figure 10.1: Emergency Occupational Hospital Route/Detail Map

[insert map if needed & available]

By signing below, the undersigned acknowledges that he/she has read and reviewed the AECOM Health and Safety Plan for the [site name] site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work, and will comply with the provisions contained therein.

[illegible]

Attachment A

Task Hazard Analyses

[attach THAs]

Attachment B

Material Safety Data Sheets

[attach MSDSs]

Attachment C

Client-Specific Health and Safety Guidelines

[attach guidelines]

Attachment D
Applicable SH&E SOPs

[attach SOPs]

Attachment E
Client Specific SH&E Guidelines and
Subcontractors SH&E Information

[attach information]

S3NA-209-TP2a HASP Assistance

This document will assist the developer of the HASP in creating information for the HASP templates. Each help section is outlined by the required section.

1.0 Scope of Work

Below is a series of tasks typically encountered on projects. Although the text below may be used to describe your work, it must be elaborated on in sufficient detail to make it site specific.

1.1 Mobilization/Demobilization

Mobilization and demobilization represent limited pre- and post-task activities. These activities include driving to and from the site; initial site preparations, such as trailer and toilet facility setup; and post-work activities, such as removing files and office equipment and general housekeeping. Mobilization and demobilization do not represent any intrusive activities. Electrical hook-up and disconnect for office trailers must be performed by a licensed electrical subcontractor. Prior to mobilization, all utility clearance shall be obtained by the authorizing authority for the subject site. If utility locations cannot be verified on site by the public authority, then a private utility location contractor may need to be utilized to confirm/deny the presence of private underground utilities on the site.

1.2 Site Preparation

Site preparation includes construction and maintenance of temporary access roads and construction area entrances, installation of silt fence around the perimeter of disturbance areas, and installation of berms to facilitate the use of existing drainage features and structures. Other pre-work activities, such as the stockpiling of backfill materials, utility mark-out and clearance, and the setup of other work support items are included as well. Other site preparation activities will include the verification of utility mark-outs and presence of the clear dig permits (on site). Typically, the lead time for a clear dig permit is three days, and the permit is generally valid for 10 days. Consult the specific clearance dates associated with the permit obtained for the site.

1.3 Clearing and Grubbing

Clearing and grubbing involves the removal of trees and vegetation and their root systems. The limits of clearing and grubbing will extend approximately 10 feet beyond the perimeter of the areas specified in the work plan. Clearing will involve the cutting of standing timber and the removal of brush-utilizing chainsaws, brush hogs, and chippers. Grubbing will be performed using a dozer and/or hydraulic excavator. All cut and chipped vegetative material will be placed in roll-off boxes for offsite disposal.

1.4 Groundwater Sampling

Groundwater sampling includes the collection of groundwater samples from existing monitoring well networks, temporary Geo-probe points, and new monitoring wells. Groundwater samples will be collected through low-flow sampling techniques using submersible pumps. During groundwater collection, appropriate air monitoring will be conducted and the appropriate chemical-resistant PPE will be worn to protect against exposure. The major activities involved with collecting groundwater samples from the site and surrounding properties include the following:

- Presampling event notifications and approval.
- Setup for sampling activities.
- Groundwater samples from monitoring wells collected using low-flow sampling techniques.
- Sample prep and sample shipping.
- Administrative activities.

1.5 Surface Water Sampling

This activity will include the collection of samples from surface water from[...]. Water samples are collected from effluent collection points accessible from the ground surface. During water collection, the appropriate chemical-resistant PPE will be worn to protect against exposure as well as the PPE prescribed. The major activities involved with collecting samples from the site and surrounding properties include the following:

- Presampling event notifications and approval.
- Setup for sampling activities.

- Samples collection from a body of surface water (Shenandoah River, intermittent stream, pond).
- Sample prep and sample shipping.
- Administrative activities.

1.6 Soil Sampling

Soil samples will be collected from Geo-probe points and during well installation activities. During sampling activities, appropriate air monitoring will be conducted and the appropriate chemical resistant PPE will be worn to protect against exposure. The major activities involved with collecting samples from the site and surrounding properties include the following:

- Presampling event notifications and approval.
- Setup for sampling activities.
- Soil sample collection during well installation activities using HSA drilling techniques or from Geo-probe points.
- Sample prep and sample shipping.
- Administrative activities.

1.7 Sub-slab Vapor Sampling

Two rounds of sub-slab vapor samples, co-located with indoor air samples, will be collected from underneath the slabs of 20 buildings listed in Table 2-1 using 6L Summa® canisters. The sub-slab vapor samples will be sent to a fixed laboratory to obtain definitive data. Definitive data will be produced by using standard methods in a fixed laboratory. The major activities involved with collecting samples from the site include the following:

- Presampling event notifications and approval.
- Setup for sampling activities.
- Air samples will be collected as needed and will consist of ambient air sampling. Summa® canisters are the expected sampling container.
- Sample prep and sample shipping.
- Administrative activities.

1.8 Indoor Air Sampling

Indoor air samples may be collected from buildings on-site or nearby the site. Air samples will be collected as-needed and will consist of ambient air sampling. Suma canisters are the expected sampling container. The major activities involved with collecting samples from the site and surrounding properties include the following:

- Presampling event notifications and approval.
- Setup for sampling activities.
- Air samples will be collected as needed and will consist of ambient air sampling. Suma canisters are the expected sampling container.
- Sample prep and sample shipping.
- Administrative activities.

1.9 Installation and Abandonment of Sub-Slab Vapor Sampling Points

Sub-slab vapor monitoring points will be permanently installed at one location for each of the 20 buildings listed in Table 2-1. Care will be taken to identify locations where the concrete floor is accessible (not covered with tile or carpet). Asbestos tile was identified during the site visit; sampling locations will be adjusted to avoid installation of monitoring points in those locations.

The monitoring points will be installed by drilling a hole in the concrete slab, installing a small amount of filter pack sand, inserting an stainless steel tube fitted with a female threaded swagelok® and sealing the tube into the drill hole with VOC-free modeling clay. The monitoring point will be completed with hydraulic cement and set flush with the surrounding floor surface. A hex-head bolt will be screwed into the fitting to seal the sampling point.

1.10 Temporary Boring and Well Installation Oversight

AECOM personnel will perform oversight for the installation of temporary borings installed using a Geo-probe rig and monitoring wells using hollow-stem auger (HSA) or air rotary drilling methods. A drilling subcontractor (TBD) will be utilized for the installation of monitoring wells (4-inch PVC typical) to a predetermined depth utilizing a HAS drill and/or air rotary drill rig. The major activities involved with the installation of a monitoring well or a temporary boring are as follows:

- Pre-sampling event notifications and approval.

- Set-up for boring/well installation.
- Monitor air quality in the workers breathing zone.
- Log soils and screen with a PID.
- Sample collection using encore or bulk sampling.
- Administrative activities.

1.11 Well Abandonment Oversight

AECOM personnel will be performing the oversight for well abandonment to be performed by a drilling subcontractor (TBD). The major activities involved with abandoning a well are

- Setting up for well abandonment.
- Removing stick-up or flushmount casing, including concrete pad.
- Pulling the well casing from the ground with drill rig or over-drill.
- Filling the well with grout.

1.12 Operations and Maintenance of GW Treatment System

AECOM personnel will conduct operation and maintenance activities at the ABC Groundwater Treatment facility for the remediation of TCE- and PCE-impacted groundwater. Activities include pump/line repair and replacement, well head checks, acid/caustic deliveries, and periodic groundwater monitoring activities within the established monitoring well network. A minimum of two technicians will be on site during O&M activities.

1.13 Underground Storage Tank Removal

Tank Removal (oversight) activities are anticipated to be conducted on approximately 23 of the 27 individual locations. Tasks included under this SOW item include removal of surface cover (asphalt, concrete), cleaning of the tank interiors, physical tank removal, and backfilling activities. The tanks will be inerted and removed from the ground, tank exteriors will be cleaned, and tanks will be rendered unusable and will be transported off site for further disposition. Confirmation sampling of the tank pits will be performed to determine the need for contaminated soil removal.

1.14 Excavation of Contaminated Soils

AECOM will excavate and dispose impacted soils off site using an excavator and direct loading into roll-off or other approved containers for off-site transportation and disposal. The impacted materials will be placed into lined/covered roll-offs and will be temporarily staged on site prior to transportation to the disposal facility. Equipment operators will be supported by a crew of technicians who will perform spotting activities, provide traffic control, the securing of roll-off containers, and general housekeeping activities on the site. Additional confirmation sampling of the excavation will be performed under this task as well.

1.15 Investigative-Derived Waste (IDW) Management

IDW will be collected and categorized as nonhazardous or hazardous. Potentially hazardous IDW (purge water, decontamination fluids, soil cuttings, if any) will be tested and disposed of within 90 calendar days of completing the field activities. Potentially hazardous IDW waste will be staged onsite, then delivered to an IDW storage facility for processing. Nonhazardous IDW (normal trash) will be disposed of in a timely fashion during fieldwork. Drum handling and drum sampling activities may take place under this task.

1.16 Equipment Decontamination

AECOM and subcontractor personnel will perform decontamination of equipment used to perform work within controlled work areas. Decontamination procedures could range from dry-brush techniques, to wet methods (rinse/wash), to steam cleaning as determined by the type of operation being conducted. Please detail-out the anticipated decon methods for the site.

Before any drilling is begun and at the completion of drilling, the drilling subcontractor shall decontaminate the drill rig, casing, samplers, and all other drilling equipment that will be used on site. The drilling subcontractor shall provide a high-pressure steam cleaner for decontamination of all downhole drilling equipment. The drill rig shall be steam cleaned between drilling at each site. Soil sampling equipment shall be decontaminated between each use, using a phosphate-free detergent and potable water in accordance with ASTM D 5088. The drilling subcontractor shall construct a temporary decontamination pad to contain all decontamination water generated during decontamination of drill rigs and tools.

And/or:

Pre-cleaned and dedicated sampling materials/equipment will be used to collect soil and groundwater samples for laboratory analysis. After the samples are collected, any disposable or one-time use equipment (tubing, bladders)

will placed in a plastic bag for disposal in accordance with the paragraph above. Nondisposable sampling and drilling equipment that has the soil and/or groundwater will be decontaminated between each sampling location. Gross sediments and/or contamination will first be removed from the sampling and drilling equipment. The equipment will then be washed with DI water and Alconox detergent and then rinsed with DI water, methanol, etc.

1.17 Site Restoration

Site restoration will involve the removal of temporary roadways and staging areas, final grading of the site, surface cover installation (asphalt and concrete placement, topsoil, seeding, mulching, tree planting, and other landscaping), removal of temporary fencing and erosion control materials, and the disposal of construction debris.

2.0 Physical Hazards

Below is a series of tasks typically encountered on projects. While the text below may be used to describe your work, it must be elaborated on in sufficient detail to make it site specific.

2.1 Slips, Trips, Falls, and Protruding Objects

A variety of conditions that may exist may result in injury from slips, trips, falls, and protruding objects. Slips and trips may occur as a result of wet, slippery, or uneven walking surfaces. To prevent injuries from slips and trips, always keep work areas clean; keep walkways free of objects and debris; and report/clean up liquid spills. Serious injuries may occur as a result of falls from elevated heights. Always wear fall protection while working at heights of 6 feet or greater above the next lower level. Protruding objects are any object that extends into the path of travel or working area that may cause injury when contacted by personnel. Always be aware of protruding objects and when feasible remove the protruding object or label it with an appropriate warning.

2.2 Housekeeping

During site activities, work areas will be continuously policed to identify excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials. Additional information on the requirements of housekeeping[...].

2.3 Manual Lifting

Most materials associated with investigation and remedial activities are moved by hand. The human body is subject to severe damage in the forms of back injury, muscle strains, and hernia if caution is not observed in the handling process. Whenever possible, use mechanical assistance to lift or move materials and, at a minimum, use at least two people to lift or roll/lift with your arms as close to the body as possible.

2.4 Utilities

Various forms of underground/overhead utility lines or pipes may be encountered during site activities. Prior to the start of intrusive operations, utility clearance is mandated, as is obtaining authorization from all concerned public utility department offices. If insufficient data is available to accurately determine the location of the utility lines, AECOM will hand clear to a depth of at least 5 feet below ground surface in the proposed areas of subsurface investigation. Should intrusive operations cause equipment to come into contact with utility lines, the SSO and an AECOM SH&E Professional will be notified immediately. Work will be suspended until the applicable utility agency is contacted and the appropriate actions for the particular situations can be taken. The phone number for the applicable state agency is provided in the Emergency Contacts list.

Ensure that backhoe operators, truck drivers, etc. and the signal person are aware of overhead power lines when working around overhead power lines. Overhead power and utility lines may be present on, or adjacent to, the site and represent a potential hazard during the mobilization/demobilization of equipment and supplies. Maintain a minimum of 10 feet between overhead power lines and the bucket and/or arm of the backhoe bed/cab of trucks, etc. Any deviation must be approved by the Regional SH&E Manager. Additional information on working adjacent to overhead power and utility lines[...].

2.5 General Electrical Hazards

Electrical and powered equipment may be used during a variety of site activities. Injuries associated with electrical and powered equipment include electric shock, cuts/lacerations, eye damage (from flying debris), and burns. To reduce the potential of injury from the hazards associated with electrical and powered equipment, always comply with the following:

- Use ground fault circuit interrupters (GFCIs) when using electrical powered tools/equipment. GFCIs prevent electrical shock by detecting the loss of electricity from a power cord and/or electrical device.
- Confirm that generators are properly grounded, including the use of a grounding rod driven to a depth of 3 feet.
- Wear ANSI-approved (Z87.1) safety glasses. Face shields may be required to provide additional face protection from flying debris.
- Wear appropriate work gloves. Work gloves may reduce the severity of burns and cuts/lacerations.

All temporary electric installations (site trailer, subpanels) will comply with OSHA (29 CFR 1926, Subpart K, and 29 CFR 1910, Subpart S) guidelines. Only qualified and competent individuals (licensed electrician) will provide electrical service/servicing. Refer to SH&E 712, *Hazardous Energy Control*, for additional requirements and information.

2.6 Hazardous Energy

Use lockout/tagout procedures when performing maintenance or repairs on equipment.

It is the responsibility of AECOM employees to verify that all remediation equipment is locked out before AECOM employees perform any maintenance or repair work on the system. The source must be locked out; it is not enough to push the power switch to off and disconnect the breaker. Anyone can re-engage power under these circumstances. Locking out the power source is the only way to guarantee that the power will not be inadvertently reactivated.

A lock-out/tag-out kit will be located in the treatment shed for the duration of the project. The kit includes standard locks, keys, and lock-out notices.

The site specific lock-out/tag-out information must be completed for both the groundwater containment system and the SSD system. These forms will then be placed within the remediation trailer so all field technicians performing operations and maintenance work on the system are familiar with how to lock out the system when necessary.

2.7 Heavy Equipment and Vehicle Operations

Heavy equipment and site vehicles present serious hazards site personnel. Blind spots, failure to yield, and other situations may cause heavy equipment/vehicles to come into contact with personnel. To reduce the possibility of contact between equipment/traffic and personnel, always adhere to the following:

- Personnel must wear a high-visibility, reflective safety vest at all times when working near heavy equipment and/or other vehicle traffic.
- Personnel must always yield to equipment/vehicle traffic and stay as far as possible from all equipment/vehicle traffic. Always maintain eye contact with operators.
- When feasible, place barriers between work areas and equipment/vehicle traffic.
- Always ensure that reverse warning alarms are working and louder than surrounding noise. Personnel must report inoperative reverse warning alarms.
- Confirm Daily Equipment Safety Inspections are being performed and that documentation is filed at the site.

2.8 Drilling Operations

Drilling operations, including hollow-stem, rotary and/or direct push drilling, present their own set of hazards. Several basic precautions that should be taken include, but are not limited to, confirming locations of underground and overhead utilities, wearing of appropriate PPE and the avoidance of loose clothing or jewelry, staying clear of moving parts, and knowing the locations of emergency shut-off switches. Other operational safety precautions regarding moving the drilling equipment, raising and lowering the derrick(mast), and drilling may be required.

2.9 Excavations and Trenches

Excavations and trenches present workers with a variety of hazards. If not properly sloped, shored, or boxed, trench walls may collapse and trap workers under the weight of the soil. Soil contaminants and other chemical hazards (e.g., carbon monoxide from equipment/vehicles) may result in a hazardous atmosphere. Confined space entry procedures may need to be followed if the potential for a hazardous atmosphere exists. Buried utilities may exist where excavations/trenches will be placed. Always contact the local utility locator service prior to beginning excavations.

2.10 UST Removal

Although AECOM employees do not actually perform underground storage tank removal operations, they may oversee or be present during the removal or closure of underground storage tanks by contractors or subcontractors. It is therefore important that AECOM employees be aware of the hazards associated with and the safe work procedures for performing underground storage tank removal. Safety measures should include confirming locations of underground and overhead utilities, heavy equipment operations awareness, excavation safety awareness, and basic UST removal procedures such as tank cleaning, inerting, physical removal, and load-out procedures.

Only experienced, demonstrably proficient, equipment operators will be used to operate such heavy equipment as backhoes, front-end loaders, cranes, etc. Where certification or licensing requirements exist, such personnel shall possess appropriate certification and/or licensing for operating specified heavy equipment. Because of the potential cave-in and atmospheric hazards, entry into the underground storage tank excavation should be avoided at all costs. Soil samples from the excavation should be collected with a remote sampling device or from the bucket of the backhoe whenever possible. Before initiating work in the tank area or on the tank, air monitoring must be performed to assess flammable vapor concentrations in the tank and the surrounding work area. For the

purposes of this SOP, atmospheres that are measured and found to contain flammable gases or vapors at concentrations greater than 10% of the LEL of flammable gas or vapor shall be considered flammable.

2.11 Elevated Work Platforms and Aerial Lifts

The use of aerial lifts presents a unique set of hazards to employees using and working around the equipment. Proper training on the safe usage of the specific type of lift being utilized is essential to the safe execution of work tasks with the equipment. Besides the daily inspections and safe usage of the equipment, numerous other safety related issues—including fall protection, safe working surfaces, and overhead power lines—need to be assessed.

2.12 Working at Heights

The following are US standards. Fall Protection Systems shall comply with OSHA Regulations (Standards – 29 CFR) Standard # 1926.502 Fall Protection Systems Criteria and Practices and OSHA Standard # 1926.502(d) – 1926 Subpart M App C Personal Fall Arrest Systems.

Specifically, anyone working in an area exposed to a fall greater than 6 feet must use appropriate fall protection. Such protection includes: guardrail systems, safety net systems, or personal fall arrest systems. Other protection methods include hole covers, positioning devices, equipment guards, fences, and barricades. Fall protection shall be provided as required in OSHA Regulations 29CFR1910 and 29CFR1926, reference: standard 1926.501 Duty to Have Fall Protection.

Work above a height of 6 feet requires a fall protection system. This project requires 100 percent tie-off using full-body harness (Class III or IV) with dual shock-absorbing lanyard (shorter than fall distance and a maximum of 6 feet long) equipped with double-locking hooks connected to a proper tie-off attachment point capable of handling potential fall loads of 5,000 pounds.

Fall protection systems classified as “job made” (not purchased, approved fall prevention devices from a fall protection supplier) shall be designed by a Registered Professional Engineer. Fall protection or restraining methods shall be in place when employees are within 6 feet of the leading or exposed edge, where a fall hazard exceeding 6 feet exists, such as during decking activities, inspecting structures, climbing, trenching, etc.

2.13 Working On or Near the Water

The buddy system should be utilized whenever there is the possibility of falling into water. In the buddy system, two persons operate as a single unit in order to monitor and assist each other in performing tasks. Whenever the possibility of falling into water exists, personnel must be attired in a USCG-approved Type III or Type V work vest. The vest must be properly sized for the individual and must be secured at all times. A throwable rescue device (Type IV flotation aid), along with other appropriate equipment (i.e., ladders, lifting gear, or rescue boat), shall be immediately available to recover an individual from the water.

Waders may not be worn when working along, over, or in moving waters; or in waters influenced by tides or acted upon by waves when water depths exceed knee height unless specifically approved by the SH&E Manager. Waders may be worn in still waters in water depths up to the waist if bottom conditions are firm and well understood. Waders shall never be worn aboard a watercraft of any kind.

Use a pole to conduct sediment probing to assess water depths, the stability of shoreline terrain, and the bearing capacity of bottom sediments ahead of the chosen path. If workers have the potential to get stuck in mud or fluidized sediment, air injection equipment designed to free workers' feet/legs may need to be available on site. At a minimum, a safety line should be available to be deployed from safe ground. If a worker does get stuck, he or she should not struggle as this causes further sinking.

Take special care on slippery rocks along shorelines, lakeshores, riverbanks, and creeks. Always look ahead at the ground when walking around the water's edge and avoid stepping on stones that have algal growth, especially those in intertidal areas, as these are extremely slippery. It is suggested that workers not be permitted to access areas where these slip/fall hazards exist, especially in locations containing tidal water flow.

2.14 Working Near Railroad Hazards

When working on or near “live” tracks, follow these general rules:

Hard hats (preferably orange), high visibility apparel, and safety footwear shall be worn on railroad right-of-way. All other owner/operator safety requirements and procedures shall be followed.

Red markers, flagging, or lights shall not be used on railroad right-of-way. Red means “immediate danger,” and trains that encounter red markers will stop without exception. Red signals shall only be used when injured persons or disabled vehicles are on the tracks or at grade crossings and cannot be moved or when any condition could cause derailment.

Train schedules cannot be relied upon. Passenger trains have published schedules but are often off schedule. Freight trains have no schedules, and move anyplace, anytime.

When tracks must be crossed, look in both directions every time. When crossing more than one set of tracks, stop after the first set and look again each way before crossing the second set. Air build-up can cause a train to “jump” forward; therefore, do not cross directly in front of a standing train. Do not lean on or crawl under stopped cars or cross tracks between cars.

Railroad equipment is not always heard, especially if there is other noise. Coasting, slow-moving trains may give no warning.

Notify the flagger each time it is necessary to “foul” the tracks, and then proceed only after “absolute protection” is received. Efforts to clear tracks must begin immediately anytime the flagger indicates to do so.

For jobs longer than one day, the flagger and project supervisor shall discuss the day’s work and any need to foul the tracks at the start of each work day. Discuss job details with each new flagger.

Be alert for buried electrical/utility lines on or near railroad right-of-way. Excavations on the right-of-way shall be filled at the end of each day.

Access roads to and across tracks shall not be blocked or disrupted. Vehicles shall not be parked within 10 feet of the tracks. Materials, tools, or equipment shall not be stored on railroad right-of-way. Track ballast shall not be eroded or contaminated. Work areas shall be inspected after each day’s work to ensure that nothing is left on or near the tracks. Appropriate lighting devices shall be used to protect the work area overnight.

It is also important to note that trains and cars in the hump yard area may be under remote operation. Exercise extreme caution when working in these areas as there may be no engineers aboard these trains and cars.

2.15 Dust and Odor Control

Specific controls will be in place to prevent dust generation. If dust is observed reaching or approaching the site boundary, activities causing the dust will be immediately stopped. Dust control measures (water spray, soil covers, slower work pace, or change in work activities) will be deployed prior to resuming work. Corrective measures will be documented in the daily report.

Because of the nature of the contaminant at the site, odors are not likely to be anticipated to be of concern. In the event that an odor complaint is received, the SS and/or SSO will immediately assess site conditions and will determine the probable cause or causes. Appropriate odor mitigation measures will be deployed. These measures may include covering sediment piles, deploying odor suppressing foam, implementing air monitoring, or discontinuing activities that are generating the odor. Corrective measures will be documented in the daily report.

2.16 Spill Prevention

Work activities may involve the use of hazardous materials (i.e. fuels, solvents) or work involving drums or other containers. The following procedures will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.

At least one spill response kit, including an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (e.g., speedy dri) shall be available at each work site (more as needed).

All hazardous commodities in use (e.g., fuels) shall be properly labeled.

Containers shall only be lifted using equipment specifically manufactured for that purpose.

2.17 Noise Exposure Monitoring

[specify if necessary]

When heavy equipment is in operation, it will be necessary to ensure that each exclusion zone fully encompasses all areas where hazardous noise levels are present (85dBA or greater). Once each work day, the SSO will use a sound level meter to survey the perimeter of each exclusion zone while all onsite heavy equipment within the zone is being operated simultaneously. If the sound pressure level exceeds 85 dBA at any location along the site perimeter, the SSO will exit the exclusion zone and use the meter to determine the 85 dBA limit. The exclusion zone boundary will then be adjusted to fully encompass this region.

2.18 Traffic Control

During certain work tasks, the establishment of traffic control to adequately protect workers and the public may be required on-site. Site-specific requirements will be determined by the site supervisor/SSO on a case-by-case basis. Only approved traffic control devices in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) will be used on public road ways per accordance with the applicable state regulatory guidance.

General traffic control precautions include placing a work vehicle between your worksite and oncoming traffic whenever possible. Not only is it a large, visible warning sign, but also if an oncoming car should fail to yield or deviate, the parked vehicle rather than your body would absorb the first impact of a crash. Turn the vehicle wheels so that if the vehicle were struck it would swing away from the worksite. When using cones or other devices to modify traffic flow, ensure use of the proper taper length and device spacing to provide adequate warning distance to oncoming motor vehicles. In addition, proper PPE, including a hardhat and a high-visibility vest shall be worn during traffic operations.

3.0 Wildlife, Plant, and Insect Hazards

Below is a series of tasks typically encountered on projects. While the text below may be used to describe your work, it must be elaborated on in sufficient detail to make it site specific.

3.1 Bears

An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting, to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously.

The hazard or risk associated with a bear encounter varies significantly depending on the location. It is important to research the project area before field work commences to determine the expected probability of encountering a bear. Remoteness from urbanized areas should not be a criteria, as bears have been encountered within city limits, especially near landfills.

The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.

Preparing staff for any type of encounter is key to managing the risk.

3.2 Small Mammals

Working in the field either directly or indirectly with small mammals has an inherent risk of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) against which all field staff need to protect themselves.

This risk is usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, air-borne diseases (e.g., Hantavirus) also pose a risk.

Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

3.3 Venomous Animals

Some animals have the ability to inject venom. These include rattlesnakes, black widow spiders, and scorpions, all of which have limited distributions and therefore are unlikely to be encountered in most areas. Other spiders possess venom but they are not potentially lethal to humans. Shrews have poisonous saliva, but the chance of being envenomated by them is extremely unlikely unless they are handled.

If bitten by any of these animals, special care should be taken to treat the wound as it may lead to complications due to the toxin.

A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

3.4 Poisonous Plants

Sensitivity to toxins generated by plants, insects, and animals varies according to dosage and the ability of the victim to process the toxin; therefore, it is difficult to predict whether a reaction will occur or how severe the reaction will be. Staff should be aware that a large number of organisms are capable of causing serious irritations and allergic reactions. Some reactions will only erupt if secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can result in severe scarring, blindness, or even death.

S3NA(US)-209-TP2b HASP Chemical Guidelines

TABLE 4-1

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Aahepta (Heptachlor Epoxide, Heptachlor, 3-chlorochlordene, hepta, heptachlorane) (76-44-8)	0.5 mg/m ³ (skin) IDLH: 35 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	MSA ≥ 0.5 mg/m ³ , Level B North and 3M ⁽³⁾
Acenaphthene (1,8,Ethylenenaphthalene, 1,2 dehydroacenaphthalene) (83-32-9)	0.2 mg/m ³ ⁽¹⁾ (0.03 ppm)	7.5-8.5	1) 306% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.1 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 10 mg/m ³ , Level C > 10 mg/m ³ , Level B
Acenaphthylene (208-96-8)	0.2 mg/m ³ ⁽¹⁾ (0.03 ppm)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 10 mg/m ³ , Level C > 10 mg/m ³ , Level B
Acetaldehyde (Ethanal, Acetic aldehyde, ethyl aldehyde) (75-07-0)	100 ppm (180 mg/m ³)	10.21	1) N/A ⁽³⁾ 2) 28% 3) 23% 4) 9.1%	1) N/A ⁽⁶⁾ 2) 28 ppm 3) 23 ppm 4) 9.1 ppm	SENS Measuring Range: 0.1 - 750 ppm ⁽⁷⁾ Detection Limit: 0.1 ppm Drager Measuring Range: 100 - 1,000 ppm	MSA, North and 3M < 1000 ppm, Level C ≥ 1000 ppm, Level B 3M ≤ 1,250 ppm, Level C > 1,250 ppm, Level B
Acetaldehyde Oxime (Acetaldoxime, Aldoxime, Ethanol Oxime, Ethylidene, Hydroxylamine) (107-29-9)	N/A ⁽²⁾	N/A ⁽²⁾	1) 23% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾
Acetaldoxime (Acetaldehyde Oxime, Aldoxime, Ethanol Oxime, Ethylidene Hydroxylamine) (107-29-9)	N/A ⁽²⁾	N/A ⁽²⁾	1) 23% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Acetic Acid (Glacial Acetic Acid, Ethanoic acid) (64-19-7)	10 ppm (25 mg/m ³)	10.35	1) 5.0% 2) 32.8% 3a) 38% - slow 3b) 11% - glacial 4) 22.7%	1) 0.50 pp 2) 3.28 ppm 3a) 3.8 ppm 3b) 1.1 ppm 4) 2.3 ppm	SENS Measuring Range: 0.125 – 100 ppm Detection Limit: 0.05 ppm	MSA < 50 ppm, Level C ≥ 50 ppm, Level B
					Drager Measuring Range: 125 - 200 ppm	North < 500 ppm, Level C ≥ 500 ppm, Level B
						3M < 100 ppm, Level C ≥ 100 ppm, Level B
Acetic Acid Anhydride (Acetic Anhydride, Acetic Oxide, Acetyl Oxide) (108-24-7)	5 ppm (20 mg/m ³)	10.14	1) 9.0% 2) N/A ⁽³⁾ 3) 61% 4) 8.2%	1) 0.45 ppm 2) N/A ⁽⁶⁾ 3) 3.05 ppm 4) 0.41 ppm	SENS Measuring Range: 0.6 – 15 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA < 200 ppm, Level C ≥ 200 ppm, Level B
						North and 3M < 250 ppm, Level C ≥ 250 ppm, Level B
Acetic Aldehyde (Acetaldehyde, Ethanal, Ethyl Aldehyde) (75-07-0)	100 ppm (180 mg/m ³)	10.21	1) N/A ⁽³⁾ 2) 28% 3) 23% 4) 9.1%	1) N/A ⁽⁶⁾ 2) 28 ppm 3) 23 ppm 4) 9.1 ppm	SENS Measuring Range: 0.1 – 750 ppm ⁽⁷⁾ Detection Limit: 0.1 ppm	MSA and North < 1,000 ppm, Level C ≥ 1,000 ppm, Level B
					Drager Measuring Range: 100-1,000 ppm	3M ≤ 1,250 ppm, Level C > 1,250 ppm, Level B
Acetic Anhydride (Acetic acid anhydride, acetic oxide, acetyl oxide) (108-24-7)	5 ppm (20 mg/m ³) (ceiling)	10.14	1) 9.0% 2) N/A ⁽³⁾ 3) 61% 4) 8.2%	1) 0.45 ppm 2) N/A ⁽⁶⁾ 3) 3.05 ppm 4) 0.41 ppm	SENS Measuring Range: 0.6 – 15 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA, North and 3M < 250 ppm, Level C ≥ 250 ppm, Level B
Acetic Oxide (Acetic acid Anhydride, Acetic Anhydride, Acetyl Oxide) (108-24-7)	5 ppm (20 mg/m ³) (ceiling)	10.00	1) 9.0% 2) N/A ⁽³⁾ 3) 61% 4) 8.2%	1) 0.45 ppm 2) N/A ⁽⁶⁾ 3) 3.05 ppm 4) 0.41 ppm	SENS Measuring Range: 0.6 – 15 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA < 250 ppm, Level C ≥ 250 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Acetone (Dimethyl ketone, ketone propane, 2-propanone) (67-64-1)	750 ppm (1800 mg/m ³)	9.69	1) 42% 2) 38% 3) 82% 4) 45%	1) 315 ppm 2) 285 ppm 3) 615 ppm 4) 337 ppm	SENS Measuring Range: 50-12,000 ppm Detection Limit: 5 ppm	MSA and North ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
					Drager Measuring Range: 100-12,000 ppm	3M ≤ 20,000 ppm, Level C > 20,000 ppm, Level B
Acetonitrile (Ethyl nitrile, methyl cyanide, cyanomethane) (75-05-8)	40 ppm (70 mg/m ³)	12.22	1) N/A ⁽³⁾ 2) 0.8% 3) 70% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.32 ppm 3) 28 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 3 – 180 ppm Detection Limit: 0.1	MSA and North Level B
						3M ≤ 400 ppm, Level C > 400 ppm, Level B
Acetophenone (acetyl benzene) (98-86-2)	TLV 10 ppm (49 mg/m ³)	9.27	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and 3M ≤ 500 ppm, Level C > 500 ppm, Level B
						North ⁽³⁾ 3M < 100 ppm, Level C ≥ 100 ppm, Level B
Acetyl Oxide (Acetic Anhydride, Acetic acid anhydride, Acetic Oxide) (108-24-7)	5 ppm (20 mg/m ³)	10.14	1) 9.0% 2) N/A ⁽³⁾ 3) 61% 4) 8.2%	1) 0.45 ppm 2) N/A ⁽⁶⁾ 3) 3.05 ppm 4) 0.41	SENS Measuring Range: 0.6 – 15 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA, North and 3M < 250 ppm, Level C ≥ 250 ppm, Level B
Acetylene (74-86-2)	N/A ⁽²⁾	11.41	1) 0.0 ⁽³⁾ 2) N/A ⁽³⁾ 3) 225% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 32.5 – 1,040 ppm Detection Limit: 5 ppm	MSA only Level B
						North and 3M ⁽³⁾
Acetylenetetrachloride (1,2,4,5-Tetrachlorobenzene, ethane tetrachloride) (95-94-3)	N/A ⁽²⁾	< 10.2	1) 128% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	N/A ⁽²⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Acetylene dichloride (1,2-DCE, 1,2-Dichloroethene, 1,2-Dichloroethylene) (540-59-0)	200 ppm (790 mg/m ³)	9.80	1) 75% 2) 85% 3) 40% 4) N/A ⁽³⁾	1) 150 ppm 2) 170 ppm 3) 80 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 5 – 800 ppm Detection Limit: 1 ppm	MSA ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾
						3M ≤ 4,000 ppm, Level C > 4,000 ppm, Level B
Acraldehyde (Acrolein) (107-02-8)	0.1 ppm	10.13	1) 31% 2) 27% 3) 27% 4) 12.8%	1) 0.03 ppm 2) 0.03 ppm 3) 0.03 ppm 4) 0.01 ppm	SENS Measuring Range: 3.3 - 800 ppm ⁽⁷⁾ Detection Limit: 2 ppm	MSA < 2 ppm, Level C ≥ 2 ppm, Level B
						North and 3M < 5 ppm, Level C ≥ 5 ppm, Level B
Acrolein (Acraldehyde) (107-02-8)	0.1 ppm	10.13	1) 31% 2) 27% 3) 27% 4) 12.8%	1) 0.03 ppm 2) 0.03 ppm 3) 0.03 ppm 4) 0.01 ppm	SENS Measuring Range: 3.3 - 800 ppm ⁽⁷⁾ Detection Limit: 2 ppm	MSA < 2 ppm, Level C ≥ 2 ppm, Level B
						North and 3M < 5 ppm, Level C ≥ 5 ppm, Level B
Acrylonitrile (Acrylonitrile monomer, propene nitrile, vinyl cyanide) (107-13-1)	2 ppm (skin)	10.91	1) N/A ⁽³⁾ 2) 28.5% 3) 98% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.77 ppm 3) 1.96 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.125 - 360 ppm ⁽⁷⁾ Detection Limit: 0.05 ppm	MSA < 85 ppm, Level C ≥ 85 ppm, Level B
					Drager Measuring Range: 0.5 – 20 ppm	North and 3M < 100 ppm, Level C ≥ 100 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Acrylonitrile monomer (Acrylonitrile, propene nitrile, vinyl cyanide) (107-13-1)	2 ppm (skin)	10.91	1) N/A ⁽³⁾ 2) 38.5% 3) 98% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.77 ppm 3) 1.96 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.125 – 360 ppm ⁽⁷⁾ Detection Limit: 0.05 ppm Drager Measuring Range: 0.5 - 20 ppm	MSA < 85 ppm, Level C ≥ 85 ppm, Level B
						North and 3M < 100 ppm, Level C ≥ 100 ppm, Level B
Aldoxime (Acetaldehyde Oxime, Acetaldoxime, Ethanol Oxime, Ethylidene) (107-29-9)	N/A ⁽²⁾	N/A ⁽²⁾	1) 23% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾
Aldrin (HHDN, Octalene) (309-00-2)	0.25 mg/m ³ IDLH: 25 mg/m ³	N/A	1) N/A 2) N/A 3) N/A	1) N/A 2) N/A 3) N/A	N/A	MSA > 0.25 mg/m ³ , Level B
						North ≤ 12.5 mg/m ³ , Level C > 12.5 mg/m ³ , Level B
Allyl Alcohol (allylic alcohol) (107-18-6)	2 ppm (5 mg/m ³)	9.67	1) 25% 2) 47% 3) 30% 4) 21%	1) 0.5 ppm 2) 0.94 ppm 3) 0.6 ppm 4) 0.4 ppm	N/A ⁽³⁾	MSA < 20 ppm, Level C ≥ 20 ppm, Level B
						North ⁽³⁾
						3M ≤ 100 ppm, Level C > 100 ppm, Level B
Allyl Chloride (3-chloropropene, 1-chloro-2-propene) (107-05-1)	1 ppm (3 mg/m ³)	10.2	1) 13% 2) 119% 3) 50% 4) 12%	1) 0.13 ppm 2) 1.19 ppm 3) 0.50 ppm 4) 0.12 ppm	SENS Measuring Range: 1 – 20 ppm ⁽⁷⁾ Detection Limit: 0.02 ppm	MSA Level B
					Drager 5-60 ppm	3M < 10 ppm, Level C ≥ 10 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Allylic Alcohol (allyl alcohol) (107-18-6)	2 ppm (5 mg/m ³)	9.67	1) 25% 2) 47% 3) 30% 4) 2%	1) 0.5 ppm 2) 0.94 ppm 3) 0.6 ppm 4) 0.4 ppm	N/A ⁽³⁾	MSA < 20 ppm, Level C ≥ 20 ppm, Level B
						North ⁽³⁾
						3M ≤ 100 ppm, Level C > 100 ppm, Level B
Alpha Pinene (2-Pinene) (80-56-8)	N/A ⁽²⁾ TLV 10 ppm	8.07	1) 7.0% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 167%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 95 – 1,140 ppm Detection Limit: 0.5 ppm	Level B ⁽⁸⁾
Aluminum (7429-90-5)	metal/dust total: 15 mg/m ³ metal/dust respirable: 5 mg/m ³ pyro powders: 5 mg/m ³ welding fumes: 5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 250 mg/m ³ , Level C > 250 mg/m ³ , Level B
Aminobenzene (Aniline, Aniline oil, Benzenamine) (62-53-3)	2 ppm (8 mg/m ³) (skin)	7.70	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) 4% slow 4) 100%	1) 1.3 ppm 2) 1.72 ppm 3) 0.08 ppm 4) 2.0 ppm	SENS Measuring Range: 1.25 - 60 ppm ⁽⁷⁾ Detection Limit: 0.25 ppm	MSA and North Level B
					Drager Measuring Range: 0.5 - 10 ppm ⁽⁷⁾	3M < 100 ppm, Level C ≥ 100 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Ammonia (Anhydrous ammonia) (7664-41-7)	25 ppm (17 mg/m ³)	10.15	1) 6.0% 2) 30% 3) N/A ⁽³⁾ 4) 5.2%	1) 1.5 ppm 2) 7.5 ppm 3) N/A ⁽⁶⁾ 4) 1.3 ppm	SENS Measuring Range: 0.5 - 1,000 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA and North ≤ 500 ppm, Level C > 500 ppm, Level B
					Drager Measuring Range: 0.25 – 1,500 ppm	3M ≤ 1,250 ppm, Level C > 1,250 ppm, Level B
Amyl Hydrine (Pentane) (109-66-0)	600 ppm (1,800 mg/m ³)	10.34	1) N/A ⁽³⁾ 2) 100.8% 3) 65% 4) 6%	1) N/A ⁽⁶⁾ 2) 605 ppm 3) 390 ppm 4) 36 ppm	SENS Measuring Range: 30 – 1,680 ppm Detection Limit: 5 ppm	MSA Level B
					Drager Measuring Range: 100 – 1,500 ppm	North ⁽³⁾ 3M < 15,000 ppm, Level C ≥ 15,000 ppm, Level B
Anhydrous Ammonia (Ammonia) (7664-41-7)	25 ppm (17 mg/m ³)	10.15	1) 6.0% 2) 30% 3) N/A ⁽³⁾ 4) 5.2%	1) 1.5 ppm 2) 7.5 ppm 3) N/A ⁽⁶⁾ 4) 1.3 ppm	SENS Measuring Range: 0.5 - 1,000 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA < 300 ppm, Level C ≥ 300 ppm, Level B
					Drager Measuring Range: 0.25 – 1,500 ppm	North and 3M < 500 ppm, Level C ≥ 500 ppm, Level B
Aniline (Aniline oil, Aminobenzene, Benzenamine) (62-53-3)	2 ppm (8 mg/m ³) (skin)	7.70	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) 4% slow 4) 100%	1) 1.3 ppm 2) 1.72 ppm 3) 0.08 ppm 4) 2.0 ppm	SENS Measuring Range: 1.25 - 60 ppm ⁽⁷⁾ Detection Limit: 0.25 ppm	MSA and North Level B
					Drager Measuring Range: 0.5 – 20 ppm	3M < 100 ppm, Level C ≥ 100 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Aniline oil (Aniline, Aminobenzene, Benzenamine) (62-53-3)	2 ppm (8 mg/m ³) (skin)	7.70	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) 4% slow 4) 100%	1) 1.3 ppm 2) 1.72 ppm 3) 0.08 ppm 4) 2.0 ppm	SENS Measuring Range: 1.25 - 60 ppm ⁽⁷⁾ Detection Limit: 0.25 ppm Drager Measuring Range: 0.5 – 20 ppm ⁽⁷⁾	MSA and North Level B 3M < 100 ppm, Level C ≥ 100 ppm, Level B
Anthracene (Paranaphthalene) (120-12-7)	0.2 mg/m ³ ⁽¹⁾ (0.03 ppm)	7.23	1) 244% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.07 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North < 10 mg/m ³ , Level C ≥ 10 mg/m ³ , Level B 3M ⁽³⁾
Antimony (7440-36-0)	0.5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	MSA < 50 mg/m ³ , Level C ≥ 50 mg/m ³ , Level B North ⁽³⁾ 3M ≤ 25 mg/m ³ , Level C > 25 mg/m ³ , Level B
Aroclor®1254 (PCB-1254, PCB-1260, PCB, chlorobiphenyl, polychlorinated diphenyl, Aroclor®1260) (53469-21-9)	0.5 mg/m ³ (skin) (0.0375 ppm) IDLH: 5 mg/m ³	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North > 0.5 mg/m ³ , Level B 3M < 25 ppm, Level C ≥ 25 ppm, Level B
Aroclor®1260 (PCB-1254, PCB-1260, PCB, polychlorinated biphenyl, chlorodiphenyl, Aroclor®1254) (53469-21-9)	0.5 mg/m ³ (skin) (0.0375 ppm) IDLH: 5 mg/m ³	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North > 0.5 mg/m ³ , Level B 3M < 25 ppm, Level C ≥ 25 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Arsenic (29 CFR 1910.1018) (7440-38-2)	PEL: 0.01 mg/m ³ Action Level: 0.005 mg/m ³ IDLH: 5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽⁴⁾	MSA ≤ 0.5 mg/m ³ , Level C > 0.5 mg/m ³ , Level B
						North < 1 ppm, Level C ≥ 1 ppm, Level B
						3M < 0.5 ppm, Level C ≥ 0.5 ppm, Level B
Atrazine (2-Chloro-4 (ethylamino)-6-isopropylamino)-s- (triazine) (1912-24-9)	5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 500 mg/m ³ , Level C > 500 mg/m ³ , Level B
						North and 3M ⁽³⁾
BHC (Lindane, HCH, HCCH, γ- hexachlorocyclohexane) (58-89-9)	0.5 mg/m ³ (skin) IDLH: 50 mg/m ³	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North ≤ 50 mg/m ³ , Level C > 50 mg/m ³ , Level B
						3M ⁽³⁾
Barium (Soluble compounds) (7440-39-3)	0.5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	MSA and 3M ≤ 25 mg/m ³ , Level C > 25 mg/m ³ , Level B
						North ⁽³⁾
Barium Dinitrate (Barium Nitrate) (10022-31-8)	0.5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	MSA ≤ 25 mg/m ³ , Level C > 25 mg/m ³ , Level B
						North and 3M ⁽³⁾
Barium Nitrate (Barium Dinitrate) (10022-31-8)	0.5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	MSA ≤ 25 mg/m ³ , Level C > 25 mg/m ³ , Level B
						North and 3M ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Benz(a)anthracene (Benzo(a)anthracene) (56-55-3)	0.2 mg/m ³ (¹) (0.02 ppm)	7.53	1) 246% 2) N/A(³) 3) N/A(³) 4) N/A(³)	1) 0.5 ppm 2) N/A(⁶) 3) N/A(⁶) 4) N/A(⁶)	N/A(³)	MSA and North < 10 mg/m ³ , Level C ≥ 10 mg/m ³ , Level B 3M(³)
Benzaldehyde (Benzoic aldehyde) (100-52-7)	AIHA WEEL TWA: 2 ppm	9.53	1) 67% 2) 86% 3) N/A(³) 4) N/A(³)	1) 1.34 ppm 2) 1.72 ppm 3) N/A(⁶) 4) N/A(⁶)	SENS Measuring Range: 4 – 92 ppm(⁷) Detection Limit: 0.05 ppm	MSA < 200 ppm, Level C ≥ 200 ppm, Level B North(³) 3M < 100 ppm, Level C ≥ 100 ppm, Level B
Benzenamine (Aniline, Aminobenzene, Aniline oil) (62-53-3)	2 ppm (8 mg/m ³) (skin)	7.70	1) 67% 2) 86% 3) 4% slow 4) 100%	1) 1.3 ppm 2) 1.72 ppm 3) 0.08 ppm 4) 2.0 ppm	SENS Measuring Range: 1.25 - 60 ppm(⁷) Detection Limit: 0.25 ppm Drager Measuring Range: 0.5-10 ppm(⁷)	MSA and North Level B 3M < 100 ppm, Level C ≥ 100 ppm, Level B
Benzene Carboxylic Acid (Benzoic Acid, Phenylformic Acid) (65-85-0)	N/A(²)	N/A(²)	1) 50% 2) N/A(²) 3) N/A(³) 4) N/A(³)	1) N/A(⁶) 2) N/A(⁶) 3) N/A(⁶) 4) N/A(⁶)	SENS Measuring Range: 0.01 – 0.8% Detection Limit: 0.003%	Level B(³)
Gamma-Benzene hexachloride (lindane, BHC, HCH, HCCH, γ- hexachlorocyclohexane) (58-89-9)	0.5 mg/m ³ (skin) IDLH: 50 mg/m ³	N/A(²)	1) N/A(⁴) 2) N/A(⁴) 3) N/A(⁴) 4) N/A(⁴)	1) N/A(⁶) 2) N/A(⁶) 3) N/A(⁶) 4) N/A(⁶)	N/A(³)	MSA and North ≤ 25 mg/m ³ , Level C > 25 mg/m ³ , Level B 3M(³)

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Benzene Tetrahydride (Cyclohexene, tetrahydrbenzene) (110-83-8)	300 ppm (1,015 mg/m ³)	8.95	1) 34% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 62.5%	1) 102 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) 187 ppm	SENS Measuring Range: 0.01 – 0.8% Detection Limit: 0.003%	MSA < 1,000 ppm, Level C ≥ 1,000 ppm, Level B North ⁽²⁾ 3M ≤ 13,000 ppm, Level C > 13,000 ppm, Level B
Benz(a)anthracene (56-55-3)	0.2 mg/m ³ ⁽¹⁾ (0.02 ppm)	7.53	1) 246% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.05 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North < 10 mg/m ³ , Level C ≥ 10 mg/m ³ , Level B 3M ⁽³⁾
Benzo(a)pyrene Coal Tar Pitch Volatile (50-32-8)	0.2 mg/m ³ ⁽¹⁾ (0.02 ppm)	7.5-8.5	1) ~300% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽⁴⁾	MSA and North < 10 mg/m ³ , Level C ≥ 10 mg/m ³ , Level B 3M ⁽³⁾
Benzo(b)fluoranthene Coal Tar Pitch Volatile (205-99-2)	0.2 mg/m ³ ⁽¹⁾ (0.02 ppm)	7.5-8.5	1) ~290% 2) N/A ⁽²⁾ 3) N/A ⁽²⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North < 10 mg/m ³ , Level C ≥ 10 mg/m ³ , Level B 3M ⁽³⁾
Benzo(k)fluoranthene Coal Tar Pitch Volatile (207-08-9)	0.2 mg/m ³ ⁽¹⁾ (0.02 ppm)	7.5-8.5	1) ~290% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North < 10 mg/m ³ , Level C ≥ 10 mg/m ³ , Level B 3M ⁽³⁾
Benzofuran Coal Tar Pitch Volatile (271-89-6)	N/A ⁽²⁾	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽³⁾
Benzoic Acid (phenylformic acid, benzene carboxylic acid) (65-85-0)	N/A ⁽²⁾	N/A ⁽²⁾	1) 50% 2) N/A ⁽²⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.01 – 0.8% Detection Limit: 0.003%	Level B ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Benzoic Aldehyde (Benzaldehyde) (100-52-7)	AIHA WEEL TWA 2 ppm	9.53	1) 67% 2) 86% 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 1.34 ppm 2) 1.72 ppm 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 4 - 92 ppm Detection Limit: 0.05 ppm	MSA ≤ 200 ppm, Level C > 200 ppm, Level B North ⁽³⁾ 3M < 20 ppm, Level C ≥ 20 ppm, Level B
1,12-Benzoperylene Coal Tar Pitch Volatile (Benzo(g,h,i)perylene) (191-24-2)	0.2 mg/m ³⁽¹⁾ (0.02 ppm)	7.5-8.5	1) ≈ 300% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 10 mg/m ³ , Level C > 10 mg/m ³ , Level B
Benzo(g,h,i)perylene Coal Tar Pitch Volatile (1,12-benzoperylene) (191-24-2)	0.2 mg/m ³⁽¹⁾ (0.02 ppm)	7.5-8.5	1) ~300% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 10 mg/m ³ , Level C > 10 mg/m ³ , Level B
Benzo(b)thiophene Coal Tar Pitch Volatile	0.2 mg/m ³⁽¹⁾ (0.02 ppm)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾
3,4-Benzpyrene Coal Tar Pitch Volatile (Benzo(a)pyrene (50-32-8)	0.2 mg/m ³⁽¹⁾ (0.02 ppm)	7.5-8.5	1) ≈ 300% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 10 mg/m ³ , Level C > 10 mg/m ³ , Level B
Benzylchloride (chlorotoluene) (100-44-7)	1 ppm (5 mg/m ³)	10.16	1) 67% 2) 117% 3) 60% 4) 25%	1) 0.66 ppm 2) 1.17 ppm 3) 0.60 ppm 4) 0.25 ppm	SENS Measuring Range: 0.8 – 20 ppm ⁽⁷⁾ Detection Limit: 0.4 ppm	MSA and 3M ≤ 10 ppm, Level C > 10 ppm, Level B North ⁽³⁾
Beryllium (7440-41-7)	0.002 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 0.05 mg/m ³ , Level C > 0.05 mg/m ³ , Level B North and 3M ≤ 0.1 mg/m ³ , Level C > 0.1 mg/m ³ , Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
BHC (γ-hexachlorocyclohexane, HCCH, HCH, lindane) (58-89-9)	0.5 mg/m ³ (skin) IDLH: 50 mg/m ³	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North ≤ 50 mg/m ³ , Level C > 50 mg/m ³ , Level B 3M ⁽³⁾
Beta Pinene (2-Pinene) (80-56-8)	N/A ⁽²⁾	8.07	1) 5% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 125%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽³⁾
Biethylene (1,3-butadiene, Divinyl, Biviny, Erythrene, Butadiene) (106-99-0)	1 ppm (2.2 mg/m ³)	9.57	1) 69.9% 2) 76% 3) 33% 4) 50%	1) 0.699 2) 0.76 ppm 3) 0.33 ppm 4) 0.5 ppm	SENS Measuring Range: 2.5-800 ppm ⁽⁷⁾ Detection Limit: 0.5 ppm	MSA and 3M ≤ 50 ppm, Level C > 50 ppm, Level B North Level B
Biphenyl (diphenyl, phenylbenzene) (92-52-4)	0.2 ppm (1 mg/m ³)	8.27	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 10 ppm, Level C > 10 ppm, Level B North ⁽³⁾
Biviny (1,3-butadiene, Divinyl, Biethylene, Erythrene, Butadiene) (106-99-0)	1 ppm (2.2 mg/m ³)	9.57	1) 69.9% 2) 76% 3) 33% 4) 50%	1) 0.699 2) 0.76 ppm 3) 0.33 ppm 4) 0.5 ppm	SENS Measuring Range: 2.5-800 ppm ⁽⁷⁾ Detection Limit: 0.5 ppm	MSA and 3M ≤ 50 ppm, Level C > 50 ppm, Level B North Level B
Bromo Benzene (Phenyl Bromide, Monobromobenzene) (108-86-1)	N/A ⁽²⁾	8.98	1) 156% 2) 178% 3) N/A ⁽³⁾ 4) 83%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ⁽³⁾
Bromodichloromethane (Dichlorobromomethane) (75-27-4)	N/A ⁽¹⁾	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Bromoform (75-25-2)	0.5 ppm (5 mg/m ³) (skin)	10.48	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 20%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) 0.1 ppm	SENS Measuring Range: 1 - 50 ppm Detection Limit: 0.5 ppm	MSA ≤ 25 ppm, Level C > 25 ppm, Level B
						North ⁽¹⁾
						3M < 5 ppm, Level C ≥ 5 ppm, Level B
Bromomethane (Monobromomethane, Methyl Bromide) (74-83-9)	5 ppm (20 mg/m ³) (skin)	10.53	1) 27% 2) N/A ⁽³⁾ 3) 23% 4) 29.4%	1) 1.35 ppm 2) N/A ⁽⁶⁾ 3) 1.15 ppm 4) 1.47 ppm	SENS Measuring Range: 1-600 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA, North and 3M Level B
					Drager Measuring Range: 0.5 – 100 ppm	
Butadiene (1,3-butadiene, Divinyl, Biviny, Erythrene, Biethylene) (106-99-0)	1 ppm (2.2 mg/m ³)	9.57	1) 69.9% 2) 76% 3) 33% 4) 50%	1) 0.699 ppm 2) 0.76 ppm 3) 0.33 ppm 4) 0.5 ppm	SENS Measuring Range: 2.5-800 ppm ⁽⁷⁾ Detection Limit: 0.5 ppm	MSA and North ≤ 50 ppm, Level C > 50 ppm, Level B
						North Level B
						3M < 10 ppm, Level C ≥ 10 ppm, Level B
1,3-Butadiene (Biethylene, Divinyl, Biviny, Erythrene, butadiene) (106-99-0)	1 ppm (2.2 mg/m ³)	9.57	1) 70% 2) 76% 3) 33% 4) 50%	1) 0.7 2) 0.76 ppm 3) 0.33 ppm 4) 0.5 ppm	SENS Measuring Range: 2.5-800 ppm ⁽⁷⁾ Detection Limit: 0.5 ppm	MSA and 3M ≤ 50 ppm, Level C > 50 ppm, Level B
						North > 1 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Butane (106-97-8)	800 ppm	10.63	1) N/A ⁽³⁾ 2) 71% 3) 63% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 568 ppm 3) 504 ppm 4) N/A ⁽⁴⁾	SENS Measuring Range: 25-1,400 ppm Detection Limit: 5 ppm	MSA and 3M > 800 ppm, Level B North ⁽³⁾
Butanone (Ethyl Methyl Ketone, MEK, Methyl Acetone, 2-butanone, Methyl ethyl ketone) (78-93-3)	200 ppm (590 mg/m ³)	9.53	1) 56% 2) 53% 3) 80% 4) 56%	1) 112 ppm 2) 106 ppm 3) 160 ppm 4) 112 ppm	SENS Measuring Range: 0.125-1,680 ppm Detection Limit: 0.125 ppm	MSA and North ≤ 1,000 ppm, Level C > 1,000 ppm, Level B 3M ≤ 3,000 ppm, Level C > 3,000 ppm, Level B
2-Butanone (MEK, Butanone, Methyl ethyl ketone, methyl acetone, ethyl methyl ketone) (78-93-3)	200 ppm (590 mg/m ³)	9.53	1) 56% 2) 53% 3) 80% 4) 56%	1) 112 ppm 2) 106 ppm 3) 160 ppm 4) 112 ppm	SENS Measuring Range: 0.125-1,680 ppm Detection Limit: 0.125 ppm	MSA and North ≤ 1,000 ppm, Level C > 1,000 ppm, Level B 3M ≤ 3,000 ppm, Level C > 3,000 ppm, Level B
2-Butenal (Crotonaldehyde) (4170-30-3)	2 ppm (6 mg/m ³)	9.73	1) 31% 2) 64% 3) N/A ⁽³⁾ 4) 45%	1) 0.62 ppm 2) 1.28 ppm 3) N/A ⁽³⁾ 4) 0.9 ppm	N/A ⁽³⁾	MSA ≤ 50 ppm, Level C > 50 ppm, Level B North ⁽³⁾ 3M < 15 ppm, Level C ≥ 15 ppm, Level B
Butyl benzyl phthalate (85-68-7)	HSE 5 mg/m ³ (0.39 ppm)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Butyl methyl ketone (MBK, methyl butyl ketone, methyl n-butyl ketone, 2-Hexanone) (591-78-6)	5 ppm (20 mg/m ³)	9.34	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 100 ppm, Level C > 100 ppm, Level B
						North ⁽³⁾
						3M < 250 ppm, Level C ≥ 250 ppm, Level B
tert-Butylbenzene (98-06-6)	N/A ⁽²⁾	8.68	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾
Cadmium (29 CFR 1910.1027) (7440-43-9)	Dust: 0.005 mg/m ³ Action level: 0.0025 mg/m ³	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 0.25 mg/m ³ , Level C (dust) > 0.25 mg/m ³ , Level B (dust)
						North < 0.5 ppm, Level C ≥ 0.5 ppm, Level B
						3M < 0.05 mg/m ³ , Level C (dust) ≥ 0.05 mg/m ³ , Level B (dust)
Cadmium (fume) (1306-19-0)	Fume: 0.005 mg/m ³ (29 CFR 1910.1027)	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North ≤ 0.125 mg/m ³ , Level C (fume) > 0.125 mg/m ³ , Level B (fume)
						3M < 0.05 mg/m ³ , Level C ≥ 0.05 mg/m ³ , Level B
Calcium (7440-70-2)	N/A ⁽²⁾	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	Level B ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Carbazole (86-74-8)	0.2 mg/m ³ (1) (0.03 ppm)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ⁽³⁾
Carbolic acid (Phenol, phenyl alcohol, phenol, hydroxybenzene, monohydroxybenzene) (108-95-2)	5 ppm (19 mg/m ³) IDLH: 250 ppm	8.5	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) 54% 4) 50%	1) N/A ⁽³⁾ 2) N/A ⁽⁶⁾ 3) 2.7 ppm 4) 2.5 ppm	SENS Measuring Range: 0.4-187 ppm Detection Limit: 0.1 ppm	MSA and North < 250 ppm, Level C ≥ 250 ppm, Level B
					Drager Measuring Range: 1-20 ppm	3M < 50 ppm, Level C ≥ 50 ppm, Level B
Carbon Bisulfide (Carbon Disulfide) (75-15-0)	4 ppm (12 mg/m ³) (skin)	10.07	1) 49% 2) 277% 3) N/A ⁽⁴⁾ 4) 41.2%	1) 1.96 ppm 2) 11.08 ppm 3) N/A ⁽⁶⁾ 4) 1.65 ppm	SENS Measuring Range: 0.63-4,000 ppm Detection Limit: 0.3 ppm	MSA and 3M ≤ 100 ppm, Level C > 100 ppm, Level B
					Drager Measuring Range: 1.25 – 100 ppm	North ≤ 400 ppm, Level C > 400 ppm, Level B
Carbon Chloride (Carbon Tetrachloride, Carbon TET, Freon 10, Halon 104, Tetrachloromethene, perchloromethane) (56-23-5)	2 ppm (12.6 mg/m ³)	11.47	1) N/A ⁽³⁾ 2) 42% 3) 8.0% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.84 ppm 3) 0.16 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.5 – 60 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA and North Level B
					Drager Measuring Range: 0.2 – 70 ppm ⁽⁷⁾	3M < 50 ppm, Level C ≥ 50 ppm, Level B
*** Carbon Dichloride (Tetrachloroethene, Tetrachloroethylene, ethylene tetrachloride, PCE, perclane, perchloroethylene) (127-18-41)	25 ppm (170 mg/m ³)	9.32	1) 86% 2) N/A ⁽³⁾ 3) 68% 4) N/A ⁽³⁾	1) 21.5 ppm 2) N/A ⁽⁶⁾ 3) 17 ppm 4) N/A ⁽⁶⁾	SENS ⁽⁷⁾ Measuring Range: 0.2 – 900 ppm Detection Limit: 0.3 ppm	MSA and North > 25 ppm, Level B
					Drager Measuring Range: 0.1 – 10,000 ppm	

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Carbon Disulfide (Carbon Bisulfide) (75-15-0)	4 ppm (12 mg/m ³) (skin)	10.07	1) 49% 2) 277% 3) N/A ⁽³⁾ 4) 41.2%	1) 1.96 ppm 2) 11.08 ppm 3) N/A ⁽⁶⁾ 4) 1.65 ppm	SENS Measuring Range: 0.63-4,000 ppm Detection Limit: 0.3 ppm	MSA ≤ 100 ppm, Level C > 100 ppm, Level B
					Drager Measuring Range: 3 – 95 ppm	North ≤ 200 ppm, Level C > 200 ppm, Level B
						3M < 500 ppm, Level C ≥ 500 ppm, Level B
Carbon Oxychloride (Phosgene, Carbonyl chloride, Chloroformyl chloride) (75-44-5)	0.1 ppm (0.4 mg/m ³)	11.77	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.05-16 ppm ⁽⁷⁾ Detection Limit: 0.02 ppm	MSA, North and 3M < 1,000 ppm, Level B
					Drager Measuring Range: 0.02-1.5 ppm	
Carbon TET (Carbon Tetrachloride, Carbon Chloride, Freon 10, Halon 104, Tetrachloromethene, perchloromethane) (56-23-5)	2 ppm (12.6 mg/m ³)	11.47	1) N/A ⁽³⁾ 2) 42% 3) 8.0% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.84 ppm 3) 0.16 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.5 - 60 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA and North Level B
					Drager Measuring Range: 0.2 - 50 ppm ⁽⁷⁾	
Carbon Tetrachloride (Carbon Chloride, Carbon TET, Freon 10, Halon 104, Tetrachloromethane, perchloromethane) (56-23-5)	2 ppm (12.6 mg/m ³)	11.47	1) N/A ⁽³⁾ 2) 42% 3) 8.0% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.84 ppm 3) 0.16 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.5 - 60 ppm Detection Limit: 0.2 ppm	MSA and North Level B
					Drager Measuring Range: 0.5 - 50 ppm ⁽⁷⁾	

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Carbonyl Chloride (Phosgene, carbon oxychloride, chloroformyl chloride) (75-44-5)	0.1 ppm (0.4 mg/m ³)	11.77	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.05-16 ppm ⁽⁷⁾ Detection Limit: 0.02 ppm Drager Measuring Range: 0.02-1.5 ppm	MSA, North and 3M < 1,000 ppm, Level B
Cesium - 137	60 pCi/l	N/a	1) N/A ⁽¹⁾ 2) N/A ⁽¹⁾ 3) N/A ⁽¹⁾	1) N/A ⁽¹⁾ 2) N/A ⁽¹⁾ 3) N/A ⁽¹⁾	N/A ⁽¹⁾	N/A
Chlorallyl Chloride (cis 1,3-Dichloropropene, 1,3-Dichloropropene, Telone) (542-75-6)	1 ppm (5 mg/m ³) (skin)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 38.46	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) 0.38 ppm	N/A ⁽³⁾	MSA Level B North and 3M ≤ 50 ppm, Level C > 50 ppm, Level B
Chlordane (gamma-chlorodan; octachlor- dihydrocyclopentadiene) (57-74-9)	0.5 mg/m ³ (skin) IDLH: 100 mg/m ³	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA Level B North ≤ 50 mg/m ³ , Level C > 50 mg/m ³ , Level B
Chlorine (7782-50-5)	0.5 ppm (1.5 mg/m ³)	11.48	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.05-100,000 ppm or 10% ⁽⁷⁾ Detection Limit: 0.02 ppm Drager 0.2-500 ppm	MSA and North ≤ 10 ppm, Level C > 10 ppm, Level B
2-Chloro-4 (ethylamino)-6-isopropylamino)-s- (triazine (atrazine) (1912-24-9)	5 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 500 mg/m ³ , Level C > 500 mg/m ³ , Level B North and 3M ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
4-Chloroaniline (para-Chloroaniline) (106-47-8)	WEL: 0.1 ppm SL: 0.5 ppm	N/A ⁽¹⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽¹⁾	Level B ⁽¹⁾
para-Chloroaniline (4-Chloroaniline) (106-47-8)	WEL: 0.1 ppm SL: 0.5 ppm	N/A ⁽¹⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽¹⁾	Level B ⁽¹⁾
Chlorobenzene (chlorobenzol, MCB, monochlorobenzene, phenyl chloride) (108-90-7)	75 ppm (350 mg/m ³) IDLH: 1,000 ppm	9.07	1) 130% 2) 144% 3) 179% 4) 125%	1) 97.5 ppm 2) 108 ppm 3) 134 ppm 4) 93.8 ppm	SENS Measuring Range: 2-500 ppm Detection Limit: 0.2 ppm	MSA only ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
					Drager Measuring Range: 5-200 ppm	North ⁽³⁾
Chlorobenzol (chlorobenzene, MCB, monochlorobenzene, phenyl chloride) (108-90-7)	75 ppm (350 mg/m ³)	9.07	1) 130% 2) 144% 3) 179%	1) 97.5 ppm 2) 108 ppm 3) 134 ppm	SENS Measuring Range: 2-500 ppm Detection Limit: 0.2 ppm	MSA only ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
					Drager Measuring Range: 5-200 ppm	North ⁽³⁾
Chlorinated camphene (Toxaphene, chlorocamphene, octachlorocamphene, polychlorocamphene) (8001-35-32)	0.5 mg/m ³ IDLH: 200 mg/m ³	N/A	1) N/A 2) N/A 3) N/A	1) N/A 2) N/A 3) N/A	N/A ⁽³⁾	MSA > 0.5 mg/m ³ , Level B
						North ⁽³⁾
Chlorocamphene (Toxaphene, chlorinated camphene, octachlorocamphene, polychlorocamphene) (8001-35-32)	0.5 mg/m ³ IDLH: 200 mg/m ³	N/A	1) N/A 2) N/A 3) N/A	1) N/A 2) N/A 3) N/A	N/A ⁽³⁾	MSA > 0.5 mg/m ³ , Level B
						North ⁽³⁾
3-chlorochlordene (Heptachlor epoxide, Heptachlor, aahepta, hepta, heptachlorane) (76-44-8)	0.5 mg/m ³ (skin) IDLH: 35 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	MSA ≥ 0.5 mg/m ³ , Level B
						North and 3M ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
1-Chlorodecane	N/A ⁽²⁾	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽³⁾	N/A ⁽³⁾
1-Chlordexadecane	N/A ⁽²⁾	N/A ⁽⁴⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽³⁾	N/A ⁽³⁾
Chlorodibromomethane (Dibromochloromethane) (124-48-1)	N/A ⁽²⁾	10.59	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾
Chlorodiphenyl (PCB-1254, PCB-1260, PCB, polychlorinated biphenyl, Aroclor®1254, Aroclor®1260) (42% - 53469-21-9) (54% - 11097-69-1)	42% - 1 mg/m ³ 54% - 0.5 mg/m ³ (skin) (0.375 ppm) IDLH: 5 mg/m ³	N/A ⁽²⁾	1) Avg. 253% 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) 0.09 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and North > 0.5 mg/m ³ , Level B
Chloroethane (ethyl chloride, monochloroethane) (75-00-3)	1,000 ppm (2,600 mg/m ³)	10.97	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) 58% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) 580 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 250-7,000 ppm	MSA > 1,000 ppm, Level B North ⁽³⁾
Chloroethanol (Ethylene Chlorohydrin, Glycol Chlorohydrin) (107-07-3)	1 ppm (3 mg/m ³) (ceiling) (skin)	10.90	1) 2.0% 2) 67% 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.02 ppm 2) 0.67 ppm 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 20-200 ppm	MSA Level B North ⁽³⁾ 3M < 10 ppm, Level C ≥ 10 ppm, Level B
Chloroethene (vinyl chloride, ethylene monochloride, chloroethylene, monochloroethene, monochloroethylene) (75-01-4)	1 ppm (4 mg/m ³)	10.0	1) 32% 2) 78% 3) 35% 4) 25%	1) 0.3 ppm 2) 0.8 ppm 3) 0.3 ppm 4) 0.2 ppm	SENS ⁽⁷⁾ Measuring Range: 0.1-20,000 ppm Detection Limit: 0.02 ppm Drager Measuring Range: 0.5-3,000 ppm	MSA > 1 ppm, Level B North and 3M Level B
bis(2-chloroethyl)ether (2,2-dichlorodiethylether, 2,2-dichloroethyether) (111-44-4)	5 ppm (30 mg/m ³) (skin)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA > 5 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Chloroethylene (vinyl chloride, chloroethene, ethylene monochloride, monochloroethene, monochloroethylene) (75-01-4)	1 ppm (4 mg/m ³)	10.0	1) 32% 2) 78% 3) 35% 4) 25%	1) 0.3 ppm 2) 0.8 ppm 3) 0.3 ppm 4) 0.2 ppm	SENS ⁽⁷⁾ Measuring Range: 0.1-20,000 ppm Detection Limit: 0.02 ppm	MSA > 1 ppm, Level B
					Drager Measuring Range: 0.5-3,000 ppm	North and 3M Level B
Chloroformyl chloride (Phosgene, carbon oxychloride, Carbonyl Chloride) (75-44-5)	0.1 ppm (0.4 mg/m ³)	11.77	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.05-16 ppm ⁽⁷⁾ Detection Limit: 0.02 ppm	MSA, North and 3M < 1,000 ppm, Level B
					Drager Measuring Range: 0.02-1.5 ppm	
bis(2-Chloroisopropyl) (Ether) (108-60-1)	N/A AIHA WEEL TWA: 3 ppm	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽¹⁾	MSA Level B
						North ⁽¹⁾
2-Chloro-1-methylbenzene (2-Monochlorotoluene, chloro-2-methylbenzene, 2-chlorotoluene, tolychloride, o-chlorotoluene) (95-49-8)	50 ppm (250 mg/m ³)	8.83	1) 106% 2) 136% 3) N/A ⁽³⁾ 4) 100%	1) 53 ppm 2) 48.6 ppm 3) N/A ⁽⁶⁾ 4) 50 ppm	N/A ⁽³⁾	MSA and 3M ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾
4-Chloro-3-Methyl-Phenol (4-Chloro-m-cresol) (59-50-7)	N/A ⁽¹⁾	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽¹⁾	N/A ⁽¹⁾
4-Chloro-m-cresol (4-Chloro-3-Methyl-Phenol) (59-50-7)	N/A ⁽¹⁾	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽¹⁾	N/A ⁽¹⁾
2-Chlorophenol (95-57-8)	N/A⁽²⁾	N/A⁽²⁾	1) N/A⁽³⁾ 2) 119% 3) N/A⁽³⁾ 4) N/A⁽³⁾	1) N/A⁽⁶⁾ 2) N/A⁽⁶⁾ 3) N/A⁽⁶⁾ 4) N/A⁽⁶⁾	N/A⁽³⁾	Level B⁽⁸⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
1-Chloro-2-propene (Allyl chloride, 3-Chloropropene) (107-05-1)	1 ppm (3 mg/m ³)	10.2	1) 13% 2) 119% 3) 50% 4) 12%	1) 0.13 ppm 2) 1.19 ppm 3) 0.50 ppm 4) 0.12 ppm	SENS Measuring Range: 1 – 34,000 ppm ⁽⁷⁾ Detection Limit: 0.02 ppm	MSA Level B
						3M < 10 ppm, Level C ≥ 10 ppm, Level B
3-Chloropropene (Allyl chloride, 1-Chloro-2-propene) (107-05-1)	1 ppm (3 mg/m ³)	10.2	1) 13% 2) 119% 3) 50% 4) 12%	1) 0.13 ppm 2) 1.19 ppm 3) 0.50 ppm 4) 0.12 ppm	SENS Measuring Range: 1 – 34,000 ppm ⁽⁷⁾ Detection Limit: 0.02 ppm	MSA Level B
						3M < 10 ppm, Level C ≥ ppm, Level B
1-Chlorotetradecane	N/A ⁽²⁾	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽³⁾	N/A ⁽³⁾
2-Chlorotoluene (2-Monochlorotoluene, 2-chloro-1-methylbenzene, chloro-2- methylbenzene, tolychloride, o-chlorotoluene) (95-49-8)	50 ppm (250 mg/m ³)	8.83	1) 106% 2) 136% 3) N/A ⁽³⁾	1) 53 ppm 2) 48.6 ppm 3) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾
Chlorotoluene (Benzylchloride) (100-44-7)	1 ppm (5 mg/m ³)	10.16	1) 67% 2) 117% 3) 60% 4) 25%	1) 0.67 ppm 2) 1.17 ppm 3) 0.60 ppm 4) 0.25 ppm	SENS Measuring Range: 0.8 – 20 ppm Detection Limit: 0.4 ppm	MSA ≤ 10 ppm, Level C > 10 ppm, Level B
						North ⁽³⁾
o-Chlorotoluene (2-chloro-1-methylbenzene, chloro-2- methylbenzene, 2-chlorotoluene, tolychloride, 2- monochlorotoluene) (95-49-8)	50 ppm (250 mg/m ³)	8.83	1) 106% 2) 136% 3) N/A ⁽³⁾ 4) 100%	1) 53 ppm 2) 48.6 ppm 3) N/A ⁽⁶⁾ 4) 50 ppm	N/A ⁽³⁾	MSA and 3M ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
p-Chlorotoluene (4-monochlorotoluene, 4-chloro-1-methylbenzene) (	N/A ⁽²⁾	8.69	1) 108% 2) 150% 3) N/A ⁽³⁾ 4) 100%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽³⁾
Chromium copper arsenate (11125-95-4) Is a mixture comprised of the following: Arsenic acid 19% (7778-39-4) Chromic acid 22.4% (1333-82-0) Copper oxide 8.6% (1317-38-0)	As arsenic: 0.01 mg/m ³ Action level: 0.005 mg/m ³ As chromium VI: 0.5 mg/m ³ As copper: Dust: 1 mg/m ³ Fume: 0.1 mg/m ³	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	N/A ⁽³⁾	North ⁽²⁾ As Arsenic: MSA: ≤ 0.5 mg/m ³ , Level C > 0.5 mg/m ³ , Level B North: ≤ 25 mg/m ³ , Level C > 25 mg/m ³ , Level B As Chromium VI: MSA: ≤ 0.1 mg/m ³ , Level C > 0.1 mg/m ³ , Level B North: ≤ 2.5 mg/m ³ , Level C > 2.5 mg/m ³ , Level B As Copper: MSA/North: ≤ 5 mg/m ³ , Level C fume > 5 mg/m ³ , Level B fume ≤ 50 mg/m ³ , Level C dust > 50 mg/m ³ , Level B dust
Chrysene (218-01-9)	0.2 mg/m ³⁽¹⁾ (0.02 ppm)	7.75	1) 296% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.06 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M Level B
Citral	N/A ⁽²⁾	N/A ⁽²⁾	1) 5.0% 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	Level B ⁽⁸⁾

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Coal tar Naptha (Naptha, high solvent naptha) (8030-30-6)	100 ppm (400 mg/m ³)	N/A ⁽²⁾	1) 50% 2) N/A ⁽³⁾ 3) 0.13% 4) N/A ⁽³⁾	1) 50 ppm 2) N/A ⁽⁶⁾ 3) 0.13 ppm 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M Level B
Cobalt (7440-48-4)	0.05 mg/m ³	N/A ⁽²⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁶⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA ≤ 2.5 mg/m ³ , Level C > 2.5 mg/m ³ , Level B
						North ≤ 2 mg/m ³ , Level C > 2 mg/m ³ , Level B
						3M Level B
Colloidal Mercury (Quicksilver, mercury) (7439-97-6)	Alkyl compounds: 0.01 mg/m ³ Others: 0.05 mg/m ³ Aryl and inorganic: ceiling 0.1 mg/m ³ skin	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 0.05-13.2 mg/m ³ Detection Limit: 0.01 mg/m ³	MSA Metal ≤ .25 mg/m ³ , Level C > .25 mg/m ³ , Level B Alkyl Compounds ≤ 0.5 mg/m ³ , Level C, contact MSA > 0.5 mg/m ³ , Level B Aryl and Inorganic Compounds ≤ 2.5 mg/m ³ , Level C, contact MSA > 2.5 mg/m ³ , Level B
					Drager (vapor) Measuring Range: 0.05 - 2 mg/m ³	North Alkyl Compounds ≤ 0.5 mg/m ³ , Level C, contact North > 0.5 mg/m ³ , Level B Aryl and Inorganic Compounds ≤ 2.5 mg/m ³ , Level C, contact North > 2.5 mg/m ³ , Level B
						3M < 1.25 mg/m ³ , Level C ≥ 1.25 mg/m ³ , Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Copper (7440-50-8)	Dust: 1 mg/m ³ Fume: 0.1 mg/m ³	N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾ 4) N/A ⁽⁴⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 5 mg/m ³ , Level C (fume) > 5 mg/m ³ , Level B (fume) ≤ 50 mg/m ³ , Level C (dust) > 50 mg/m ³ , Level B (dust)
2-Cresol (2-methylphenol, o-cresol) (95-48-7)	5 ppm (22 mg/m ³) (skin)	8.93	1) ≈ 10% 2) N/A ⁽³⁾ 3) Not feasible	1) ≈ 5.35 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	SENS Measuring Range: 0.4 ppm - 62.5 ppm Detection limit: 0.1 ppm	MSA ≤ 230 ppm, Level C > 230 ppm, Level B
						North ≤ 250 ppm, Level C > 250 ppm, Level B
o-Cresol (2-cresol, 2-methylphenol) (95-48-7)	5 ppm (22 mg/m ³) (skin)	8.93	1) ≈ 10% 2) N/A ⁽³⁾ 3) Not feasible	1) ≈ 5.35 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	SENS Measuring Range: 0.4 ppm - 62.5 ppm Detection limit: 0.1 ppm	MSA ≤ 230 ppm, Level C > 230 ppm, Level B
						North ≤ 250 ppm, Level C > 250 ppm, Level B
4-Cresol (p-cresol, 4-methylphenol) (106-44-5)	5 ppm (22 mg/m ³) (skin)	8.97	1) 10% 2) N/A ⁽³⁾ 3) Not feasible	1) 5.35 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	SENS Measuring Range: 1-25 ppm	MSA ≤ 230 ppm, Level C > 230 ppm, Level B
						North ≤ 250 ppm, Level C > 250 ppm, Level B
p-Cresol (4-methylphenol, 4-cresol) (106-44-5)	5 ppm (22 mg/m ³) (skin)	8.97	1) 10% 2) N/A ⁽³⁾ 3) Not feasible	1) 5.35 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	SENS Measuring Range: 1-25 ppm	MSA ≤ 230 ppm, Level C > 230 ppm, Level B
						North ≤ 250 ppm, Level C > 250 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Crotonaldehyde (2-Butenal) (4170-30-3)	2 ppm (6 mg/m ³)	9.73	1) 31% 2) 64% 3) N/A ⁽³⁾ 4) 45.45%	1) 0.62 ppm 2) 1.28 ppm 3) N/A ⁽³⁾ 4) 90.9 ppm	N/A ⁽³⁾	MSA ≤ 100 ppm, Level C > 100 ppm, Level B
						North ⁽³⁾
						3M Level B
Cumene (isopropylbenzene) (98-82-8)	50 ppm (245 mg/m ³) (skin)	8.75 eV	1) 122% 2) N/A ⁽³⁾ 3) 18% 4) 100%	1) 61.0 ppm 2) N/A ⁽⁶⁾ 3) 9.0 ppm 4) 50 ppm	SENS Measuring Range: 1 – 100 ppm	MSA and 3M ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾
Cyanides (sodium, as CN) (151-50-8)	5 mg/m ³	N/A	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾	N/A ⁽¹⁾	MSA and North Level B
Cyanomethane (Acetonitrile, Ethyl Nitrile, Methyl Cyanide) (75-05-8)	40 ppm (70 mg/m ³)	12.22	1) N/A ⁽³⁾ 2) 1.0% 3) 70% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 0.4 ppm 3) 28 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 3-180 ppm	MSA and North Level B
						3M < 40 ppm, Level C ≥ 40 ppm, Level B
Cyclohexanone (108-94-1)	25 ppm (100 mg/m ³) skin	9.14	1) 51% 2) 73% 3) 43% 4) 55.55%	1) 12.7 ppm 2) 18.2 ppm 3) 10.7 ppm 4) 13.8875 ppm	SENS Measuring Range: 2 – 40 ppm ⁽⁷⁾ Detection Limit: 0.2 ppm	MSA and 3M ≤ 250 ppm, Level C > 250 ppm, Level B
						North ⁽³⁾
Cyclohexene (Benzene Tetrahydride) (110-83-8)	300 ppm (1,015 mg/m ³)	8.95	1) 34% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 62.5%	1) 102 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) 187.5	SENS Measuring Range: 100-1,000 ppm	MSA ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾
						3M < 300 ppm, Level C ≥ 300 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
Cyclopentane (Pentamethylene) (287-92-3)	600 ppm (1,720 mg/m ³)	10.52	1) 9.0% 2) 132% 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 54 ppm 2) 792 ppm 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA and 3M Level B
						North ⁽³⁾
DBP (Di-n-butylphthalate, Dibutyl Phthalate) (84-74-2)	5 mg/m ³ (0.44 ppm)	N/A ⁽²⁾	1) 106% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.5 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	MSA and North ≤ 250 mg/m ³ , Level C > 250 mg/m ³ , Level B
						3M < 25 mg/m ³ , Level C ≥ 25 mg/m ³ , Level B
1,1-DCA (1,1-Dichloroethane, 1,1-ethylidene dichloride, ethylidene chloride) (75-34-3)	100 ppm (400 mg/m ³)	11.06	1) N/A ⁽³⁾ 2) 105% 3) 70% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 105 ppm 3) 70 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 40-200 ppm	MSA and 3M < 100 ppm, Level C ≥ 100 ppm, Level B
						North ⁽⁶⁾
1,2-DCA (1,2-Dichloroethane, ethylene dichloride, ethylene chloride, glycol dichloride) (107-06-2)	1 ppm (4 mg/m ³)	11.04	1) N/A ⁽³⁾ 2) 105% 3) 89% 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) 1.05 ppm 3) 0.89 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 8-80 ppm Detection Limit: 3 ppm	MSA > 1 ppm, Level B
						North ⁽⁶⁾
						3M < 10 ppm, Level C ≥ 10 ppm, Level B
1,4-DCB (1,4-dichlorobenzene, para-dichlorobenzene, P-DCB) (106-46-7)	75 ppm (450 mg/m ³)	8.94	1) 119% 2) 155% 3) 113%	1) 89.0 ppm 2) 116 ppm 3) 85.0 ppm	SENS Measuring Range: 2.5-300 ppm Detection Limit: 1 ppm	MSA and North < 150 ppm, Level C ≥ 150 ppm, Level B
					Drager Measuring Range: 2-100 ppm	
P-DCB (1,4-Dichlorobenzene, para-dichlorobenzene, 1,4-DCB) (106-46-7)	75 ppm (450 mg/m ³)	8.94	1) 119% 2) 155% 3) 113%	1) 89.0 ppm 2) 116 ppm 3) 85.0 ppm	SENS Measuring Range: 2.5-300 ppm Detection Limit: 1 ppm	MSA and North < 150 ppm, Level C ≥ 150 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
					Drager Measuring Range: 2-100 ppm	
o-DCB (1,2-Dichlorobenzene, ortho-dichlorobenzene, o-dichlorobenzene, 1,2- DCB) (95-50-1)	50 ppm (300 mg/m ³) ceiling IDLH: 200 ppm	9.07	1) 119% 2) 155% 3) 119%	1) 59.5 ppm 2) 77.5 ppm 3) 59.5 ppm	SENS Measuring Range: 2.5-300 ppm Detection Limit: 1 ppm	MSA and North < 200 ppm, Level C ≥ 200 ppm, Level B
					Drager Measuring Range: 2-100 ppm	
1,2-DCB (1,2-dichlorobenzene (ortho-dichlorobenzene, o-DCB) (95-50-1)	50 ppm (300 mg/m ³) ceiling IDLH: 200 ppm	9.07	1) 119% 2) 155% 3) 119%	1) 59.5 ppm 2) 77.5 ppm 3) 59.5 ppm	SENS Measuring Range: 2.5-300 ppm Detection Limit: 1 ppm	MSA and North < 200 ppm, Level C ≥ 200 ppm, Level B
					Drager Measuring Range: 2-100 ppm	
1,1-DCE (1,1-Dichloroethene, vinylidene chloride) (75-35-4)	1 ppm (4 mg/m ³)	9.6	1) 64% 2) N/A ⁽³⁾ 3) 49% 4) 55.55%	1) 0.64 ppm 2) N/A ⁽⁶⁾ 3) 0.49 ppm 4) 0.55 ppm	SENS Measuring Range: 0.4-31.5 ppm ⁽⁷⁾ Detection Limit: 0.1 ppm	MSA > 1 ppm, Level B
						North ≤ 50 ppm, Level C > 50 ppm, Level B
						3M < 5 ppm, Level C ≥ 5 ppm, Level B
1,2-DCE (1,2-Dichloroethene, acetylene dichloride, 1,2- dichloroethylene) (540-59-0)	200 ppm (790 mg/m ³)	9.80	1) 75% 2) 85% 3) 40% 4) N/A ⁽³⁾	1) 150 ppm 2) 170 ppm 3) 80 ppm 4) N/A ⁽⁶⁾	SENS Measuring Range: 5 – 800 ppm Detection Limit: 1 ppm	MSA ≤ 1,000 ppm, Level C > 1,000 ppm, Level B
						North ⁽³⁾
						3M ≤ 4,000 ppm, Level C > 4,000 ppm, Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
2,4-DCP (2,4-dichlorophenol, DCP) (120-83-2)	N/A ⁽²⁾	N/A ⁽²⁾	1) 134% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 62.5%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	Level B ⁽³⁾
DCP (2,4-Dichlorophenol, 2,4-DCP) (120-83-2)	N/A ⁽²⁾	N/A ⁽²⁾	1) 134% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) 62.5%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	Level B ⁽³⁾
4,4-DDD	N/A ⁽²⁾	N/A	1) N/A ⁽²⁾ 2) N/A ⁽²⁾ 3) N/A ⁽²⁾	1) N/A ⁽²⁾ 2) N/A ⁽²⁾ 3) N/A ⁽²⁾	N/A ⁽²⁾	N/A ⁽²⁾
4,4-DDT (DDT, p,p-DDT, dichlorodiphenyltrichloroethane) (50-29-3)	1 mg/m ³	N/A	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾	N/A ⁽²⁾	MSA > 1 mg/m ³ , Level B
DDT (4,4-DDT, p,p-DDT, dichlorodiphenyltrichloroethane) (50-29-3)	1 mg/m ³	N/A	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾	1) N/A ⁽⁴⁾ 2) N/A ⁽⁴⁾ 3) N/A ⁽⁴⁾	N/A ⁽²⁾	MSA > 1 mg/m ³ , Level B
Decalin	N/A ⁽²⁾	N/A ⁽²⁾	1) 96% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4)	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾	N/A ⁽²⁾	Level B ⁽⁸⁾
Decane	N/A ⁽²⁾	10.19	1) 33% 2) N/A ⁽³⁾ 3) 53% (slow) 4) 35.7%	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	SENS Measuring Range: 200-6,000 ppm Detection Limit: 20 ppm	Level B ⁽⁸⁾
1,2-Dehydroacenaphthalene (Acenaphthene, 1,8-Ethylenenaphthalene) (83-32-9)	0.2 mg/m ³ ⁽¹⁾ (0.03 ppm)	7.5-8.5	1) 306% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.1 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽³⁾	MSA, North and 3M ≤ 10 mg/m ³ , Level C > 10 mg/m ³ , Level B
Di-n-butylphthalate (DBP, dibutyl phthalate) (84-74-2)	5 mg/m ³ (0.44 ppm)	N/A ⁽²⁾	1) 106% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.5 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	MSA and North ≤ 250 mg/m ³ , Level C > 250 mg/m ³ , Level B

Chemical	PEL	I.P. (eV)	Relative Response HNu 1) 10.2 eV 2) 11.7 eV 3) OVA 4) 10.6 MiniRae	Reading to be at PEL 1) 10.2 eV Probe 2) 11.7 eV Probe 3) OVA 4) 10.6 MiniRae	Colorimetric Tubes SENS= Sensidyne	Respiratory Protection Required Above PEL
						3M < 5 mg/m ³ , Level C ≥ 5 mg/m ³ , Level B
Dibenzo(a,h)anthracene (53-70-3)	0.2 mg/m ³ ⁽¹⁾ (0.03 ppm)	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	MSA and North Level B
Dibenzofuran (132-64-9)	N/A ⁽²⁾	N/A ⁽²⁾	1) 210% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	Level B ⁽⁸⁾
Dibenzothiophene	N/A ⁽²⁾	N/A ⁽²⁾	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	Level B ⁽⁸⁾
Dibromochloropropane (1,2-dibromo-3-chloropropane, Nemagon, Fumazone) (96-12-8)	.001 ppm (0.01 mg/m ³) (29 CFR 1910.1044)	N/A ⁽²⁾	1) 7.0% 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) 0.0 ppm 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	MSA and 3M < 10 ppm, Level C ≥ 10 ppm, Level B
Dibromochloromethane (chlorodibromomethane) (124-48-1)	N/A ⁽²⁾	10.59	1) N/A ⁽³⁾ 2) N/A ⁽³⁾ 3) N/A ⁽³⁾ 4) N/A ⁽³⁾	1) N/A ⁽⁶⁾ 2) N/A ⁽⁶⁾ 3) N/A ⁽⁶⁾ 4) N/A ⁽⁶⁾	N/A ⁽²⁾	North ⁽³⁾ Level B ⁽⁸⁾

S3NA-302-PR Electrical, General

1.0 Purpose and Scope

- 1.1 To minimize and control electrical hazards in the workplace.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.
- 1.3 As a general rule, AECOM employees should not work on exposed, energized systems with a potential greater than 50 volts. This work should be subcontracted to a qualified electrician. Should it be necessary for an AECOM employee to perform work on exposed, energized systems with a potential greater than 50 volts, the requirements of this procedure will be followed.

2.0 Terms and Definitions

- 2.1 **Arc Rating:** The maximum incident energy resistance demonstrated by a material prior to breakdown or at the onset of a second-degree skin burn (expressed in cal/cm²).
- 2.2 **Arc Flash:** A dangerous condition associated with the release of energy during an electrical arc.
- 2.3 **Arc Flash Analysis:** A mathematical determination of the energy released by an electric arc and the distance from the source that a flash hazard exists. The process for an Arc Flash Analysis is defined in NFPA 70E of the National Electric Code.
- 2.4 **Circuit Protective Device:** A load-rated switch, circuit breaker, or other device specifically designed as a disconnecting means for opening, reversing, or closing of live circuits.
- 2.5 **Energized Electrical Equipment:** Electrically connected to or having a source of voltage.
- 2.6 **Flash Hazard:** A dangerous situation associated with the release of energy caused by an electric arc.
- 2.7 **Ground Fault Circuit Interrupter (GFCI):** An electrical device that protects the users of all devices connected to it from electrical shock. The GFCI is part of the circuit or device in use and continuously measures the current in that circuit. If a leakage of current is detected, as in the case of an electrical short circuit, the circuit is opened at the GFCI and current cannot flow beyond the GFCI.
- 2.8 **Hazardous Atmospheres:** Areas that contain or may contain explosive or flammable atmospheres require specific electrical precautions. OSHA regulates the use of electrical devices in explosive atmospheres according to National Electrical Code criteria and classifications for hazardous atmospheres.
- 2.9 **Portable Electric Equipment:** Cord- and plug-connected equipment and extension cords.
- 2.10 **Qualified Persons:** Individuals who have specific and documented training to avoid the hazards of working on or near energized electrical equipment and have been specifically permitted to work on or near exposed energized and parts.
- 2.11 **Shock Hazard:** A dangerous situation associated with the possible release of energy caused by contact or approach to live parts.
- 2.12 **Unqualified Persons:** Individuals with little or no training to avoid the hazards of energized electrical parts or equipment.

3.0 Attachments

- 3.1 S3NA-302-FM Energized Electrical Work Permit
- 3.2 S3NA-302-ST Electrical Regulations
- 3.3 S3NA-302-WI1 Electrical Safe Work Practices
- 3.4 S3NA-302-WI2 Ground Fault Protection Safe Work Practices
- 3.5 S3NA-302-WI3 Generator Safety Card

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Project Manager (Field Task Manager, Supervisor)

- The **Manager** of any **employee** performing work on exposed, energized systems above a potential of 50 volts will be trained to the same level as a Qualified Person (1910.332).
- The AECOM **Project Manager, Field Task Manager, or Supervisor** is responsible for determining if AECOM employees are exposed to electrical hazards.
- The **Manager or Supervisor** will determine the appropriate safe guards to be put in place to protect employees.
- The **Manager or Supervisor** will confirm that only Qualified Persons are assigned duties that expose them or others to live electrical current above 50 volts.

4.1.2 Region/District SH&E Manager is responsible for the following:

- Approving all Energized Electrical Work Permits.
- Providing technical guidance in support of this procedure.

4.1.3 Site Safety Coordinator shall assist the site manager/supervisor in compliance with the requirements of this procedure.

4.1.4 Employees

- All AECOM **employees** engaged in project field activities shall follow these procedures.
- AECOM **employees** will stop work if workers, other than Qualified Persons, are exposed to live electrical systems at unknown voltages or potentials greater than 50 volts
- No staff shall open electrical panels unless they are a Qualified Person.

4.2 Training

4.2.1 Employees who have potential exposures to electrical hazards, Qualified Persons, shall be trained in and be familiar with the electrical safety-related work practices required by the applicable regulations.

4.2.2 All other on-site personnel, Unqualified Persons, will be advised of the electrical hazards and the procedures to mitigate their risk.

4.3 General Requirements for Use of Electricity

4.3.1 AECOM personnel who meet the requirements of a Qualified Person and have been specifically designated as such in the project health and safety plan may set up temporary circuits up to 240 volts. Maintenance or installation of circuits over 240 volts will require professionally trained personnel (i.e. professional electricians).

4.3.2 All electrical panels, lines, equipment, and facilities are to be considered energized unless confirmation that they are de-energized can be obtained from a Qualified Person or electrician.

4.3.3 All work on de-energized systems will be performed using established Hazardous Energy Control procedures. Lockout devices will be used to prevent the operation/energizing of equipment or circuits during maintenance or other work. Tagout devices will be used only where it is not feasible to use a lockout device.

4.3.4 Insulated tools and electrical handling equipment shall be inspected prior to use to confirm that their protective properties are not damaged. Damaged equipment will be tagged "DAMAGED" and removed from service.

4.3.5 S3NA-302-WI1 *Electrical Work Safe Work Practices* outlines additional requirements for working on live electrical systems located on AECOM job sites. All work on exposed, energized electrical systems at potentials above 50 volts will be approved by the **Region or District Safety Manager**

4.4 General Requirements for Field/Worksite Use of Electricity

4.4.1 Electrical outlets utilized to supply power for electrical equipment during field operations shall be of the three-wire grounding type. Whenever possible, they should be tested for correct polarity and adequacy of the ground with a circuit analyzer. If it is determined that the outlet is incorrectly wired or inadequately grounded, it should not be used.

- 4.4.2 Ground Fault Circuit Interrupter (GFCI) devices will be in place between the equipment and power source for all temporary circuits unless protected by an assured equipment grounding program as defined in this procedure and *S3NA-302-WI2 Ground Fault Protection Safe Work Practices* (i.e., circuits that are not part of a permanently installed facility electrical system, such as on a construction site or temporary field installation).

4.5 **Distribution System Setup**

- 4.5.1 Only qualified personnel shall perform electrical wiring or connections.
- 4.5.2 Under no circumstances shall electrical lines be routed through doorways, hatches, windows, or other openings where lines could be crimped, bent, or cut.
- 4.5.3 Electric lines crossing work areas, personnel, or vehicular traffic areas shall be either fastened securely overhead (at a height that provides safe clearance for work operations), or protected by a cover capable of withstanding the imposed loads without creating a trip hazard.
- 4.5.4 Circuit breakers shall be labeled to indicate their use.
- 4.5.5 All circuit breaker panels shall be kept covered when not in use.
- 4.5.6 A fuse puller shall be used to remove cartridge fuses where one or more energized circuits are present.
- 4.5.7 All live parts of electrical equipment operating at 50 volts or more shall be properly guarded against accidental contact, which includes:
- Limit access to the equipment to qualified employees only.
 - Unqualified Persons shall remain at least one meter (three feet) from exposed, energized systems managed by AECOM Qualified Persons. This distance shall be nine meters (10 feet) for systems with a potential greater than 240 volts.
 - Label using the proper accident prevention sign, stating DANGER as well as the voltage of the equipment.
 - Provide a conductor of the ampacity of not less than the rating of the circuit breaker or fuses protecting that circuit.
 - Confirm that a bare conductor or earth return is not used for any temporary circuit.
 - Confirm that all electrical wiring is protected from physical damage by covering and by not placing it in a location where it can be crimped or cut, etc.
- 4.5.8 **Extension Cord Use**
- Extension cords and electrical connections on handheld and other power tools will be inspected prior to use for cuts, kinks, frayed wires, etc. If any deficiency is noted, the equipment will be tagged "DAMAGED" and removed from service. Manufacturer-installed insulated electrical cords will not be repaired or spliced.
 - Extension cords are to be kept clean, free of kinks, and protected from oil, hot or sharp surfaces, and chemicals. Extension cords are not to be placed across aisles, through doors, through holes in a wall, or in areas where the cord may be damaged or create a tripping hazard. Extension cords will be appropriate for the specific task and environment.
 - Extension cord sets for use in field operations should be of the three-wire grounding type and should be designed for hard or extra-hard use. This type of cord will typically utilize insulated wires within an outer insulated sleeve. Examples of such cord include the type marked S, ST, SO, STO, SJ, SJO, or SJTO. Molded wire (flat) cord sets should not be used in field situations. The cord will minimally be rated for the intended current (e.g., heavy duty extension cords are often available in both 15 and 20 amp versions).
 - Use of extension cords is allowed only for temporary installations not to exceed 90 days (e.g., decorations).
 - Extension cords shall be provided with a plug cap that is either molded to the cord or equipped with a cord clamp to prevent strain on the terminal screws.
 - Extension cords shall not be fastened with staples or otherwise hung in a manner that could damage the outer jacket or insulation.

- Extension cords shall be inspected prior to each use to confirm that there is no damage or defects. Defective cords shall not be used.
- Extension cords used with grounding-type equipment (e.g., three-prong plug) shall contain a grounding-type conductor (have three prongs to accept the ground plug).
- Ground fault circuit interrupters shall be used for all nonpermanent wiring needed for construction purposes or when working in wet or moist areas or onboard ships.
- Extension cords used in highly conductive work locations (e.g., wet areas) shall be of the type approved for such locations.
- Grounding-type equipment (e.g., three-prong plugs) shall not be modified to mate to incompatible outlets (e.g., cut off grounding prong to fit two prong outlets).

4.5.9 Temporary Lights/Task Lights

- A temporary light shall not be suspended by the cord unless the cord and light are designed for suspension.
- Temporary lights shall be equipped with bulb protectors unless they are installed at least 7 or more feet overhead.

4.6 Working on or Near Energized Parts

4.6.1 Working on Energized Circuits

Working on or near energized parts covers either potential direct physical contact or contact by means of tools or equipment and working close enough to the energized part to draw an arc. Any AECOM **employee** (Qualified Person) assigned to work on exposed, live electrical systems above 50 volts shall have a person knowledgeable about the task to be performed and emergency response procedures assigned to observe the Qualified Person during the task with the potential exposure. This observer shall have no other assignments during the potential exposure.

- Prior to performing any work near exposed, energized systems, the Qualified Person shall:
 - Perform a Shock Hazard Analysis.
 - Perform an Arc Flash Analysis.
 - Establish emergency contacts.
 - Complete and have approved the Energized Electrical Work Permit.
 - Have all required personal protective equipment (PPE), insulated tools, and test equipment tested and ready to use.
 - Know and understand the procedures to be followed.
 - Ensure that adequate lighting and clearance space is available.
 - Remove all conductive clothing and jewelry.

4.6.2 Working Near Overhead Power Lines

- Personnel working in the vicinity of overhead power lines, either on the ground or elevated, shall comply with *S3NA-406-PR Electrical Lines, Overhead*.
- All workers and equipment including cranes and drill rigs shall maintain a clearance distance of at least 50 feet from overhead power lines unless a detailed assessment demonstrating that a smaller clearance distance provides protection has been completed.

4.7 Grounding

4.7.1 The path to ground from circuits, equipment, and enclosures will be permanent and continuous.

4.7.2 Electrical installations at project sites will be protected by either an equipment grounding conductor program or GFCIs. The two options are:

- All 120-volt, single-phase, 15- and 20-amp receptacles that are not part of permanent wiring will be protected by GFCIs.
- The equipment grounding conductor program will cover extension cords, receptacles, and cord-and-plug-connected equipment. The program will include the following elements:

- A written description of the program.
- At least one competent person to implement the program.
- Daily visual inspections of extension cords and cord- and plug-connected equipment for defects. Equipment found damaged or defective shall be removed from use and not used until repaired.
- Continuity tests of the equipment grounding conductors or receptacles, extension cords, and cord- and plug-connected equipment every three months.
- Compliance with the requirements for grounding of systems, circuits, and equipment (see 1926.404 in the US).

4.7.3 If the equipment grounding conductor program option is chosen, the designated competent person at the site shall maintain inspection records.

4.8 **Assured Grounding**

4.8.1 Where AECOM Operations is responsible, projects will have in place a program for the testing and inspection of all temporary electrical supply systems.

4.8.2 Assured grounding is applicable to all cord sets, receptacles that are not a part of the permanent wiring of a building or structure, and all equipment and tools connected by cord or plug.

4.8.3 All cord sets and receptacles will be visually inspected for damage before use.

4.8.4 All items covered by this procedure shall have their grounding conductor tested for continuity and all cord attachments and receptacles shall be tested for polarity to be sure the ground conductor is connected to the proper terminal.

4.8.5 Testing will be done on the following intervals:

- Before first use of any item.
- After repairs and before placing back into service.
- After every incident that might reasonably be suspected of causing damage.
- At intervals not to exceed 3 months.\
- Any tool, cord, or service that does not pass the required tests may not be made available to employees. Such equipment shall be tagged out of service and delivered to the supervisor or competent person for repair or replacement.
- Only a qualified employee (electrician) designated as the competent person may test electrical devices and will:
 - Prior to testing any item, remove any and all of the old color-coding tape or zip strips.
 - Perform the required ground conductor testing and polarity verifications.
 - After passing the necessary tests, the items will be marked by putting a wrap of the color coding tape or zip strip (of the appropriate color) around the cord close to the male and female ends of the electrical cord or by the male end on tools. Receptacle outlets will be marked in the most practical manner.

4.9 **Personal Protective Equipment/Work Practices**

4.9.1 PPE requirements shall be determined based on the results of each of the following: Task Hazard Analysis, Shock Hazard Analysis, and Arc Flash Analysis.

4.9.2 Nonconductive hardhats shall be worn when there is danger of head injury from electric shock or burns due to exposure to energized parts.

4.9.3 Jewelry shall not be worn when working around or with energized parts.

4.9.4 Insulated tools shall be used to work with energized parts. Tools that have insulation that might be damaged (e.g., rubber handles) shall be inspected prior to each use to confirm the insulation is not damaged.

4.9.5 Eye protection with side shields shall be worn when working with energized parts.

- 4.9.6 Rubber mats, non-conductive shields, or protective barriers shall be used as needed to protect employees from electrical hazards.
- 4.9.7 Appropriate insulating gloves shall be worn to pick up or unplug connections that are in highly conductive areas, such as in water.
- 4.9.8 Do not plug in or unplug electric equipment with wet hands.
- 4.10 **Portable Electrical Equipment**
- 4.10.1 Double-insulated, portable, industrial-type electrical tools meeting the requirements of the National Electrical Code (NEC) are authorized for use (ground wire not required). Where this type of tool is used, the equipment will be distinctly marked.
- 4.10.2 Portable electrical tools not provided with special insulating or grounding protection are not for use in damp, wet, or conductive locations (e.g., by persons standing on the ground or on metal floors).
- 4.10.3 All portable electrical appliances and equipment with non-current-carrying metal parts to which personnel may be exposed shall be grounded by a continuous conductor of adequate capacity from the device to a grounded receptacle. The Site Safety Officer shall resolve any question of whether or not a particular appliance should be grounded.
- 4.10.4 Manufacturer-installed guards shall not be tampered with, modified, or removed. These guards will be in place and utilized during operation of equipment.
- 4.10.5 The dimension of the working space in the direction of access to energized parts in switchboards, control panels, fused switches, circuit breakers, panel boards, motor controllers, and similar equipment that requires examination, adjustment, servicing, or maintenance while energized shall not be less than 36 inches deep and 30 inches wide or the width of the equipment, whichever is greater.
- 4.10.6 Portable electrical equipment shall be handled in a manner that will not cause physical damage to the equipment.
- 4.10.7 Portable electrical equipment shall not be carried by the cord.
- 4.10.8 Cords shall not be used to raise or lower equipment.
- 4.10.9 Extension cords shall not be fastened with staples, nails, wire, or otherwise hung in such a fashion that could damage the outer jacket or insulation.
- 4.10.10 Electrical cords shall not be removed from a receptacle by pulling on the cord line.
- 4.10.11 Employees' hands shall not be wet when plugging and unplugging cord and plug connected equipment and extension cords.
- 4.10.12 Disconnect portable electric equipment when not in use, before servicing, and when changing accessories such as blades, bits, and cutters.
- 4.10.13 Portable electric equipment and extension cords used in potentially wet locations shall be approved for use in those locations by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation (e.g., F.M., UL, etc.).
- 4.10.14 Portable electric equipment and extension cords used in areas exposed to gases, fumes, vapors, liquids, or other agents having a deteriorating effect shall be approved for use in those locations.
- 4.10.15 Portable electric equipment and extension cords used in areas in which hazardous concentrations of flammable gases or vapors exist shall be approved for use in those locations.
- 4.10.16 If an adapter is used to accommodate a three-wire cord to a two-hole receptacle, the adapter wire will be attached to a known ground. The third prong shall never be removed from the plug.
- 4.10.17 After a circuit is de-energized by a circuit protective device, the circuit may not be manually reenergized until it has been determined that the equipment and circuit can be safely energized.
- 4.10.18 The outlet box for portable extension cords for outdoor use shall be weatherproof and shall be maintained in good condition.

5.0 Records

- 5.1 The Shock Hazard Analysis and the Arc Flash Analysis forms shall be retained in the project file.
- 5.2 The completed *S3NA-302-FM Energized Electrical Work Permit* shall be retained in the project file.

6.0 References

- 6.1 S3NA-406-PR Electrical Lines, Overhead
- 6.2 S3NA-410-PR Hazardous Energy Control

S3NA-302-FM Energized Electrical Work Permit

PART 1: To be completed by the requester

Job Work Number

- (1) Description of circuit/equipment/job location:
- (2) Description of work to be done:
- (3) Justification of why the circuit/equipment cannot be de-energized or the work cannot be deferred until the next scheduled outage:

Requester/Title

Date

Time

PART II: To be completed by the electrically qualified persons *doing* the work:

Check When
Complete

(1) Detailed job description procedure to be used in performing the above detailed work:	☐
(2) Description of the Safe Work Practices to be employed:	☐
(3) Results of the Shock Hazard Analysis:	☐
(4) Determination of Shock Protection Boundaries:	☐
(5) Results of Flash Hazard Analysis:	☐
(6) Determination of the Flash Protection Boundary:	☐
(7) Necessary personal protective equipment to safely perform the job:	☐
(8) Means employed to restrict the access of unqualified persons from the work area:	☐
(9) Evidence of completion of a Job Briefing including discussion of any job-related hazards:	☐

(10) Do you agree that the above described work can be done safely?
(If *no*, return to requester)

☐ Yes ☐ No

Electrically Qualified Person(s) Date/Time Electrically Qualified Person(s) Date/Time

Electrically Qualified Person(s) Date/Time Electrically Qualified Person(s) Date/Time

Authorized by:

Authorized Supervisor

Date/Time

Notes:

S3NA-302-ST Electrical Regulations

1.0 Regulations

Jurisdiction Regulation	
United States	
OSHA	National Fire Protection Association (NFPA) Publication 70, National Electrical Code Occupational Health and Safety Administration 29 CFR 1910, Subpart S Electrical Occupational Health and Safety Administration 29 CFR 1926, Subpart K Electrical
Canada	
Alberta	OHS Code (2009) Sect 225 – 227, Schedule 4 Alberta Electrical and Communication Utility Code (2002)
British Columbia	OHS Regulation (1997) Sect 19.1 – 19.40 Electrical Safety Act
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 25.0 – 25.8, 26.45, 38.1 – 38.17
New Brunswick	OHS Regulation (91-191) Sect 286 – 298
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 84 – 87
Nova Scotia	OHS Regulation (N.S. Reg. 44/99) Sect 120 – 128
NWT/NU Territories	General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 96
Ontario	Reg. 213/91 Sect 181 – 195.3 Reg. 851 Sect 41, 60
Prince Edward Island	OHS Regulations (EC180/87) Sect 36.1 – 36.44
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 331 Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 2.11.1 – 2.11.6, 5.1.1 – 5.3.1, Schedule 7
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 450 – 466, Schedule Table 22
Yukon Territory	OHS Regulations (O.I.C. 2006/178) Sect 9.18 – 9.20

2.0 Standards

Canadian Standards Association	C22.1-98, Canadian Electrical Code - Part I

S3NA-302-WI1 Electrical Safe Work Practices

1.0 Purpose

The purpose of this guideline is to confirm that all live electrical work conducted under the control of AECOM personnel is carried out in accordance with recognized best practices in order to provide adequate protection to workers from the hazards of potential arc flash and/or electrical shock.

2.0 Associated AECOM Policies

In addition to this guideline, AECOM will also follow all Federal and State/Provincial Regulations, in particular NFPA-70E and 29CFR part 1910 as well as relevant AECOM SH&E procedures, including *S3NA-302-PR Electrical, General* and *S3NA-410-PR Hazardous Energy Control*.

3.0 Responsibilities

3.1 AECOM's Project Manager

- 3.1.1 Be familiar with all precautions and Federal and State/Provincial regulations and Best Practices, including NFPA-70E.
- 3.1.2 Provide training on this Best Management Practice to authorized employees covering:
 - Nature and control of known shock and arc flash hazards.
 - Means of eliminating and controlling shock and arc flash hazards.
 - Special electrical personal protective equipment (PPE) requirements (task-specific).
 - Procedure for reporting any deviations to this Best Practice.
- 3.1.3 Control access to energized electrical equipment with potential of shock or arc flash to authorized personnel only.
- 3.1.4 Confirm availability of proper tools for the operation and maintenance of electrical equipment.
- 3.1.5 Proper identification and guarding of potentially hazardous electrical equipment.
- 3.1.6 Providing available electrical one-line diagrams.
- 3.1.7 Confirm proper housekeeping around energized electrical equipment at all times.
- 3.1.8 Provide proper working conditions, including adequate lighting, to facilitate work in a safe environment.
- 3.1.9 Proper supervision of employees.
- 3.1.10 Maintaining a list of authorized electrical supervisor, authorized electrical worker, and attendant.
- 3.1.11 Implementation and ongoing evaluation of this Best Management Practice.
- 3.1.12 Terminate the work and cancel the permit when live work has been completed or any new electrical hazard arises.
- 3.1.13 Verify that communication modes are available and have been tested.
- 3.1.14 Remove unauthorized individuals who enter or who attempt to enter the approach boundaries during live work.
- 3.1.15 Confirm that live work remains consistent with terms of the live work permit and that acceptable working conditions are maintained.

- 3.1.16 Withdraw the live work permit and stop all work if unsafe conditions are reported during any live work (e.g. sparking, smoldering etc.). Do not permit work on that equipment until the cause of any unsafe condition is thoroughly investigated and the live work procedure has been reviewed to prevent reoccurrence.

3.2 **Authorized Electrical Attendant**

- 3.2.1 Practice all precautions and federal and state/provincial regulations and Best Practices including NFPA-70E.
- 3.2.2 Understand the hazards that may be faced during live work, including the potential for arc flash, shock hazard, and other related hazards.
- 3.2.3 Be aware of the potential of arc flash or shock possible to the authorized worker.
- 3.2.4 Maintain an accurate count of authorized workers working near the live equipment or inside approach boundaries.
- 3.2.5 Remain near the approach boundary until relieved by another authorized electrical attendant.
- 3.2.6 Communicate with authorized workers as necessary to confirm maintenance of safe conditions at all times.
- 3.2.7 Monitor activities inside and outside the approach zone to determine if it is safe for the worker to continue to remain in the approach zone. Order the authorized worker to stop live work under any of the following conditions:
- The attendant detects a problem;
 - The attendant detects the signs of short-circuiting, such as electrical sparking, smoldering, or any other abnormality;
 - The attendant detects a situation outside the approach zone that could endanger the worker; and
 - If the attendant cannot effectively and safely perform all assigned duties.
- 3.2.8 Perform no other duties that might interfere with the attendant's primary duty to monitor and protect the authorized worker.

3.3 **Authorized Electrical Worker**

- 3.3.1 Practice all precautions and federal and state/provincial regulations and Best Practices including NFPA-70E.
- 3.3.2 Be continuously alert, focused, and aware of the hazards of performing the task.
- 3.3.3 Understand AECOM Safety, Health and Environmental policies and standards as well as site-specific electrical safe work practices.
- 3.3.4 Examine and understand all the documents provided by AECOM and manufacturers, including all specific hazards, advisories, cautions, etc.
- 3.3.5 Perform all work in accordance with applicable federal and state/provincial regulations, AECOM policies, safe work practices, and this Best Management Practice.
- 3.3.6 Be knowledgeable of the use and selection of the proper tools to safely perform the electrical task safely.
- 3.3.7 Complete a Safe Work Plan prior to the start of a task and during work, if conditions change.
- 3.3.8 Maintain good housekeeping around work areas. Remove all debris, materials, etc., at the completion of tasks.
- 3.3.9 Report any hazardous (uncontrolled) conditions to AECOM's authorized supervisor.
- 3.3.10 Understand the hazards that may be faced during live work, including arc flash, shock, or other electrical hazards.

- 3.3.11 Properly use required PPE and electrical tools as specified in this best practice.
- 3.3.12 Communicate with the attendant as necessary.
- 3.3.13 Alert the attendant whenever any abnormality occurs (e.g., sparking, minor shock, burning smell, etc.) or symptoms of unsafe conditions are observed.
- 3.3.14 Stop all work and exit from the approach zone whenever:
 - An order to evacuate is given by the authorized attendant or the authorized supervisor; or
 - When the worker observes any warning sign or symptom of short circuiting or a dangerous situation; or
 - When the supervisor gives an order to stop work.

4.0 Multi-employer Live Electrical Work Coordination

- 4.1 **AECOM's Requirements:** When using another employer to perform work involving live electrical work, AECOM will:
 - 4.1.1 Inform the contractor that the workplace contains shock and/or arc flash potential and that live work is allowed only through compliance with a live work permit program meeting the requirements of NFPA-70E.
 - 4.1.2 Appraise the contractor of the elements of the work, including the hazards identified and all past experiences with the live work that make the live work hazardous.
 - 4.1.3 Appraise the contractor of any precautions or procedures that have been implemented for the protection of employees in the approach zone where contractor personnel will be working.
 - 4.1.4 Coordinate live work operations with the contractor when both AECOM employees and contractor employees will be working in or near approach zone, so that employees of AECOM and the contractor do not endanger each other.
 - 4.1.5 Debrief the contractor at the conclusion of the live work operations.
- 4.2 **Contractor Requirements:** In addition to complying with the live work permit requirements, each contractor who is retained to perform live electrical work will:
 - 4.2.1 Obtain any available information regarding live work from the project manager.
 - 4.2.2 Coordinate live work operations with the project manager when both AECOM personnel and contractor personnel will be jointly working in or near the approach zone.
 - 4.2.3 Practice all precautions and federal and state/provincial regulations and Best Practices including NFPA-70E.
 - 4.2.4 Inform AECOM's project manager of the live work permit that the contractor will be using and of any hazards confronted or created during live work, either through debriefing or during live work.

5.0 Review and Update

This Best Management Practice will be reviewed and updated annually.

6.0 Definitions

- 6.1 **Arc Rating:** The maximum incident energy resistance demonstrated by a material prior to breakdown or at the onset of a second-degree skin burn (expressed in cal/cm²).
- 6.2 **Flash Hazard:** A dangerous situation associated with the release of energy caused by an electric arc.
- 6.3 **Energized Electrical Equipment:** Electrically connected to or having a source of voltage.
- 6.4 **Shock Hazard:** A dangerous situation associated with the possible release of energy caused by contact or approach to live parts.

7.0 Required Minimum Qualifications

- 7.1 All electrical work including instrumentation, installations, maintenance, troubleshooting, calibration, and operation of breakers will only be conducted by qualified, trained, and skilled personnel (this includes AECOM personnel and contractors/subcontractors). These personnel will meet all qualification requirements mandated by the federal/state regulations as well as applicable electrical associations and trade bodies.
- 7.2 The Project Manager, in consultation with SH&E Department, will determine the minimum qualifications requirements for any work with the potential for arc flash.

8.0 Working on or Near Electrical Conductors of Circuit Parts

- 8.1 Safe work practices shall be used to safeguard employees from injury when working on or near exposed electric conductors or circuit parts that can be energized.
 - 8.1.1 Live Parts – Safe Work Conditions: Live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them.
 - 8.1.2 Live Parts – Unsafe Work Conditions: Only qualified persons shall be permitted to work on electrical conductors or circuit parts that have not been put into electrically safe conditions.
- 8.2 Working on or near exposed electrical conductors OR circuit parts that are, or might become, energized – Prior to working on or near exposed electrical conductors and circuit parts operating at 50 volts or more, lockout/tagout devices shall be applied in accordance with AECOM and site-specific policies.
- 8.3 Electrical Hazard Analysis – If the live parts operating at 50 volts or more are not placed in electrically safe condition, other safety-related work practices shall be used to protect employees who might be exposed to electrical hazards. Safe work practices mentioned below shall be established before any person approaches exposed live parts within limited approach boundary:
 - 8.3.1 Shock Hazard Analysis – A shock hazard analysis shall determine the voltage to which personnel will be exposed, boundary requirements, and the PPE necessary in order to minimize the possibility of electrical shock.
 - 8.3.2 Flash Hazard Analysis – A flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the flash protection boundary and the PPE that people within the flash protection boundary shall use.

9.0 Shock Hazard Analysis and Approach Boundaries

- 9.1 The National Fire Protection Association (NFPA) has determined that a comprehensive Shock Hazard Analysis Survey is the best method to:
- 9.1.1 Systematically analyze shock hazards,
 - 9.1.2 Identify approach boundaries, and
 - 9.1.3 Identify appropriate PPE.
- 9.2 Before permitting live work on electrical equipment, each project site having electrical equipment operating at more than 50 volts is required to conduct Shock Hazard Analysis Survey. Upon completion of the survey, the applicable electrical areas/spaces will be labeled in accordance with survey results.
- 9.3 Shock hazard analysis for individual equipment is not required if a facility-wide shock hazard analysis has been conducted and if conditions (including labels and signage) are maintained at all times.
- NOTE: Only authorized personnel are allowed to work within the approach boundaries.*
- 9.4 No qualified person shall approach or take any conductive object closer to exposed live parts operating at 50 volts or more than the restricted approach boundary set forth in Appendix A-1 [Table 130.2 (C) of NFPA 70-E].
- 9.5 In the absence of facility-wide survey, a shock hazard analysis (including the identification of approach boundaries) shall be conducted in accordance with NFPA 70E Section 130.2 and Table 130.2 (C) (see Appendix A-1 of this Practice) for all electrical equipment operating at over 50 volts.
- 9.6 Results of both facility-wide as well as individual shock hazard survey shall be made available to all authorized employees. Additionally, any recommendations given by the survey generated from the survey shall be reviewed by the project manager and shall be addressed in a timely manner.

10.0 Arc Flash Hazard Analysis and Approach Boundaries

- 10.1 Arc flash safety requirements apply to all electrical equipment operating at 50 volts or more.
- 10.2 Similar to the shock hazard analysis, the NFPA has determined that a comprehensive Arc Flash Hazard Analysis Survey is the best method to:
- 10.2.1 Systematically analyze the potential for arc flash,
 - 10.2.2 Identify the limits of the approach, and
 - 10.2.3 Identify appropriate PPE.
- 10.3 Once a comprehensive facility arc flash survey has been conducted and electrical work areas/spaces are labeled in accordance with survey results, an individual arc flash hazard analysis is not required, provided that qualified personnel confirm that the conditions, as indicated on the labels and signs, are maintained.
- NOTE: Only authorized personnel are allowed to work within the limits of approach.*
- 10.4 Please refer to Appendix A-1 for details.
- 10.5 Prior to performing any work on energized electrical systems, an arc flash hazard analysis [including the identification of approach boundaries] will be conducted in accordance Appendix F of this practice (taken from NFPA 70E Section 130.3)].

11.0 Required PPE Categorized by Exposure

The following specialized PPE requirements will be used while working on energized electrical systems:

- 11.1 PPE as prescribed by the shock hazard analysis and arc flash analysis; or
- 11.2 PPE requirements identified in Appendix A-2 of this practice (taken from NFPA 70E Sections 130.2 and 130.7).

12.0 Required Tools and Equipment

- 12.1 Only tools and testing or protective equipment approved by ANSI/ASTM for the relevant voltage rating [see Table 130.7(C)(8) or Canadian Standards Association for appropriate voltage rating] will be used when working on energized electrical systems. All tools and testing or protective equipment will be visually inspected prior to use to confirm that the protection systems associated with the tool or equipment are not damaged or impaired and that diagnostic meters and tools are configured properly. Any tool or testing or protective equipment suspected of being compromised will be immediately taken out of service and will be tagged for disposal.

13.0 Work on Energized Electrical Systems

- 13.1 It is the policy of AECOM that all electrical maintenance or troubleshooting will be done on de-energized circuits, to the extent practical. Work on energized circuits can only be done under special circumstances using a "Live Work Permit" issued by authorized electrical supervisor. This permit takes into consideration the voltage levels, known electrical hazards, communication requirements, and need for watch persons, etc. The following procedure will be observed for a live work permit:
 - 13.1.1 The person requesting the work (authorized worker) will complete the permit and will retain the original with him or her during the work. Copy of the permit will be displayed at a prominent location in the control room as a notice that live work has been authorized in certain part of the plant/project.
 - 13.1.2 Permit will be reviewed for correctness, proper safety precautions, and adequacy of controls by the authorized electrical supervisor. After satisfying all safety requirements, an authorized electrical supervisor will sign the permit and will give the original copy to the authorized electrical worker.
 - 13.1.3 Upon work completion, the authorized worker will note any observation on the permit and will return the original to the authorized supervisor.
 - 13.1.4 Authorized supervisor will keep both copies of the permit as a controlled record for a period of 12 months.
- 13.2 The following conditions will be met for live electrical work:
 - 13.2.1 If any equipment or instrumentation is to be disabled while other related components or systems are still functioning, the Live Work Permit should record how process safety of the remaining systems will be maintained.
 - 13.2.2 All electrical and instrumentation work conducted will be recorded in the applicable MCC log. The documentation will include a reference to the permit number where appropriate.
 - 13.2.3 The worker will inform the operations supervisor that he or she intends to de-energize a circuit. He or she will also inform the operations supervisor when the work is complete and that the system can be returned to service.
- 13.3 See *S3NA-302-FM Energized Electrical Work Permit* for a suggested template for a "Live Work Permit."

14.0 Lockout/Tagout Policy and Procedures

- 14.1 All equipment will be locked out prior to any work commencing in accordance with AECOM's policy *S3NA-410-PR Hazardous Energy Control* and applicable site specific lockout/tagout program.

15.0 Troubleshooting Procedure

- 15.1 The troubleshooting of electrical equipment often requires working with live circuits. Where possible, work will be done on de-energized circuits following the relevant AECOM and site-specific lockout/tagout policy. However, troubleshooting may require limited work on live circuits; if such work is required it will be done using the "Live Work Permit" and site-specific Troubleshooting Guidelines.

16.0 Housekeeping

- 16.1 All areas containing electrical equipment will:
- 16.1.1 Be maintained and kept clean.
 - 16.1.2 Be well illuminated.
 - 16.1.3 Not be used for storage of supplies.
 - 16.1.4 Not be used for the storage of any flammable materials.
 - 16.1.5 Be assessed for safety hazards.
 - 16.1.6 Be suitably ventilated to control dust, temperature, and humidity.

17.0 Communication

- 17.1 Personnel working in or around equipment with electrical hazards will employ a suitable means of communication to confirm their safety.
- 17.2 The means of communication may include:
- 17.2.1 Authorized attendant (required for ALL live work conducted on 600 volts and above) (CFR 29 1910.335(b)(3) in the United States).
 - 17.2.2 Permits.
 - 17.2.3 Two-way radios.

18.0 Signage and Labels

- 18.1 MCCs, ECRs, battery rooms, and electrical panels are required to have the following labeling to identify arc flash and shock hazards. The information on the label will include:
- 18.1.1 Flash Hazard Boundary (Arc Flash Current).
 - 18.1.2 Flash Hazard at 18 inches in cal/cm² or joules.
 - 18.1.3 Hazard Risk Categories (PPE requirements).
 - 18.1.4 Shock Hazards.
 - 18.1.5 Limited Approach Boundaries.
 - 18.1.6 Restricted Approach.
 - 18.1.7 Prohibited Approach.
 - 18.1.8 Log book to record all electrically related activities.
- 18.2 All doorways to buildings and enclosures containing energized electrical equipment will be signed to indicate that:
- 18.2.1 Access is restricted to authorized personnel only.
 - 18.2.2 Electrical hazards exist beyond this (boundary, door, etc.).

19.0 Management of Change

- 19.1 Any changes to electrical and/or project instrumentation will be conducted following the prescribed management of change policy.

APPENDIX A-1

Table 130.2(C) Approach Boundaries to Live Parts for Shock Protection

(All dimensions are distance from live part to employee.)

Nominal Voltage Range (Phase to Phase)	Limited Approach Boundary	Exposed Fixed Circuit Parts	Restricted Approach Boundary; includes inadvertent movement adder	Prohibited Approach Boundary
	Exposed Moveable Conductor			
Up to 50 Volts	Not Specified	Not Specified	Not Specified	Not Specified
50-300	10 ft	3.5 ft	Avoid Contact	Avoid Contact
300-750	10 ft	3.5 ft	1 ft	1 inch
More than 750 volts	Consult NACO's Master Electrician or other authorized electrician.			

APPENDIX A-2

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Matrix

Table 130.7(C)(11) Protective Clothing Characteristics

Hazard/Risk Category	Clothing Description (Typical number of clothing layers is given in parentheses)	Required Minimum Arc Rating of PPE [[J/cm ² (cal/cm ²)]
0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd ² (1)	N/A
1	FR shirt and FR pants or FR coverall (1)	16.74 (4)
2	Cotton underwear – conventional short sleeve and brief/shorts, plus FR shirt and FR pants (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	104.6 (25)
4	Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more)	167.36 (40)
NOTE: Arc rating: Arc rating is defined in Article 100 and can be either ATPV or E_{BT}. ATPV: ATPV is defined in ASTM F 1959-99 as the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve. E_{BT}: E_{BT} is defined in ASTM F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakopen. E_{BT} is reported when ATPV cannot be measured due to FR fabric breakopen.		

APPENDIX B

Protective Clothing and Equipment	Protective Systems for Hazard/Risk Category					
Hazard/Risk Category Number	-1 (Note 3)	0	1	2	3	4
Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber						
a. T-shirt (short-sleeve)	X			X	X	X
b. Shirt (long-sleeve)		X				
c. Pants (long)	X	X	X (Note 4)	X (Note 6)	X	X
FR Clothing (Note 1)						
a. Long-sleeve shirt			X	X	X (Note 9)	X
b. Pants			X (Note 4)	X (Note 6)	X (Note 9)	X
c. Coverall			(Note 5)	(Note 7)	X (Note 9)	(Note 5)
d. Jacket, parka, or rainwear			AN	AN	AN	AN
FR Protective Equipment						
a. Flash suit jacket (multilayer)						X
b. Flash suit pants (multilayer)						X
c. Head protection						
1. Hard hat			X	X	X	X
2. FR hard hat liner					AR	AR
d. Eye protection		—	—	—	—	—
1. Safety glasses	X	X	X	AL	AL	AL
2. Safety goggles				AL	AL	AL
e. Face and head area protection		—	—	—	—	—
1. Arc-rated face shield, or flash suit hood				X (Note 8)		
2. Flash suit hood					X	X
3. Hearing protection (ear canal inserts)				X (Note 8)	X	X
f. Hand protection			—	—	—	—
Leather gloves (Note 2)			AN	X	X	X
g. Foot protection						
Leather work shoes			AN	X	X	X
AN = As needed AL = Select one in group AR = As required X = Minimum required						
NOTES: 1. See Table 2. Arc rating for a garment is expressed in cal/cm ² . 2. If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy this requirement. 3. Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Table 130.7(C)(9)(a). 4. Regular weight (minimum 12 oz/yd ² fabric weight), untreated, denim cotton blue jeans are acceptable in lieu of FR pants. The FR pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4. 5. Alternate is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants. 6. If the FR pants have a minimum arc rating of 8, long pants of non-melting or untreated natural fiber are not required beneath the FR pants. 7. Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or untreated natural fiber pants and T-shirt. 8. A face shield with a minimum arc rating of 8, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or, alternately, a flash suit hood), is required. 9. Alternate is to use two sets of FR coveralls (the inner with a minimum arc rating of 4 and outer coverall with a minimum arc rating of 5) over non-melting or untreated natural fiber clothing, instead of FR coveralls over FR shirt and FR pants over non-melting or untreated natural fiber clothing.						

Table 2: Protective Clothing Characteristics

Hazard/Risk Category	Clothing Description (Typical number of clothing layers is given in parentheses)	Required Minimum Arc Rating of PPE [(J/cm ² (cal/cm ²)]
0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd ² (1)	N/A
1	FR shirt and FR pants or FR coverall (1)	16.74 (4)
2	Cotton underwear – conventional short sleeve and brief/shorts, plus FR shirt and FR pants (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	104.6 (25)
4	Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more)	167.36 (40)
NOTE: Arc rating is defined in Article 100 and can be either ATPV or E_{BT}. ATPV is defined in ASTM F 1959-99 as the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve. E_{BT} is defined in ASTM F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakopen. E_{BT} is reported when ATPV cannot be measured due to FR fabric breakopen.		

APPENDIX C

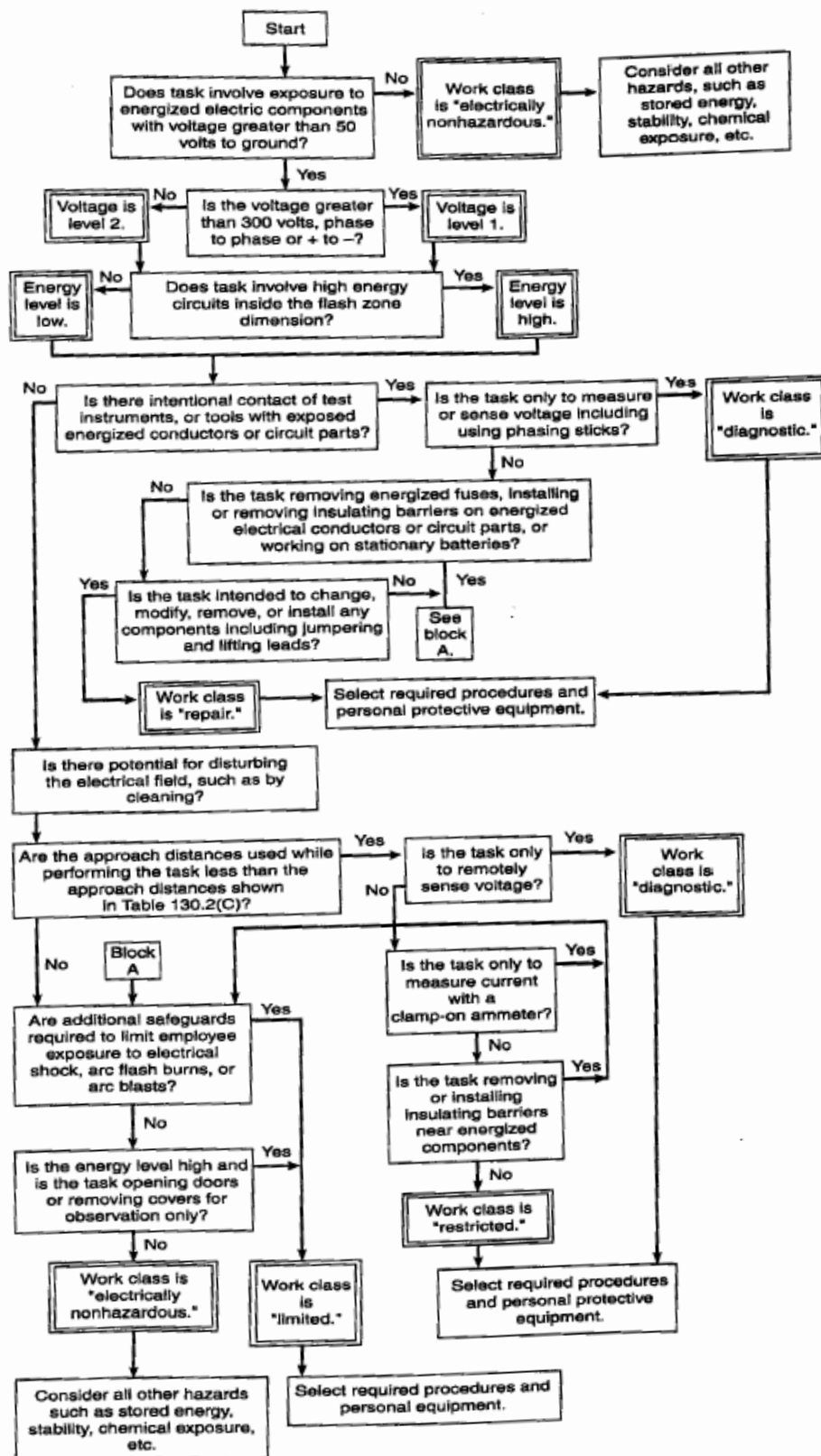


Figure F.1 Hazard/Risk Analysis Evaluation Procedure Flow Chart.

APPENDIX E**Flash Protection Boundary**

For system that are above 600 volts or less, the Flash Protection Boundary shall be 4.0 ft., based on the product of clearing time of 6 cycles (0.1 second) and the available bolted fault current of 50 kA, or any combination not exceeding 300 kA cycles (5,000 ampere seconds).

For clearing times and bolted fault currents other than 300kA cycles, or under engineering supervision, the Flash Protection Boundary shall alternatively permitted to be calculated in accordance with the following general formula:

$$D_c = [2.65 \times MVA_{bf} \times t]^{1/2}$$

or

$$D_c = [53 \times MVA \times t]^{1/2}$$

where:

D_c = distance in feet from an arc source for a second-degree burn

MVA_{bf} = bolted fault capacity available at point involved (in mega volt-amps)

MVA = capacity rating of transformer (mega volt-amp). For transformer with an MVA rating below 0.75 MVA, multiply the transformer MVA rating by 1.25

t = time of arc exposure (in seconds)

At voltage levels above 600 volts, the Flash Protection Boundary is the distance at which the incident energy equals 5 J/cm² (1.2 cal/cm²). For situations in which fault-clearing time is 0.1 second (or faster), the Flash Protection Boundary is the distance at which the incident energy equals 6.24 J/cm² (1.5 cal/cm²).

S3NA-302-WI2 Ground Fault Protection Safe Work Practices

1.0 Background

- 1.1 OSHA standard 1926.404(b)(1) requires “ground fault protection” on construction sites. The standard allows two different approaches to providing the required protection for employees from electrical ground faults. Either “ground fault circuit interrupters” (GFCI) are to be used with temporary receptacles, or an “assured equipment grounding conductor program” is to be established in which plug-connected electrical equipment, extension cords, and temporary receptacles are tested on a periodic basis.

2.0 Ground Fault Circuit Interrupters

- 2.1 A GFCI is an electrical device that is designed to prevent electrocution from electrical leakage. It is designed to measure the difference in amperage between the “hot” wire and the “neutral” wire in a circuit. Under ideal conditions, the amperage should be the same in both wires. If there is electrical leakage (a ground-fault), the amperages will be different. If the difference is more than a predetermined amount, the GFCI “trips” and stops the flow of electricity.
- 2.2 GFCIs may trip from many causes:
- 2.2.1 Electrical leakage in the tool from internal defects.
- Electrical leakage in the extension cord from damaged insulation or from normal leakage in long runs of cords.
- 2.2.2 Moisture in the air or cords lying in water or on moist dirt.
- 2.2.3 Too many tools on one GFCI circuit.
- Electromagnetic interference from two-way radios or from power transmission lines.
- 2.2.4 Faulty wiring of the GFCI into the circuit.
- 2.2.5 Defective GFCI.
- 2.2.6 Any such tripping will require the problem to be corrected before the protected circuit can be re-set.
- 2.3 All 120-volt, single phase, 15 and 20 ampere temporary receptacles shall be protected with “approved” GFCIs. “Approved” means listed by Underwriters Laboratories.
- 2.4 There are several types of GFCIs.
- 2.4.1 A combination circuit breaker and GFCI that is installed in place of the ordinary circuit breaker.
- 2.4.2 A receptacle containing a built-in GFCI.
- 2.4.3 A portable GFCI that plugs into a receptacle and allows the extension cord or tool to be plugged into the GFCI.
- 2.4.4 A portable unit containing several GFCI protected receptacles.
- 2.5 GFCIs contain a test button and a reset button. Each GFCI needs to be tested prior to use and on a periodic basis depending upon the manufacturer's recommendations (at a minimum monthly).

3.0 Assured Equipment Grounding Conductor Program

- 3.1 If an assured equipment grounding conductor program is to be used instead of GFCIs to provide ground fault protection, the program shall be governed by the following requirements.

- 3.1.1 Temporary receptacles shall be electrically grounded in accordance with the temporary wiring requirements of the National Electrical Code.
- 3.1.2 Extension cords shall be three-wire cords containing an equipment grounding conductor (ground wire).
- 3.1.3 Electrical equipment that is plugged into a receptacle or extension cord (portable electrical tools, bench grinders, electric heaters, etc.) shall have a ground wire properly attached to the non-current-carrying metal parts of the equipment. (Double-insulated tools have no ground wire and are therefore exempt from these testing and recording requirements but still need to be inspected for defects.)
- 3.1.4 The Worksite Manager and/or Supervisor are required to designate one or more competent persons to administer this testing and recording program.
- 3.1.5 Periodic testing of all plug-connected equipment, all extension cords, and all temporary receptacles is to be conducted at the following times:
- Before a new item (equipment, cord, or receptacle) is put into use.
 - After any repairs to the item.
 - After any incident in which the item may have been damaged.
 - Within 3 months of the last test. (An exception is allowed in the Standard in which extension cords, and temporary receptacles, which are fixed in place and are not exposed to damage, may be tested every 6 months.)
- 3.1.6 The purpose of the test is to determine the following:
- Temporary receptacles—to be sure that the receptacle is grounded.
 - Extension Cords—to be sure that the ground wire is connected to the proper terminal at each end and that the ground wire is continuous throughout the length of the cord.
 - Plug Connected Equipment—to be sure that the ground wire is connected to the proper terminal and to the non-current carrying metal parts of the equipment and that the ground wire is continuous from the equipment to the plug.
- 3.1.7 The tests may be conducted using the following instruments:
- A receptacle tester may be used to test receptacles and to test extension cords when plugged into a receptacle.
 - A continuity tester, or a volt-ohm meter, may be used to test equipment and to test extension cords when not plugged into a receptacle.
- 3.1.8 Records must be kept to show which items have passed the test and when the test was conducted. These records may be either written inspection logs, a color coding system using colored tape attached to the item, or some other effective means.
- 3.1.9 Color coding shall be used in the following manner:
- After a plug-connected piece of equipment or an extension cord has passed the test, colored tape is to be placed around the cord near the plug. After a temporary receptacle has passed the test, colored tape is to be placed on the cover plate.
 - Any set of colors may be used, with the exception of white, black, or silver.
 - If there has been no overall site requirements established by the general contractor, use the following colors for the test periods.

January, February, March	Red
April, May, June	Blue
July, August, September	Orange
October, November, December	Green

- 3.1.10 The tests administered every three months are to begin on the first working day of each quarter. Testing and color coding are to be continued until all items covered by this program have been tested. The test administered every six months, for those receptacles and extension cords needing only semi-annual testing, are to be color coded using the quarterly color current at the time of the semi-annual test.
- 3.1.11 A visual inspection of plug-connected equipment, extension cords, and temporary receptacles is to be made by the user before each use. The purpose of the visual inspection is to look for damage or defects that could affect the safe use of the item. (Exception: extension cords and temporary receptacles that are fixed in place and not exposed to damage are not required to be give a daily visual inspection, but it is a good idea to do the daily visual inspection anyway.)
- 3.1.12 Equipment, cords, or receptacles showing damage or defects that could affect its safe operation are not to be used. This applies not only to the visual inspection before each use but also applies to any evidence of damage observed any time during use. Damaged items are to be taken out of service and are not to be used until properly repaired and retested.
- 3.1.13 Equipment covered by this program is not to be used until the equipment has been tested and color coded according to the requirements of this program.
- 3.1.14 A copy of this program is to be kept at the worksite.

S3NA-302-WI3 Generator Safety Card

1.0 Objective/Overview

- 1.1 Portable generators should be used with extreme caution in order to prevent personal injury. When using a portable generator it is important to follow the manufacturer's instructions to avoid injuring someone or damaging your generator or appliances. Allow only trained, authorized personnel to operate the generator. Along with training, other safety measures include proper maintenance of equipment and personal protective equipment (PPE). Remember muscle strains are the most common injury associated with portable generators.



2.0 Safe Operating Guidelines:

- 2.1 Follow manufacturer's recommended operating instructions; every generator is not the same. Maintain adequate ventilation. Generators emit carbon monoxide (CO). Never operate a generator in an enclosed building without proper ventilation. Turn the generator off to refuel. Gasoline and its vapors may ignite if they come into contact with hot components or an electrical spark, so store fuel in a properly designed container in a secure location. To avoid a shock, make sure that your hands are dry and that you are standing in a dry place whenever you operate the generator. Turn off equipment and lights supplied by the generator until it is running. Use the right extension cord. Use only UL-listed, three-prong extension cords. Be sure the extension cord is the proper size (wire-gauge) to handle the electric load that will be plugged into it. Make sure the generator is properly grounded prior to each use. Using a portable generator to tie into the wiring of an existing structure shall be done only by a licensed electrician.

2.1.1 Potential Hazards:

- Lifting, carrying, and pulling starter cords.
- Burns from contact with the hot muffler or engine.
- Shocks/electrocution.
- Noise exposure.
- Inhaling exhaust gases, CO.

2.1.2 Training Requirements:

- Review of Applicable SOPs.
- Back Injury Prevention.
- Demonstrated knowledge on the use of a generator.
- Review of manufacturers operating guidelines.

2.1.3 Personal Protective Equipment (Level D PPE):

- Leather Gloves.
- Hearing Protection.
- Long Sleeve Shirt (i.e., to shield from burns, etc.).

2.1.4 Other Safety Tips:

- Have a Class A:B:C fire extinguisher readily available at all times.

S3NA-303-PR Excavation and Trenching

1.0 Purpose and Scope

- 1.1 To evaluate all excavation operations to provide for proper protective systems for employee protection from associated hazards.
- 1.2 This SOP applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Benching (Benching system):** A series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels to protect employee from cave-ins.
- 2.2 **Cave-in (collapse):** The separation of a mass of soil or rock material from the side of an excavation or the loss of soil from under a trench shield or support system and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.
- 2.3 **Competent person:** Person, who, by way of training, knowledge, and/or experience, is capable of classifying soils and is also capable of identifying existing and predictable hazards in excavation/trenching work area and who has the authority to take prompt corrective measures to eliminate them. The person must also be familiar with the requirements in the regulation.
- 2.4 **Excavation:** A manmade cut, cavity, trench, or depression in an earth surface formed by earth removal. Examples include trenches, tunnels, shafts, caissons and open cut holes.
- 2.5 **Faces (or sides):** The vertical or inclined earth surfaces formed as a result of excavation work.
- 2.6 **Failure:** A structural member's integrity and supportive capabilities is compromised, causing a breakage, displacement, or permanent deformation.
- 2.7 **Hazardous Atmosphere:** An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful may cause death, illness, or injury.
- 2.8 **Protective Systems:** Devices or methods in protecting employees in an excavation from cave-ins, a collapse or falling material. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.
- 2.9 **Ramp:** An inclined walking or working surface that is used to gain access to one point from another and is constructed from earth or from structural materials such as steel or wood.
- 2.10 **Registered Professional Engineer:** An engineer who can authorize any state of work by his professional designation. However, a professional engineer registered in the state, province, or territory is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.
- 2.11 **Shield (Shield system):** A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."
- 2.12 **Shoring (Shoring system):** A structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and that is designed to prevent cave-ins.
- 2.13 **Sloping (Sloping system):** An alternative to shoring is trench sloping. This means that the trench walls are cut back to decrease the possibility of cave-ins. The angle of incline required to prevent a cave-in varies with such factors as soil type, environmental conditions of exposure, and application of surcharge loads.

- 2.14 **Stable rock:** A natural solid mineral material that can be excavated with vertical side wall; unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against cave-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.
- 2.15 **Support system:** A structure such as underpinning, bracing, or shoring that provides support to an adjacent structure, underground installation, or the sides of an excavation.
- 2.16 **Trench:** An open narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width (measured at the bottom) is often not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered a trench.
- 2.17 **Trench Box:** A trench box is a unit of shoring that is an engineered shoring system capable of protecting workers in case of cave-in of trench walls. The space between the trench wall and the trench box must be backfilled.

3.0 Attachments

- 3.1 S3NA-303-FM Daily Excavation Checklist
- 3.2 S3NA-303-WI1 Selection of Protective Systems
- 3.3 S3NA-303-WI2 Sloping Options
- 3.4 S3NA-303-WI3 Shoring or Shielding Options
- 3.5 S3NA-303-WI4 Factors Affecting Shoring Methods

4.0 Procedure

4.1 Restrictions

- 4.1.1 Because of their inherent dangers, entry into trenches and excavations shall not be performed if there are means other than entry to perform the work. Where entry into trenches and excavations is necessary, strict adherence to the procedures specified below is extremely important. Whenever there are questions regarding the safety of trench or excavation entry, contact shall be made with the Competent Person or the **Region SH&E Manager**.
- 4.1.2 No one shall enter any trench or excavation until the walls have been adequately cut back or temporary protective structures have been installed unless the trench or excavation is shallower than the legal minimums and the soil is stable.
- 4.1.3 Excavation work must be completed and inspected in accordance with the written instructions of a qualified professional and in accordance to the provincial, territorial, state, or federal regulations.

4.2 Competent Person

- 4.2.1 A competent person must be present during all work that involves entry by AECOM personnel into trenches or excavations greater than 5 feet/1.5m in depth (as above).
- 4.2.2 The competent person does not have to be an AECOM employee; however, an AECOM competent person must be qualified per *S3NA-202-PR Competent Person Designation*.
- 4.2.3 For the purpose of this SOP, a competent person is defined as an individual, who by education or experience, is capable of evaluating the hazards associated with trench or excavation collapse and is capable of classifying soils. The competent person for the project will be indicated in the Task Hazard Analysis for the project.
- 4.2.4 The competent person:
- Will determine the maximum allowable slope for the walls of the trench or excavation.
 - Will classify the soil in the trench or excavation in accordance with the requirements specified in the legislation (e.g., CFR 1926 subpart P, Appendix A Soil Classification) prior to determining that a maximum allowable slope, other than 34° with the horizontal is selected.
 - Will inspect the excavation or trench on a daily basis when the potential for employee exposure to the hazards of the trench or excavation exists (*S3NA-303-FM Daily Excavation Checklist*).

4.3 **Project Managers**

- 4.3.1 All projects under their direct control or authority and involve excavations or trenching are conducted in a safe and efficient manner and in accordance with the requirements of this SOP.
- 4.3.2 All projects under their direct control or authority have a written HASP prepared for the activity.

4.4 **Underground and Overhead Utilities**

- 4.4.1 Prior to beginning any excavation work at a site, the location of all underground and overhead utilities shall be identified and work locations will be carefully planned to avoid any potential for inadvertent contact with them.
- 4.4.2 Locate underground utilities and expose prior to excavating.
- 4.4.3 Identify any overhead power lines and de-energize or protect by other appropriate means.

4.5 **Excavation Requirements**

- 4.5.1 Soil conditions, wall slope, or shoring must be identified and designed by a professional engineer or qualified professional to meet the federal, state, provincial, territorial regulations.
- 4.5.2 Excavated (spoil) material shall be kept at least 1.0 metre (3.2 feet) from the edge of the excavation, or further if local regulations are more stringent.
- 4.5.3 If the walls of an excavation or trench are not sloped or cutback, barriers must be placed around the perimeter. The barrier must be at least 1.1 metres (3.6 feet) in height.
- 4.5.4 Workers must be protected whenever shoring is being installed or removed.
- 4.5.5 If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored regularly to ensure proper operation.
- 4.5.6 If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require regular inspections.
- 4.5.7 All excavations must be secured at the end of the day with a protective covering or appropriate barriers to prevent the public from falling into the open excavation.
- 4.5.8 Backfill trenches as soon as reasonably possible after work is complete.

4.6 **Sloping or Shoring Protection Requirements**

- 4.6.1 A Professional Engineer or Qualified Soils professional can properly assess the need for and the type of shoring required for specific applications. Shoring may not be needed in all cases, but failure to recognize the need for shoring can be catastrophic.
- 4.6.2 **Exceptions.** Each individual in an excavation shall be protected from cave-ins and trench collapse by an adequate protective system except when
 - Excavations are made entirely in stable rock.
 - Excavations are less than 5 feet (and as above) in depth and an examination of the excavation by a competent person reveals no indication of a potential cave-in.
- 4.6.3 The depth of the excavation is to be measured at its greatest vertical dimension. Be aware that crouching or kneeling in a trench that is greater than 3 feet in depth may still pose significant hazard for the employee involved. The three means for supporting trench walls are sloping, shoring, and trench boxes.
- 4.6.4 The protective system may include sloping the excavation walls, shoring the excavation walls, or installing a shielding system. The protective system chosen must have the capacity to resist, without failure, all loads to be applied to the system.
- 4.6.5 Any excavation deeper than 20 feet (6.0 m); a professional engineer must approve and sign on all protective systems.

4.6.6 Trenches must be protected from cave-ins or loss of ground prior to workers entering the trench when the following conditions apply:

- The trench is greater than 3'11" (1.2 m) in depth (however, even if the trench is less than 1.2 meters deep the potential for a cave-in exists, and appropriate controls must be implemented prior to entry to ensure the trench is safe);
- A worker is required to enter the trench;
- A worker is required to be closer to a trench wall than the height of the trench wall; and,
- If an excavation may affect the stability of an adjacent building or structure, precautions must be taken to prevent damage to the structure. The precautions shall be specified in writing by a professional engineer.

4.7 Use of Sloping as a Means of Protection

4.7.1 Sloping the walls of the trench or excavation is the preferred, and typically simplest, means of protecting employees who must enter trenches or excavations which are greater than 5 feet (1.5 m) in depth or where there is danger of collapse.

4.7.2 The trench or excavation walls may be sloped back so that the ratio of the horizontal distance to the vertical rise (H:V ratio) of the sloped wall is at least 1½:1 (i.e., equivalent to an angle with the horizontal of 34° or less) or,

4.7.3 In many cases, determining the maximum allowable slope may allow the use of a steeper slope, which will result in a narrower excavation. However, determination of soil classification is complicated and requires that the competent person be familiar with the manual and visual tests. Since incorrect soil classification may result in the use of a steeper, and potentially unsafe, slope, it is recommended that an angle of 34° (or less) with the horizontal typically be selected.

4.8 Use of Shoring or Shielding as a Means of Protection

4.8.1 Where sloping the walls of the trench or excavation is unfeasible (e.g., when there are dimensional constraints or adjacent structures), the use of shoring or shield systems (e.g., trench boxes) may be necessary.

4.9 Work Around the Trench/Excavation

4.9.1 While workers are in a trench, an aboveground observer must be present to warn of earth movements and to advise equipment operators of the presence and location of those in the trench so as to avoid vibrating equipment near trenches or excavations.

4.9.2 If there is a danger of a worker or equipment falling into an excavation, or whenever the edge is not clearly visible, you must identify the trench or excavation perimeter with visual markers (e.g., barricade tape, wooden railings, stop logs, etc). If the trench or excavation is 4 ft (1.2 m) or greater in depth, the visual barrier must be a minimum of 6 ft (1.8 m) from the edge.

4.9.3 Personnel must notify workers of the excavation through flagging, marking, safeguards, or other appropriate and effective means.

4.9.4 Where employees or equipment are required or permitted to cross over excavations, walkways, or bridges, walkways or bridges over excavations must have a minimum clear width of 20 inches (0.6 meters), be fitted with standard guard rails and extend a minimum of 24 inches (0.6 meters) past the surface edge of the trench. If vehicle crossings over excavations are required, they must be designed by and installed under the direction of a registered professional engineer.

4.9.5 Precautions must be taken to isolate loose rocks or other materials that may slide, roll, or fall into the trench and onto workers are stripped prior to entry by workers into an excavation.

4.9.6 While operating heavy equipment in the work area, the equipment operator shall maintain communication with a designated signal person through either direct voice contact or approved standard hand signals.

4.9.7 When mobile equipment is operated adjacent to an excavation or when such equipment is required to approach the edge of an excavation and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs shall be used. If possible, the grade should be away from the excavation.

4.9.8 All site personnel should maintain a safe distance and remain clear of the swing of operating excavation equipment.

- 4.9.9 Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.
- 4.9.10 All site personnel that operate or work in the vicinity of heavy equipment shall wear all AECOM-required safety equipment.
- 4.9.11 All materials such as pipe, rebar, etc., shall be kept out of traffic lanes and access ways. Materials and equipment shall be stored in a designated area so as not to endanger personnel at any time.
- 4.9.12 A flagman with roadwork, signs, cones, and high-level warning signs shall be provided when it is necessary to control normal vehicular traffic due to vehicles, such as end-dumps, entering, or leaving the site.
- 4.10 Work Within the Trench/Excavation**
- 4.10.1 Employees shall not work in excavations in which there is accumulated water or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.
- 4.10.2 A stairway, ladder, ramp, or other safe means of egress shall be located in excavations or trenches that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees. Ladders should extend at least 3 feet (0.75m) above the trench top.
- 4.10.3 Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design and shall be constructed in accordance with the design.
- 4.10.4 Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement. Structural members used for ramps and runways shall be of uniform thickness. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping. Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.
- 4.11 Hazardous Atmospheres**
- 4.11.1 Confined spaces may exist in excavations where there is limited access or egress and in which a hazardous gas, vapor, dust, or fume or an oxygen-deficient atmosphere may occur.
- 4.11.2 To prevent exposure to harmful levels of atmospheric contaminants, entry into trenches and excavations greater than 5 feet/1.5m in depth in which a hazardous atmosphere exists, or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, entry must be performed in accordance with the requirements specified in *S3NA-301-PR Confined Spaces*.
- 4.11.3 Adequate precautions, such as mechanical ventilation or appropriate respiratory protection, shall be taken prior to entry into trenches and excavations in which the oxygen concentration is less than 19.5 percent or the concentration of flammable gases or vapors is in excess of 10 percent of the lower explosive limit (LEL).
- 4.11.4 When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to confirm that the atmosphere remains safe. Atmospheric testing will be conducted in the anticipated breathing zone of the work area to determine oxygen content, combustible gas, and toxic gases and vapors, if applicable.
- 4.11.5 Appropriate respiratory protection shall be donned prior to entry into any trench or excavation in which airborne levels of toxic substances are present at concentrations in excess of their Threshold Limit Value (TLV) or Permissible Exposure Limit (PEL).
- 4.11.6 If a confined space is identified, emergency rescue procedures will be in place in accordance with *S3NA-301-PR Confined Spaces*.

4.12 Stability of Adjacent Structures

- 4.12.1 Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.
- 4.12.2 Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when
- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or
 - The excavation is in stable rock; or
 - A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or
 - A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.
- 4.12.3 In addition, sidewalks, pavements, and appurtenant structures shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

4.13 Inspections

- 4.13.1 Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.
- 4.13.2 An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.
- 4.13.3 Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

4.14 Personal Protective Equipment

- 4.14.1 Hard hats
- 4.14.2 Steel-toed boots
- 4.14.3 Reflective vest
- 4.14.4 Respiratory equipment, as required
- 4.14.5 Safety glasses with side shields

4.15 Special Excavation Entry Permit Required for California

- 4.15.1 In California, for the construction of trenches or excavations that are 5 feet/1.5 m or deeper and into which a person is required to descend, an additional permit must be obtained from Cal/OSHA.

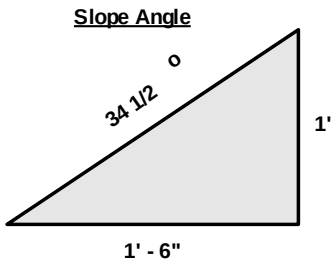
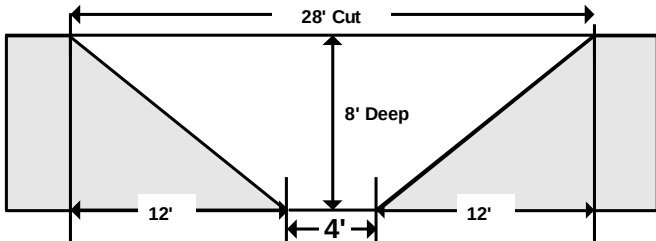
5.0 Records

- 5.1 Completed Daily Excavation Checklist—must be retained for +1 year

6.0 References

- 6.1 None

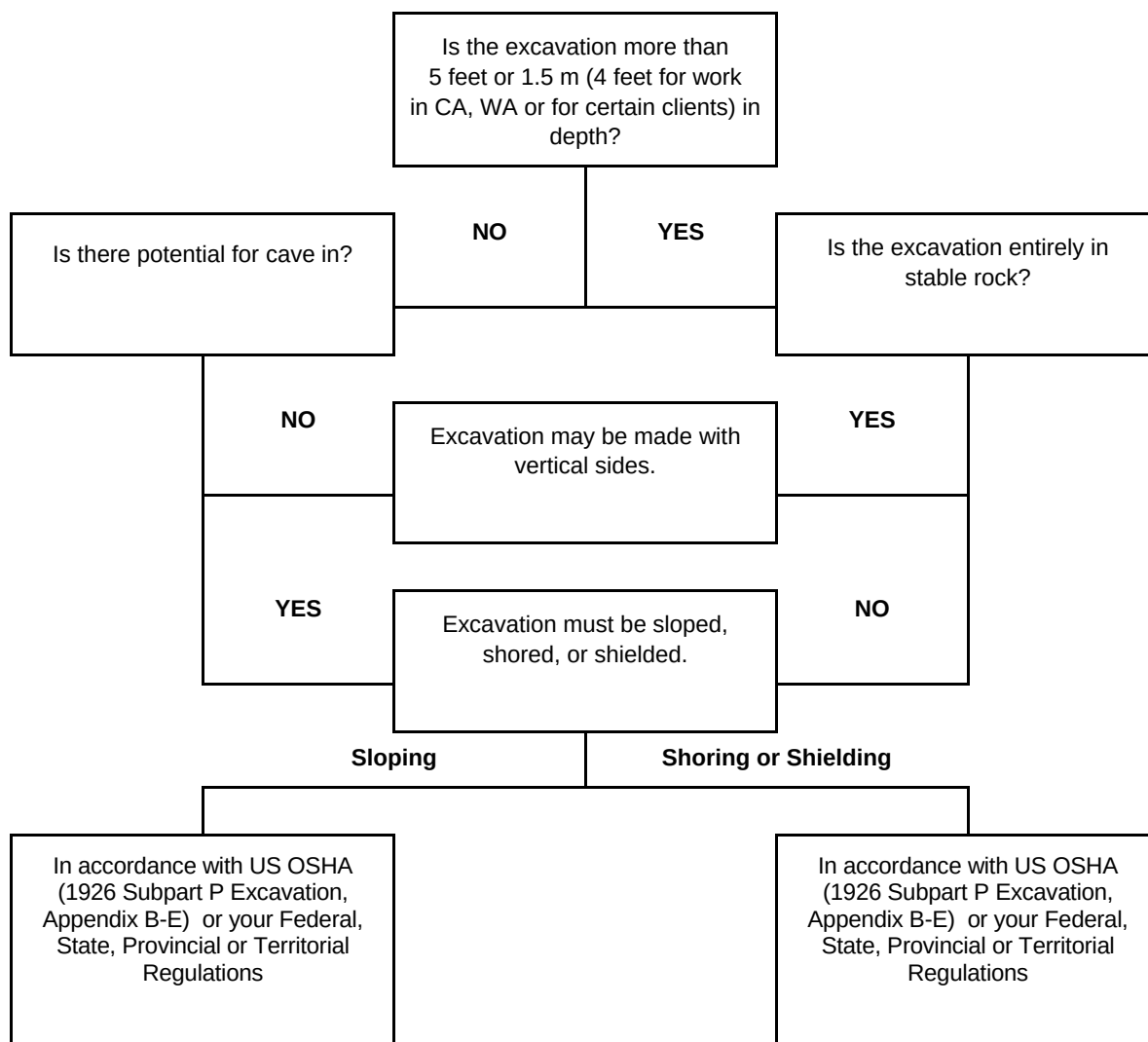
S3NA-303-FM Daily Excavation Checklist

Daily Excavation Checklist			
Competent Person:		Date:	
Site Location:		Job Number:	
Soil Type:	Excavation Depth:	Excavation Width:	
Type of Protective System Used:			
Indicate for each item: Yes – No – or N/A for not applicable:			
1. General Information:	Yes	No	N/A
A. Is excavation less than five feet in depth?			
B. Is there a potential for a cave-in? *IF YES, excavation must be sloped, shored, or shielded.			
C. Is excavation deeper than 5 feet? * IF YES, excavation must be sloped, shored, or shielded.			
D. Is sloping used as your protective system?			
<u>Slope information to keep in mind:</u>   Example of a Simple 34-degree Slope commonly used around the site for cave-in protection.			
E. 1- Manual and 1- Visual Method utilized to determine Soil Classification as A-B-C.			
2. Inspection of Job Site	Yes	No	N/A
A. Excavations, adjacent areas, and protective systems inspected by a competent person daily before the start of work.			
B. Competent person has the authority to remove all individuals from the excavation immediately.			
C. Surface encumbrances removed or supported.			
D. All individuals protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.			
E. Hard hats, safety-toed boots, and safety glasses worn by all individuals.			

F. Spoils, materials, and equipment set back at least 2 feet from the edge of the excavation.			
G. Adequate barriers provided at all excavations, wells, pits, shafts, etc.			
H. Warning vests or other highly visible clothing provided and worn by all individuals. Wearing a vest at all times around heavy equipment is required.			
I. All individuals are required to stand away from vehicles being loaded or unloaded.			
J. Warning system established and utilized when mobile equipment is operating near the edge of the excavation (e.g., barricade tape, signalpersons, stop logs, etc).			
K. All individuals prohibited from going under suspended loads.			
3. Utilities	Yes	No	N/A
A. Location of utilities marked.			
B. Prior to the use of equipment, underground utilities have been located by hand digging.			
C. Underground utilities are protected, supported, or removed when excavation is open.			
4. Means of Access and Egress:	Yes	No	N/A
A. Travel distance to means of egress no greater than 25 feet in excavations 4 feet or more in depth.			
B. Straight ladders used in excavations extend at least 3 feet above the edge of the trench.			
C. Ramps being used for employee access have been designed by the competent person.			
D. All individuals are protected from cave-ins when entering or exiting the excavation.			
5. Wet Conditions:	Yes	No	N/A
A. Precautions have been taken to protect all individuals from the accumulation of water.			
B. Water removal equipment monitored by a competent person.			
C. Surface water or runoff is diverted or controlled to prevent accumulation in the excavation.			
D. Inspections have been made after every rainstorm or other hazard-increasing occurrence (freeze/thaw, local demolition, rerouting of traffic, etc).			
6. Hazardous Atmosphere: The atmosphere within the excavation must be tested where there is a reasonable possibility of an oxygen deficiency or a combustible or other harmful contaminant exposing any individual to a hazard.	Yes	No	N/A
A. Are there exposed sewer or natural gas lines in excavation?			
B. Is excavation near a landfill area, or are hazardous substances being stored close to the excavation?			
If you answered YES to A or B, then treat the excavation as a confined space. See S3NA-301-PR Confined Spaces			
C. All individuals will contact the Fire/Rescue Group at _____ prior to entry and in case of emergencies.			
7. Support Systems:	Yes	No	N/A
A. Materials and/or equipment for support systems are selected based on soil analysis, trench depth, and expected loads.			

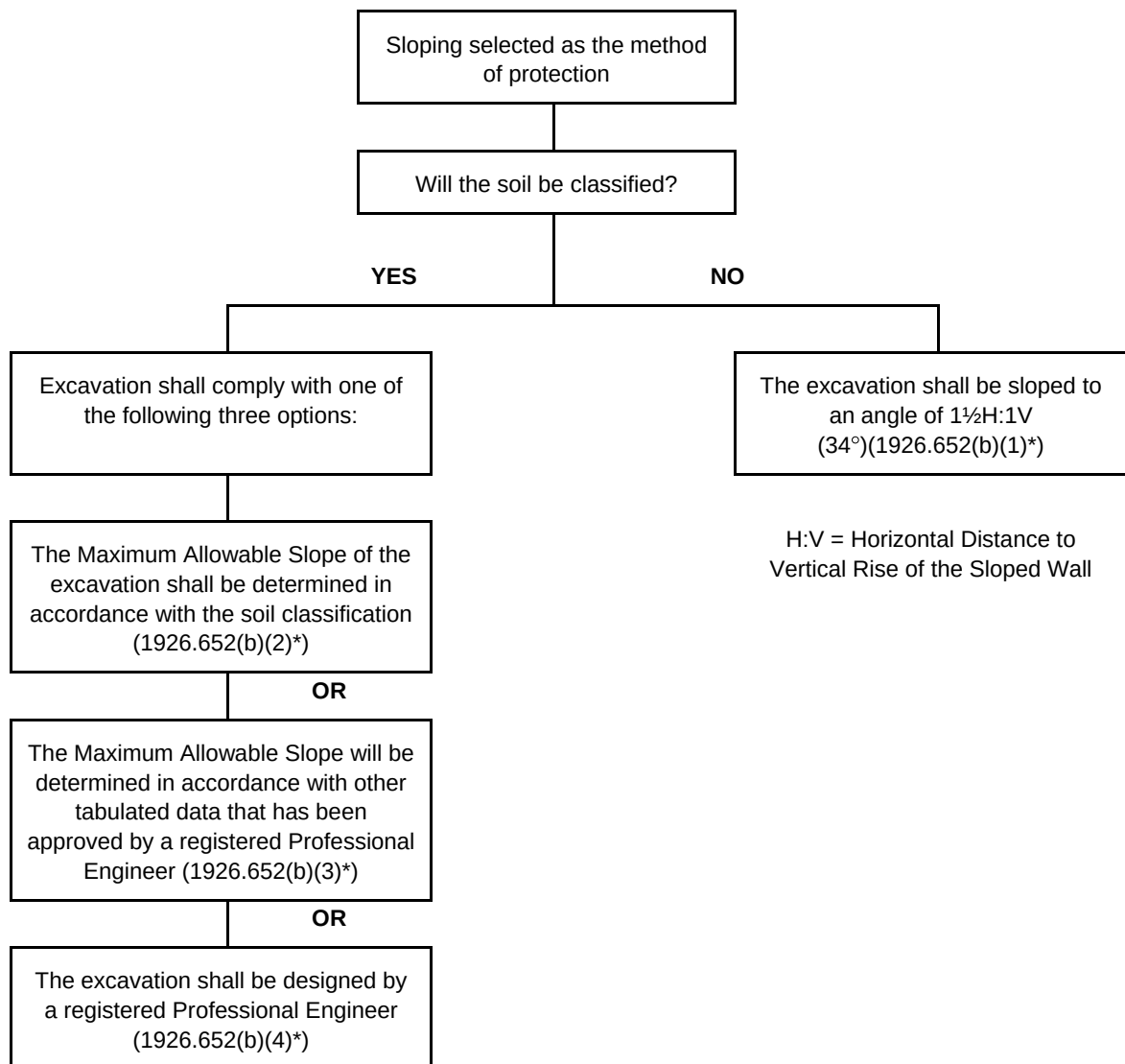
B. Materials and equipment used for protective systems have been inspected and are in good condition.			
C. Materials and equipment not in good condition have been removed from service.			
D. Protective systems installed without exposing all individuals to the hazards of cave-ins, collapses, or the threat of being struck by materials or equipment.			
E. Members of support system are securely fastened to prevent failure.			
F. Support systems are provided to ensure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc.			
G. Excavations below the level of the base of a footing have been approved by a registered Professional Engineer.			
H. Removal of support systems progresses from the bottom, and members are released slowly so that you can note any indication of possible failure.			
I. Backfilling progresses with the removal of the support system.			
J. Material is excavated to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.			
K. A shield system has been placed to prevent lateral movement.			
M. All individuals are prohibited from remaining in the shield system during vertical movement.			
8. Training:	Yes	No	N/A
A. All individuals have had Excavation Safety Awareness Training.			

S3NA-303-WI1 Selection of Protective Systems



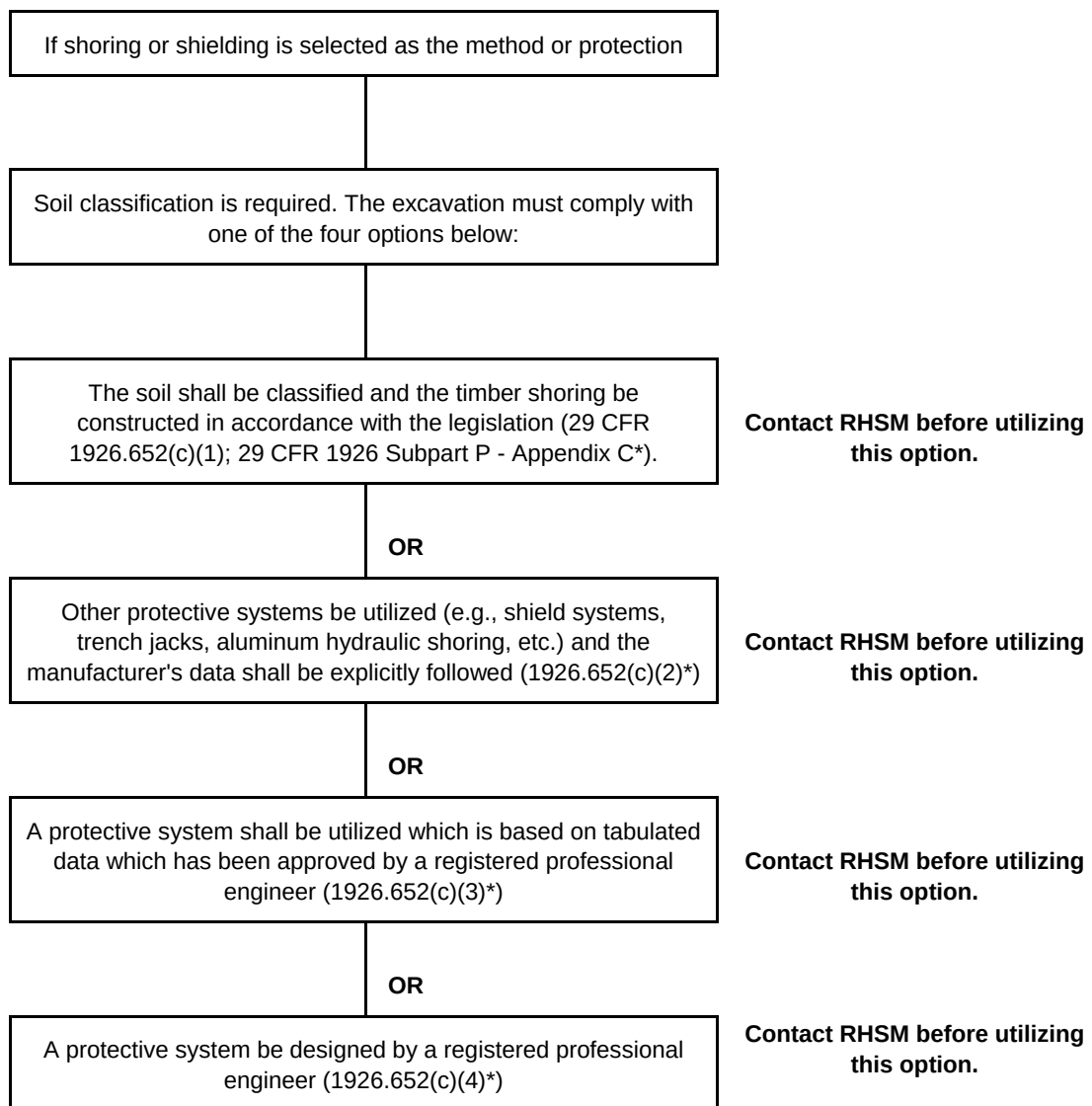
⁽¹⁾ Protective systems for excavations greater than 20 feet in depth must be designed by a registered professional engineer in accordance with 1926.652 (b) and (c) in the United States.

S3NA-303-WI2 Sloping Options



**Please refer to your provincial, territorial, for local requirements.*

S3NA-303-WI3 Shoring or Shielding Options



**Please refer to your provincial, territorial, for local requirements.*

S3NA-303-WI4 Factors Affecting Shoring Methods

Factor	Description
Soil Structure and Strength	Trench walls, at first glance, may appear to have strength, particularly if rock is encountered. Fractures in the rock can develop because of construction and soil strength may fail when subjected to undercutting or high-energy impacts. Irregular slopes on stratified soils that appear stable can fail if lower materials do not have adequate strength.
Soil Moisture Content	Soil may be moist even though the weather has been dry. Care must be taken and shoring provided if the soil appears to be moist.
Weather and Humidity	These can have a significant impact on shoring requirements. Frozen stable soil may collapse if warm mild weather persists. Percolation of water into the soil can increase the load on the shoring due to the increased weight and mobility of saturated soils. Frozen ground does not preclude the need to install shoring unless the freezing process is designed and approved by a Professional Engineer.
Soil Stress	Stress can originate from many sources. Heavy machinery passing close to the shoring creates vibrations that decrease the soil strength and can result in shoring failure. Stationary equipment at the edges of the excavation can transmit loads and additional stresses to the shoring.
Trench Depth and Width	These directly influence the choice of materials and the spacing of support bracing. The shoring requirements of a wide and deep trench differ substantially from those of a narrower trench.
Erosion Time	If excavations are to be left for extended periods, shoring materials may have to be increased.

S3NA-305-PR Hand and Power Tools

1.0 Purpose and Scope

- 1.1 Provides the AECOM requirements for all manually-operated hand and power tools and equipment use, handling and storage.
- 1.2 This procedure applies to all AECOM North America based employees and operations.

2.0 Terms and Definitions

- 2.1 None

3.0 Attachments

- 3.1 S3NA-305-GL Hand and Power Tools Guide
- 3.2 S3NA-305-WI1 Chainsaw Safety Card
- 3.3 S3NA-305-WI2 Circular Saw Safety Card
- 3.4 S3NA-305-WI3 Cut Off Saw Safety Card
- 3.5 S3NA-305-WI4 Hand-held Grinder Safety Card
- 3.6 S3NA-305-WI5 Impact Wrench Safety Card
- 3.7 S3NA-305-WI6 Nail Gun Safety Card
- 3.8 S3NA-305-WI7 Pentak Vacuum Safety Card
- 3.9 S3NA-305-WI8 Power Drill Safety Card
- 3.10 S3NA-305-WI9 Pressure Washer Safety Card
- 3.11 S3NA-305-WI10 Reciprocating Saw Safety Card
- 3.12 S3NA-305-WI11 Sander Safety Card
- 3.13 S3NA-305-WI12 Utility Knife Safety Card
- 3.14 S3NA-305-WI13 Wood Chipper Safety Card
- 3.15 S3NA-305-WI14 Clearing and Grubbing Equipment Safety Card
- 3.16 S3NA-305-WI15 Pneumatic Tools Safety Card
- 3.17 S3NA-305-WI16 Manual Hand Tools Safety Card
- 3.18 S3NA-305-WI17 Small Engines Safety Card
- 3.19 S3NA-305-WI18 Electric and Battery Powered Hand Tools Safety Card

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Project Managers/Field Task Managers/Supervisors.** Each **Manager/Supervisor** must ensure that all aspects of this procedure are followed and adhered to on all AECOM projects, sites and locations. If a specific tool is not included in this work instruction section of this SOP, appropriate guidelines shall be established prior to work associated with that equipment, including following manufacturer's recommendations.
- 4.1.2 **Region SH&E Manager** provides technical guidance and support as to this procedure.
- 4.1.3 **Employees.** **Employees** shall not work with any tool that they are not familiar with without first obtaining training associated with that equipment. In addition, **employees** must following manufacturer's recommendations for its use and must not modify the equipment without first obtaining authorization from the manufacturer.

4.2 **Restrictions**

- 4.2.1 No **employee** shall use any hand tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.
- 4.2.2 All tools will be used in accordance with manufacturer's specifications.

4.3 **Training**

- 4.3.1 Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool.

4.4 **Personal Protective Equipment**

- 4.4.1 Lockout devices (padlocks, multiple lock hasps, tags), gloves appropriate to the task, safety-toed boots, as required, hard hats and eye & face protection, as required.

4.5 **Inspections**

- 4.5.1 All tools must be inspected prior to each use. Any tool that is defective or has missing parts must not be used. Every broken or defective tool must be tagged or identified as such. Tagged tools will be returned to your supervisor for repair or replacement. Tagged tools will be immediately removed from service.
- 4.5.2 All tools must be inspected to manufacture's specifications according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly.

5.0 **Records**

- 5.1 None

6.0 **References**

- 6.1 S3NA-208-PR Personal Protective Equipment Program
- 6.2 S3NA-302-PR Electrical, General
- 6.3 S3NA-305-GL1 Hand and Power Tools
- 6.4 S3NA-410-PR Hazardous Energy Control
- 6.5 S3NA-510-PR Hearing Conservation Program

S3NA-305-GL Hand and Power Tools

1.0 Exposure

- 1.1 Employees who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and splashing objects, or to harmful dusts, fumes, mists, vapors, or gases must be provided with the appropriate personal protective equipment.

2.0 Basic Safety rules

- 2.1 Keep all tools in good condition with regular maintenance.
- 2.2 Use the right tool for the job.
- 2.3 Examine each tool for damage before use and do not use damaged tools.
- 2.4 Operate tools according to the manufacturers' instructions.
- 2.5 Provide and use properly the right personal protective equipment.
- 2.6 All electrical connections for these tools must be suitable for the type of tool and the working conditions (wet, dusty, flammable vapors).
- 2.7 When a temporary power source is used for construction a ground-fault circuit interrupter should be used
- 2.8 Eye protection is required, and head and face protection is recommended for employees working with pneumatic tools.
- 2.9 Screens must also be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.
- 2.10 Compressed air guns should never be pointed toward anyone.
- 2.11 Workers should never "dead-end" them against themselves or anyone else.
- 2.12 A chip guard must be used when compressed air is used for cleaning.
- 2.13 Use of heavy jackhammers can cause fatigue and strains. Heavy rubber grips reduce these effects by providing a secure handhold.
- 2.14 Workers operating a jackhammer must wear safety glasses and safety shoes that protect them against injury if the jackhammer slips or falls. A face shield also should be used.
- 2.15 Noise hazard associated with pneumatic tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

3.0 Hazard Prevention Sharp Objects

- 3.1 Employees, when using saw blades, knives, or other tools, should direct the tools away from aisle areas and away from other employees working in close proximity.
- 3.2 Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones.
- 3.3 Cracked saw blades must be removed from service.
- 3.4 Wrenches must not be used when jaws are sprung to the point that slippage occurs.
- 3.5 Impact tools such as drift pins, wedges, and chisels must be kept free of mushroomed heads.
- 3.6 The wooden handles of tools must not be splintered.
- 3.7 Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

4.0 Hazard Prevention of Power tools

4.1 Precautions

- 4.1.1 Never carry a tool by the cord or hose.
- 4.1.2 Never yank the cord or the hose to disconnect it from the receptacle.
- 4.1.3 Keep cords and hoses away from heat, oil, and sharp edges.
- 4.1.4 Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.
- 4.1.5 Keep all people not involved with the work at a safe distance from the work area.
- 4.1.6 Secure work with clamps or a vise, freeing both hands to operate the tool.
- 4.1.7 Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.
- 4.1.8 Maintain tools with care; keep them sharp and clean for best performance.
- 4.1.9 Follow instructions in the user's manual for lubricating and changing accessories.
- 4.1.10 Be sure to keep good footing and maintain good balance when operating power tools.
- 4.1.11 Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.
- 4.1.12 Remove all damaged portable electric tools from use and tag them: "Do Not Use."

4.2 Guards

- 4.2.1 The exposed moving parts of power tools need to be safeguarded. Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded.
- 4.2.2 Machine guards, as appropriate, must be provided to protect the operator and others from the following:
 - Point of operation.
 - In-running nip points.
 - Rotating parts.
 - Flying chips and sparks.
- 4.2.3 Safety guards must never be removed when a tool is being used. Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards.
- 4.2.4 An upper guard must cover the entire blade of the saw.
- 4.2.5 A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work position.

5.0 Operating Controls and Switches

- 5.1 The following hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released: drills; tappers; fastener drivers; horizontal, vertical, and angle grinders with wheels more than 2 inches (5.08 centimeters) in diameter; disc sanders with discs greater than inches (5.08 centimeters); belt sanders; reciprocating saws; saber saws, scroll saws, and jigsaws with blade shanks greater than 1/4-inch (0.63 centimeters) wide; and other similar tools.
- 5.2 These tools also may be equipped with a "lock-on" control, if it allows the worker to also shut off the control in a single motion using the same finger or fingers.
- 5.3 The following hand-held power tools must be equipped with either a positive "on-off" control switch, a constant pressure switch, or a "lock-on" control:
 - 5.3.1 Disc sanders with discs 2 inches (5.08 centimeters) or less in diameter.
 - 5.3.2 Grinders with wheels 2 inches (5.08 centimeters) or less in diameter.

- 5.3.3 Platen sanders, routers, planers, laminate trimmers, nibblers, shears, and scroll saws; and jigsaws, saber and scroll saws with blade shanks a nominal 1/4-inch (6.35 millimeters) or less in diameter.
- 5.3.4 It is recommended that the constant-pressure control switch be regarded as the preferred device.
- 5.3.5 Other hand-held power tools such as circular saws having a blade diameter greater than 2 inches (5.08 centimeters), chain saws, and percussion tools with no means of holding accessories securely must be equipped with a constant-pressure switch.

6.0 Electrical Shock Caution

- 6.1 Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electricpowered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death.
- 6.2 An electric shock also can cause the user to fall off a ladder or other elevated work surface and be injured due to the fall.
- 6.3 To protect the user from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a lowvoltage isolation transformer.
- 6.4 Three-wire cords contain two currentcarrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground.
- 6.5 The third prong must never be removed from the plug.
- 6.6 Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On doubleinsulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

7.0 Electric Tools General Practice

- 7.1 Operate electric tools within their design limitations.
- 7.2 Use gloves and appropriate safety footwear when using electric tools.
- 7.3 Store electric tools in a dry place when not in use.
- 7.4 Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- 7.5 Keep work areas well lighted when operating electric tools. Ensure that cords from electric tools do not present a tripping hazard.
- 7.6 In the construction industry, employees who use electric tools must be protected by ground-fault circuit interrupters or an assured equipment-grounding conductor program.

8.0 Pneumatic Tools (powered by compressed air)

- 8.1 There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.
- 8.2 Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected.
- 8.3 A short wire or positive locking device attaching the air hose to the tool must also be used and will serve as an added safeguard.
- 8.4 If an air hose is more than 1/2-inch (12.7 millimeters) in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.
- 8.5 In general, the same precautions should be taken with an air hose that are recommended for electric cords, because the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards.
- 8.6 When using pneumatic tools, a safety clip or retainer must be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.

- 8.7 Pneumatic tools that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa), must be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.
- 8.8 Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch (6,890 kPa) must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

9.0 Liquid Fuel Tools (operated with gasoline)

- 9.1 The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.
- 9.2 Before refilling a fuel-powered tool tank, the user must shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors.
- 9.3 When a fuel-powered tool is used inside a closed area, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide.
- 9.4 Noise hazards associated with gasoline engines must be mitigated by proper hearing protection utilization. Ear Plugs, ear muffs or a combination of the two must be used to protect workers from excessive noise levels.
- 9.5 Fire extinguishers must also be available in the area.

10.0 Hydraulic Power Tools (fluid run)

- 10.1 The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.
- 10.2 The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.
- 10.3 All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.
- 10.4 A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.
- 10.5 To set up a jack, make certain of the following:
 - 10.5.1 The base of the jack rests on a firm, level surface;
 - 10.5.2 The jack is correctly centered;
 - 10.5.3 The jack head bears against a level surface; and
 - 10.5.4 The lift force is applied evenly.
- 10.6 Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule:
 - 10.6.1 For jacks used continuously or intermittently at one site—inspected at least once every 6 months;
 - 10.6.2 For jacks sent out of the shop for special work—inspected when sent out and inspected when returned; and
 - 10.6.3 For jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

S3NA-305-WI1 Chainsaw Safety Card

1.0 Objective / Overview

- 1.1 Available in a variety of types and capacities, chainsaws are one of the most powerful, yet dangerous cutting tools available.
- 1.2 Working safely with a chain saw begins with training.
- 1.3 Additional safety measures include proper training, good body mechanics and felling technique, well-maintained equipment, and protective clothing.



2.0 Safe Operating Guidelines

- 2.1 A sharp chainsaw is safer than a dull one. Keep the saw clean, lubricated, and adjusted. Before starting work inspect and test the chain brake, chain catch, throttle lock, handles and guards, all nuts and bolts, spark arrestor, and muffler and air filter. The chain tension should be properly adjusted and the carburetor tuned. Never "drop start" the saw.
- 2.2 A chainsaw is not only dangerous to the operator but to those around him. Keep the saw close to the body. Bend from the knees, not the waist. Improper lifting techniques and poor posture contribute to injuries.

3.0 Potential Hazards

- 3.1 Kickback – Sudden and violent reverse movement of the saw
- 3.2 Hand / arm vibration syndrome
- 3.3 Flying / falling debris
- 3.4 Severe cuts

4.0 Training Requirements

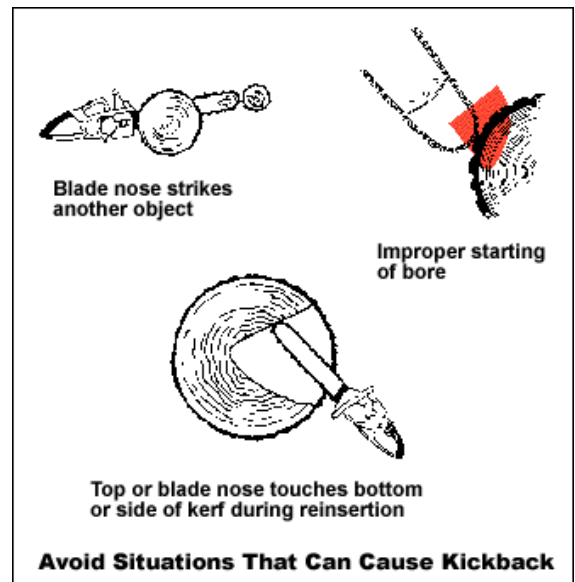
- 4.1 Review of Applicable SOPs
- 4.2 Demonstrated knowledge on the use of a chainsaw
- 4.3 Review of manufacturers operating guidelines

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Debris Shield
- 5.2 Chainsaw Chaps
- 5.3 Leather Gloves
- 5.4 Hearing Protection

6.0 Other Safety Tips

- 6.1 Always avoid standing on the log and making cuts with the saw between your legs; always cut with the saw to the outside of your legs.
- 6.2 Determine where the tree/limb will fall prior to cutting. Always ensure that personnel and equipment are not in the path the falling tree/log, and that you have time to move away. If necessary, flag/or fence off the area to prevent entry.



- 6.3 Always stand to one side of the limb you are to cut, never straddle it.
- 6.4 Always keep in mind where the chain will go if it breaks, never position yourself or other people in line with the chain.
- 6.5 Keep the chain out of the dirt, debris will fly, the teeth will be dulled and the chain life shortened.

S3NA-305-WI2 Circular Saw Safety Card

1.0 Objective / Overview

- 1.1 Among professionals, the circular saw is probably the most commonly used powered saw and perhaps the most commonly abused. Familiarity should not breed carelessness.
- 1.2 Safe measures include proper training, good body mechanics and felling technique, well-maintained equipment, and protective equipment.
- 1.3 The circular saw is used in cutting wood products (i.e., plywood, construction lumber, etc.).



2.0 Safe Operating Guidelines

- 2.1 Use sharp blades. Dull blades cause binding, stalling and possible kickback.
- 2.2 Use the correct blade for the application and check for proper operation before each cut.
- 2.3 Check often to ensure that guards return to their normal position quickly. Never defeat the guard to expose the blade.
- 2.4 Before starting a circular saw, be sure the power cord and extension cords are out of the blade path and are long enough to freely complete the cut. A sudden jerk or pulling on the cord can cause loss of control of the saw and a serious accident.
- 2.5 For maximum control, hold the saw firmly with both hands after securing the work piece.
- 2.6 Check frequently to be sure clamps remain secure.
- 2.7 Avoid cutting small pieces that can't be properly secured and material on which the saw shoe can't properly rest.
- 2.8 When you start the saw, allow the blade to reach full speed before contacting the work piece.

3.0 Potential Hazards

- 3.1 Kickback – Sudden and violent reverse movement of the saw
- 3.2 Hearing loss
- 3.3 Flying debris
- 3.4 Severe cuts

4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Demonstrated knowledge on the use of a circular saw.
- 4.3 Review and follow manufacturer's operating guidelines.



5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Leather Gloves
- 5.2 Hearing Protection

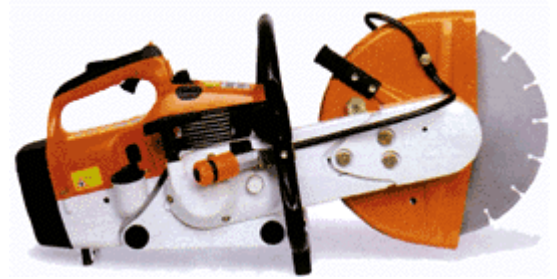
6.0 Other Safety Tips

- 6.1 Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.
- 6.2 Disconnect power supply before adjusting or changing the blade.
- 6.3 Do not place hand under or in front of the shoe or guard of the saw when operating.
- 6.4 Cut at the proper depth ($\frac{1}{4}$ in.) below work surface (see picture).
- 6.5 Circular saw must be double-insulated or protected by a GFCI.

S3NA-305-WI3 Cut Off Saw Safety Card

1.0 Objective / Overview

- 1.1 Cut-off saws are high-speed cutting tools and very dangerous to operate. Therefore, it is very important to review the general safety rules, training, PPE and procedures for working with portable cut off saws.
- 1.2 Cut off saws are used in a variety of activities (i.e. concrete, piping, metal, etc.).



2.0 Safe Operating Guidelines

- 2.1 **Starting** - Start the saw on firm ground or other solid surface in an open area. Never attempt to drop-start the engine. Clear the working area. Avoid operating the saw if the terrain is wet and/or frozen.
- 2.2 **Handling** - Hold the saw firmly with two hands when the engine is running, and *whenever the blade is rotating until it comes to a complete stop*. Carry the saw with engine stopped, muffler away from your body, while protecting the cutting wheel from striking the ground or other objects.
- 2.3 **Cutting** - Begin cutting at full throttle and continue at full throttle until the cut is finished. Avoid standing in a direct line with the cutting wheel. Use only downward pressure on the saw, as lateral pressure may cause the blade to break and shatter. Do not change the direction of the cut once started, as this can also cause the blade to break and shatter. Do not use abrasive-type wheels for rough grinding. Do not cut above shoulder height.
- 2.4 **Maintenance** - Shut off the engine and remove the spark plug wire before adjusting or working on the saw.
- 2.5 Hearing loss
- 2.6 Flying debris
- 2.7 Severe cuts
- 2.8 Burns from engine
- 2.9 Fire Hazard from sparks and gasoline
- 2.10 Hand / arm vibration syndrome

3.0 Potential Hazards

- 3.1 Kickback – Sudden and violent reverse movement of the saw

4.0 Training Requirements

- 4.1 Review of Applicable SOPs
- 4.2 Demonstrated knowledge on the use of a cut off saw
- 4.3 Review and follow manufacturers operating guidelines



302BA058 KN

Never drop-start saw

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Face shield
- 5.2 Chainsaw Chaps
- 5.3 Leather gloves
- 5.4 Hearing protection: earplugs and/or earmuffs

5.5 Respirator if required (concrete operations)

6.0 Other Safety Tips

- 6.1 Keep flammable and combustible materials away from saw while cutting metal.
- 6.2 Make sure the fuel cap is properly secured.
- 6.3 Inspect the abrasive wheel for cracks and chips. If cracked or chip replace wheel before use.
- 6.4 Ensure guard is positioned properly prior to start-up (*S3NA-411-PR Machine Guarding*).
- 6.5 Never try to drop-start the engine (see picture).

S3NA-305-WI4 Hand-Held Grinder Safety Card

1.0 Objective / Overview

- 1.1 Hand held grinders are high-speed electric- or pneumatic-powered grinding tools used to shape or cut metal, and can be dangerous to operate.
- 1.2 Grinders are used in a variety of activities (i.e., piping installation/repair, metal, restoring, polishing, sharpening, etc.).



2.0 Potential Hazards

- 2.1 Kickback – Sudden and violent reverse movement of the grinder.
- 2.2 Flying debris.
- 2.3 Severe cuts.
- 2.4 Fire Hazard from sparks igniting nearby debris or objects.
- 2.5 Hand / arm vibration syndrome.



3.0 Safe Operating Guidelines

- 3.1 Basic safety rules can help prevent hazards associated with the use of hand-held grinders:
 - 3.1.1 Never carry the tool by the cord (or the hose for pneumatic tools).
 - 3.1.2 Never yank the cord or the hose to disconnect the tool from the receptacle.
 - 3.1.3 Keep cords and hoses away from heat, oil, and sharp edges.
 - 3.1.4 Denergize tools when not in use, before servicing, and when changing accessories such as blades/bits/cutters.
 - 3.1.5 All observers should be kept at a safe distance from the work area.
 - 3.1.6 Always secure work with clamps or a vise, freeing both hands to operate the tool.
 - 3.1.7 Avoid accidental starting; do not hold a finger on the trigger/switch while carrying a powered tool.
 - 3.1.8 Tools should be maintained with care. They should be kept clean and sharp for the best performance. Follow instructions in the user's manual for lubricating and care instructions.
 - 3.1.9 Be sure to keep your footing and maintain proper balance.
 - 3.1.10 The proper apparel should be worn. Loose clothing or jewelry can become caught in moving parts.
 - 3.1.11 Inspect the tool before every use. Damaged tools must be removed from use and tagged "DO NOT USE".

4.0 Training Requirements

- 4.1 Review applicable SOPs.
- 4.2 Demonstrated knowledge on the use of a hand-held grinder.
- 4.3 Follow manufacturers operating guidelines, especially for proper grinding wheel attachment.

5.0 Personal Protective Equipment

- 5.1 Leather gloves
- 5.2 Safety glasses with sideshields
- 5.3 Hearing protection: earplugs and/or earmuffs
- 5.4 Other PPE as necessary for the worksite/activity

6.0 Other Safety Tips

- 6.1 Keep flammable and combustible materials away from the grinder.
- 6.2 Have a fire extinguisher on hand while using grinder.
- 6.3 Inspect the abrasive wheel for cracks and chips. If cracked or chipped replace wheel before use.
- 6.4 Ensure safety guard(s) is positioned properly prior to start-up.
- 6.5 Never clamp a hand held grinder in a vice.

S3NA-305-WI5 Impact Wrench Safety Card

1.0 Objective / Overview

- 1.1 Impact wrenches are mainly used for tire changing but that does not limit their use. They can be used in all applications when a certain amount of torque is needed to loosen or tighten nuts and bolts.
- 1.2 The danger comes in to play when employees try to use the wrong sockets with an air wrench. Employees using air wrenches must have a general understanding of how to use them.



2.0 Safe Operating Guidelines

- 2.1 Drain water from air compressor tank and condensation from air lines.
- 2.2 Disconnect the tool from the air supply before lubricating or changing sockets. Impact wrench sockets and accessories must be used with this tool.
- 2.3 Do not use hand sockets and accessories. Select the required impact socket.
- 2.4 Connect tool to air hose of recommended size. The use of a quick connect set makes connecting easier.
- 2.5 Never use a wire, soft pin, or nail to hold the socket onto the square spindle of the impact wrench.
- 2.6 If the proper retaining device on the tool is broken, the tool should be repaired.
- 2.7 On applications where a low or critical level of torque is required, it is recommended that you impact each fastener lightly, and then perform the final tightening with a hand torque wrench.

3.0 Potential Hazards

- 3.1 Flying debris
- 3.2 Hearing loss
- 3.3 Cuts
- 3.4 Hand / arm vibration syndrome

4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Demonstrated knowledge on the use of a electric drill.
- 4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Leather gloves/anti-vibration gloves
- 5.2 Hearing protection

6.0 Other Safety Tips

- 6.1 Be sure no one is below when using the tool in high locations.
- 6.2 The proper fastening torque may differ depending upon the kind or size of the bolt.
- 6.3 Check the torque with a torque wrench.

S3NA-305-WI6 Nail Gun Safety Card

1.0 Objective / Overview

- 1.1 Nail guns are useful tools, but must be handled with care, and have been shown to be the cause of unnecessary injuries when the design of the gun places emphasis on speed, rather than safety.

2.0 Safe Operating Guidelines

- 2.1 Watch out for other crewmembers working near you.
- 2.2 Never let an inexperienced crewmember use a nail gun without supervised training.
- 2.3 Never use bottled gas as a power source for pneumatic tools.
- 2.4 Disconnect a nail gun before you service it.
- 2.5 Hold your hand a good 12 inches back from the ends of studs or joists when you are nailing.
- 2.6 Keep the gun properly aligned with your work both vertically and horizontally.
- 2.7 Never nail with the gun pointed toward you or anyone else on the job.
- 2.8 Never try to nail beyond your reach.

3.0 Potential Hazards

- 3.1 Flying debris/nails
- 3.2 Imbedded object
- 3.3 Puncture wounds

4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Demonstrated knowledge on the use of a coring machine.
- 4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Leather gloves
- 5.2 Hearing protection

6.0 Other Safety Tips

- 6.1 When you are moving about the work area - keep your finger off the trigger until you are ready to fire. Make sure you have only placed the nose guard against the material you are going to nail together.
- 6.2 Never rest the gun against any part of your body, or try to climb a ladder with the gun cradled against your body.
- 6.3 Be aware of what is located behind the nailing surface. Never place hands or other body parts directly behind the nailing surface.
- 6.4 Use only for intended work.
- 6.5 Avoid nailing into knots as nail can splinter wood.
- 6.6 Never disable safety tip on gun.



S3NA-305-WI7 Pentak Vacuum Safety Card

1.0 Objective / Overview

- 1.1 Pentek's dustless decontamination system removes and packages surface contamination from concrete and steel structures.
- 1.2 The Pentek integrated suite of manually operated equipment (e.g., squirrel III, corner cutter, roto-peen, and crack chaser) is designed for the safe removal of radioactive materials, lead-based paints, PCBs, pesticides, chemical residues, and other contaminated coatings.
- 1.3 The Pentek system incorporates a high-performance vacuum and waste packaging unit, the VAC-PAC, in conjunction with pneumatically operated equipment to remove contaminated material. Dust and debris are captured at the cutting tool surface. Supporting equipment required to operate the unit includes a 60 kW generator and an air compressor (minimum 350 ft³ capacity), as well as a drum grappler for drum handling activities.



Worker is using the roto-peen (scabbling) attachment; VAC-PAC collection system shown with 55 gal drum.

2.0 Safe Operating Guidelines

- 2.1 Prior to use, a pre-operation inspection must be completed to determine if the unit is in safe working condition.
- 2.2 The vacuum unit should be placed a minimum of 50 feet away from the work area.
- 2.3 Once in position to begin work, apply the brake to stabilize the unit. When raising the VAC-PAC to insert/remove a drum, do not place your body or any extremity under the VAC-PAC while it is in the raised position.
- 2.4 Two workers should be used to maneuver the unit into place.
- 2.5 A minimum 10 ft clearance will be established around the unit while in operation.
- 2.6 Workers should be aware of their position in relation to the hoses and cable to minimize tripping hazards.
- 2.7 A competent person will train each worker in the operation of the unit.
- 2.8 Maintenance in excess of preventive maintenance activities (e.g., lubrication) will be performed by manufacturer personnel ONLY.

3.0 Potential Hazards

- 3.1 Hazardous noise
- 3.2 Vibration
- 3.3 Tripping hazard from cables and hoses
- 3.4 Hot surfaces (vacuum unit)
- 3.5 Electrical (high voltage)
- 3.6 Pinch hazard
- 3.7 Back strain
- 3.8 High pressure air

4.0 Personal Protective Equipment (Level D ensemble)

- 4.1 Leather gloves (maintenance)

- 4.2 Tyvek suit (with hood)
- 4.3 Vibration gloves (operation)
- 4.4 Hearing protection (plugs or muffs)

5.0 Other Safety Tips

- 5.1 Always know where the emergency stop is located.
- 5.2 Operators of a motorized drum grapppler must be trained IAW the powered industrial truck standard.
- 5.3 Review *S3NA-302-PR Electrical, General* prior to refueling the electrical generator and/or compressor.

S3NA-305-WI8 Power Drill Safety Card

1.0 Objective / Overview

- 1.1 Available in a variety of types and capacities, portable power drills are undoubtedly the most used power tools.
- 1.2 Because of their handiness and application to a wide range of jobs, drills often receive heavy use. For this reason, you'll need to carefully check your drill's capacity limitations and accessory recommendations.

2.0 Safe Operating Guidelines

- 2.1 Check carefully for loose power cord connections and frays or damage to the cord.
- 2.2 Replace damaged tool and extension cords immediately.
- 2.3 Be sure the chuck is tightly secured to the spindle. This is especially important on reversible type drills. Tighten the bit securely as described by the owner / operators manual.
- 2.4 The chuck key must be removed from the chuck before starting the drill.
- 2.5 A flying key can be an injury-inflicting missile.
- 2.6 Check auxiliary handles, if part of the tool. Be sure they are securely installed.
- 2.7 Always use the auxiliary drill handle when provided. It gives you more control of the drill, especially if stalled conditions occur.
- 2.8 Grasp the drill firmly by insulated surfaces.
- 2.9 Always hold or brace the tool securely. Brace against stationary objects for maximum control. If drilling in a clockwise -- forward -- direction, brace the drill to prevent a counter-clockwise reaction.
- 2.10 Don't force a drill. Apply enough pressure to keep the drill bit cutting smoothly. If the drill slows down, relieve the pressure. Forcing the drill can cause the motor to overheat, damage the bit and reduce operator control.

3.0 Potential Hazards

- 3.1 Electrical shock
- 3.2 Leaving chuck wrench in tool
- 3.3 Puncture wounds
- 3.4 Flying debris
- 3.5 Severe cuts
- 3.6 Fire
- 3.7 Burns (hot bits)
- 3.8 Sprains/strains (wrist)



4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Demonstrated knowledge on the use of a power drill.
- 4.3 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather Gloves

6.0 Other Safety Tips

6.1 Electric drills must be double-insulated or plugged into a GFCI outlet.

6.2 Never carry tool by cord or yank it to disconnect from receptacle.

6.3 Keep cord away from sharp edges.

S3NA-305-WI9 Pressure Washer Safety Card

1.0 Objective / Overview

- 1.1 High pressure washers can operate up to pressures of 5,000 psi and come in a variety of types ranging from gas operated to electrical. If not used correctly and safely, pressure washers can be dangerous piece of work equipment.
- 1.2 AECOM only allows trained, authorized personnel to operate the high pressure washers. Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

2.0 Safe Operating Guidelines

- 2.1 The gun valve must always be pointed at the work area, NEVER point the gun valve at yourself or another person.
- 2.2 High pressure washers shall be used to clean or decontaminate equipment, surfaces or structures only.
- 2.3 High pressure washers WILL NOT be used to clean or decontaminate workers or personal protective equipment while it is being worn.
- 2.4 Always set the tripper safety lock when the gun valve is not in use.

3.0 Training Requirements

- 3.1 Review of Applicable SOPs
- 3.2 Demonstrated knowledge on the use of a pressure washer
- 3.3 Review of manufacturers operating guidelines

4.0 Potential Hazards

- 4.1 Kickback – Sudden and violent reverse movement of the gun
- 4.2 Flying debris
- 4.3 Slips and trips on wet surfaces and hoses
- 4.4 Exhaust fumes/carbon monoxide (CO) in enclosed spaces
- 4.5 Severe cuts



5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Hard hat with faceshield
- 5.2 Heavy gloves
- 5.3 Hearing protection
- 5.4 PVC (or equivalent) rain suit

6.0 Other Safety Tips

- 6.1 Never fill a pressure washer fuel tank with fuel while the engine is running or if the engine is still hot.
- 6.2 Non-operators must remain a minimum of 25 feet from the operator.
- 6.3 High pressure washing equipment should be cleaned often to avoid dirt buildup, especially around the trigger and guard area.

- 6.4 Always set the trigger safety lock when the gun valve is not in use.
- 6.5 Relieve the pressure in the system before coupling and uncoupling hoses.
- 6.6 Visually inspect the full length of high pressure discharge hose and inspect other high pressure fluid-handling components for abrasions or cuts, damage caused by exposure to chemicals and for damage caused by kinks in the hose.

S3NA-305-WI10 Reciprocating Saw Safety Card

1.0 Objective / Overview

- 1.1 The versatility of the reciprocating saw, in cutting metal, pipe, wood and other materials have made it a widely used tool.
- 1.2 By design, it is a simple tool to handle. Its demands for safe use, however, are very important.

2.0 Safe Operating Guidelines

- 2.1 Use sharp blades. Dull blades can produce excessive heat, make sawing difficult, result in forcing the tool, and possibly cause an accident.
- 2.2 Position yourself to maintain full control of the tool, and avoid cutting above shoulder height.
- 2.3 To minimize blade flexing and provide a smooth cut, use the shortest blade that will do the job.
- 2.4 The work piece must be clamped securely, and the shoe of the saw held firmly against the work to prevent operator injury and blade breakage.
- 2.5 Maintain firm contact between the saw's shoe and the material being cut.
- 2.6 When making a "blind" cut (you can't see behind what is being cut), be sure that hidden electrical wiring, or water pipes are not in the path of the cut.
- 2.7 If wires are present, they must be disconnected at their power source by a qualified person or avoided, to prevent the possibility of lethal shock or fire.
- 2.8 Water pipes must be drained and capped.
- 2.9 Always hold the tool by the insulated grouping surfaces. When making anything other than a through cut, allow the tool to come to a complete stop before removing the blade from the work piece. This prevents breakage of the blade, and possible loss of tool control.
- 2.10 Different work surfaces demand different blades.

3.0 Potential Hazards

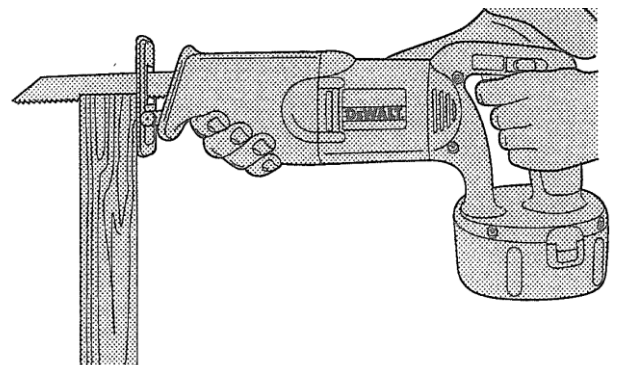
- 3.1 Flying debris
- 3.2 Hearing loss
- 3.3 Cuts
- 3.4 Hand / arm vibration syndrome

4.0 Training Requirements

- 4.1 Review of Applicable SOPs
- 4.2 Demonstrated knowledge on the use of a reciprocating saw
- 4.3 Review and follow manufacturers operating guidelines

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Leather Gloves/anti-vibration gloves
- 5.2 Hearing protection



The correct way to hold the reciprocating saw while operating.

6.0 Other Safety Tips

- 6.1 Do not operate reciprocating saw in explosive atmospheres.
- 6.2 Do not overreach. Keep proper footing and balance at all times.
- 6.3 Do not use tool if switch is not operating correctly.
- 6.4 Check for misalignment or binding of moving parts, breakage or parts and any other condition that may affect the tool's operation.
- 6.5 Always use two hands to operate saw (see picture).

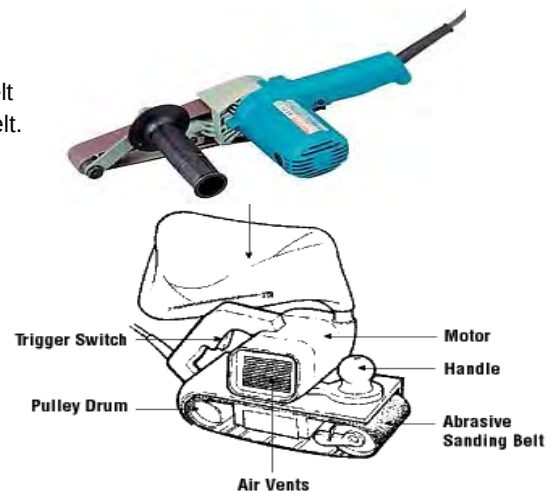
S3NA-305-WI11 Sander Safety Card

1.0 Objective / Overview

- 1.1 Sanders are commonly used at project sites for a variety of tasks.
- 1.2 Often times the hazards associated with sanders are overlooked; they don't appear threatening because they don't have sharp blades or bits. These misconceptions can be prevented through proper training and PPE selection.

2.0 Safe Operating Guidelines

- 2.1 Make sure the sander is switched "OFF" before connecting the power supply. Disconnect power supply before changing a sanding belt, making adjustments, or emptying dust collector. Inspect sanding belts before using them.
- 2.2 Replace those belts that are worn or frayed. Install sanding belts that are the same widths as the pulley drum.
- 2.3 Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.
- 2.4 Secure the sanding belt in the direction shown on the belt and the machine. Keep hands away from the sanding belt.
- 2.5 Use two hands to operate sanders – one on the trigger and the other on the front handle knob.
- 2.6 Clean dust from the motor and vents on a regular basis.
- 2.7 Do not use a sander without an exhaust system or dust collector present that is in good working order.
- 2.8 Empty the collector when $\frac{1}{4}$ full.
- 2.9 Do not exert excessive pressure on a moving sander. The weight of the sander provides adequate pressure for the job.
- 2.10 Do not work on unsecured stock unless it is heavy enough to stay in place.
- 2.11 Do not overreach. Always keep proper footing and balance.
- 2.12 Do not cover air vents of the sander.
- 2.13 Check often to ensure that guards are in their normal position.
- 2.14 Before starting a sander, be sure the power cord and extension cords are out of the belt path and are long enough to freely complete the task. The sander must be either double insulated or connected to a GFCI.



3.0 Potential Hazards

- 3.1 Kickback – Sudden and violent reverse of the sander
- 3.2 Hearing loss
- 3.3 Flying debris
- 3.4 Severe abrasive cuts
- 3.5 Electrocution
- 3.6 Explosion/fire hazard from the dust

4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Review and follow manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Hearing protection
- 5.2 Leather gloves

S3NA-305-WI12 Utility Knife Safety Card

1.0 Objective / Overview

- 1.1 Utility knives serve a variety of purposes at worksites, and can be a useful tool, when used safely and correctly.
- 1.2 Learning proper positioning and correctly using a utility knife will drastically reduce the potential of cut related injuries.

2.0 Safe Operating Guidelines

- 2.1 Always be sure that knives are sharp and not dull. A dull blade will require more force to cut, increasing the likelihood of slipping.
- 2.2 Be sure to blade is seated in the frame of the knife correctly, closed, and fastened together properly.
- 2.3 Always keep body parts away from the cut line, (e.g., fingers), and ensure that the material being cut is on firm ground and not against a body part (e.g. cutting rope against your leg).
- 2.4 Always pull the knife, never push the knife (the blade may break, and momentum could cause the body to come into contact with broken blade).
- 2.5 Always retract the blade when not in use.

3.0 Potential Hazards

- 3.1 Lacerations from direct contact with the blade
- 3.2 Lacerations from blade breaking or shattering
- 3.3 Ergonomics



4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Review of client specific requirements.
- 4.3 Demonstrated knowledge on the safe use of a utility knives.
- 4.4 Review and follow manufacturers operating guidelines for specialized or unusual knives.

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Cut resistant gloves (Kevlar, thick leather, etc.).

6.0 Other Safety Tips

- 6.1 Purchase safety equipped utility knives with guarding or automatically retracting blades.
- 6.2 Replace dull blades – When knife begins to tear rather than cut, it is a good indicator the blade is dull.
- 6.3 Always wear a cut resistant glove on your free hand.
- 6.4 Always use the right tool for the job – NEVER use the blade as a screwdriver or prying tool.
- 6.5 When using a knife to cut thicker materials, use several passes. Increased force on the blade can cause it to stray from the intended cut path, or break the blade.
- 6.6 When changing blades, always handle from the non-sharp side. Cover blade with duct tape and dispose.
- 6.7 Use an alternate tool when possible (scissors, wire cutters, etc.).



S3NA-305-WI13 Wood Chipper Safety Card

1.0 Objective / Overview

- 1.1 Wood chippers should be used with extreme caution in order to prevent personal injury, as the wood chipper is open to receive tree branches and other wooden material.
- 1.2 AECOM only allows trained, authorized personnel to operate the wood chipper.
- 1.3 Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

2.0 Safe Operating Guidelines

- 2.1 The operator must be completely familiar with the controls and proper use of the equipment.
- 2.2 Workers feeding material into self-feeding wood chippers are at risk of being fed through the chipper if they reach or fall into the infeed hopper or become entangled in braches feeding into the machine.
- 2.3 Prior to use, make sure all safety devices and controls, such as emergency shut-off devices, are tested and verified to be functioning properly.
- 2.4 Make sure two workers (buddy system) are in close contact with each other when operating the chipper.

3.0 Potential Hazards

- 3.1 Burns from contact with the hot muffler or engine
- 3.2 Flying debris
- 3.3 Noise exposure
- 3.4 Inhaling exhaust fumes
- 3.5 Entanglement in limbs and contact with chipper blades



4.0 Training Requirements

- 4.1 Review of Applicable SOPs.
- 4.2 Demonstrated knowledge on the use of a wood chipper.
- 4.3 Review of manufacturers operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Leather gloves
- 5.2 Hearing protection
- 5.3 Debris shield
- 5.4 Long sleeve shirt (e.g. working near poison ivy, poison oak, etc.)

6.0 Other Safety Tips

- 6.1 Stand to the side of the chipper while inserting limbs into chipper, never stand directly in front.
- 6.2 Insert trunk portion of tree/limb first. This will prevent the branches from getting entangled with clothing, etc. and pulling you in with the tree/limb.

- 6.3 Bystanders should be kept at least 25 feet away when in operation.
- 6.4 Keep the area around the wood chipper free of tripping hazards.
- 6.5 Never wear loose clothing that may get caught on feed material or moving parts.
- 6.6 Always set the trigger safety lock when the gun valve is not in use.
- 6.7 Never fill the fuel tank while the engine is running or if the engine is still hot.

S3NA-305-WI14 Clearing and Grubbing Equipment Safety Card

In accordance with 29 CFR 1910.266, the following safety precautions will be followed during site clearing and tree felling:

1.0 Hand Tools

- 1.1 All hand tools shall be in safe condition. Tools shall be inspected by the user daily.
- 1.2 Handles shall be sound, straight and tight-fitting.
- 1.3 Driven tools shall be dressed to remove any mushrooming.
- 1.4 Cutting tools shall be kept sharp and properly shaped.
- 1.5 All clearing activities shall terminate during electrical storms and periods of high winds.
- 1.6 Dead, broken or rotted limbs or trees (widow makers) shall be felled first.
- 1.7 Always wear the appropriate Personal Protective Equipment (PPE) when using hand tools, particularly eye and hand protection.
- 1.8 Use the right tool that is being used for the job to reduce chance of unexpected occurrences. Do not submit or use makeshift tools.
- 1.9 Defective tools shall not be used. They shall be taken out of service until repaired or replaced.
- 1.10 Check tools for damage or wear prior to each use to reduce chance of unexpected occurrences.
- 1.11 Replace cracked or broken handles on files, hammers, screwdrivers, or sledges.
- 1.12 Replace worn jaws on wrenches, pipe tools, and pliers
- 1.13 Redress burred or mushroomed heads on striking tools.
- 1.14 Sharpen cutting tools frequently to reduce chance of unexpected occurrences.
- 1.15 Store hand tools properly after each use.
- 1.16 Tools shall be clean and dry to avoid slippage when in use.
- 1.17 Never leave tools on ladders, scaffolds, or overhead work areas when they are not in use (a high number of injuries occur from objects/tools falling from overhead work areas in construction).
- 1.18 Always keep tools being used in overhead work areas in containers that will prevent them from falling.
- 1.19 Carry tools using a heavy belt or apron and hang tools at your sides.
- 1.20 Never carry tools in your pockets or hanging behind your back.
- 1.21 Avoid muscle strain and fatigue by doing the following:
 - Avoid using hand tools with your wrist bent.
 - Choose tools that allow you to keep your wrist straight when using them.
 - Always PULL on wrenches and pliers. Never push unless you hold the tool with your palm open.
 - Always cut away from yourself when using cutting tools.
- 1.22 Establish balance and stable footing when using a bar for prying. Pry bars can slip or break without warning.
- 1.23 Be aware of the presence of other personnel when using any tool, especially picks or axes.

2.0 Machete Use

- 2.1 A machete will only be used for its designated purpose; do not carelessly swing the machete when it is not needed.
- 2.2 To prevent lacerations, employees will wear Kevlar gloves and Kevlar chain saw chaps.

- 2.3 Machetes shall not be used when other employees are in the immediate work area.

3.0 Use of Weed Whips

- 3.1 Weed whips may be used to clear vegetation such as grass, light brush, briars and tree seedlings. The L-shaped weed whip cuts grass and weeds but is unstable for use on larger growth; the triangular-frame weed whip cuts briars and woody stems up to a half-inch in diameter. A "Suwannee" sling is a heavy duty weed whip that also has an axe blade. It does the same work as a weed whip, but can also cut through large materials. The heavier weight of this tool allows it to more easily cut off larger material than a weed whip.
- 3.2 When using weed whips, employees should follow these safety procedures:
- 3.2.1 Select the correct tool for the types and size of vegetation present across the landfill.
- 3.2.2 Employees will wear leather gloves when using weed whips.
- 3.2.3 Weed whips are meant to be swung back and forth with both hands. Avoid using a golf swing. The tool should be swung no higher than an employee's side.
- 3.2.4 Strong swings should be made to prevent the blade from bouncing or glancing off springy growth.
- 3.2.5 Screws hold the serrated double-edge blade in place. These screws can work loose so check them before each use.
- 3.2.6 At the end of the day, inspect the whips for damage. Clean, sharpen, and oil as necessary and store with a sheath in place.

4.0 Chain Saws

- 4.1 Hand Protection (leather gloves)
- 4.2 Eye Protection
- 4.3 Hearing Protection
- 4.4 Long sleeves and pants; no loose clothing
- 4.5 Chaps (full protection) or pants with full front protection as well as all around protection below the knee
- 4.6 As per manufacturer's instructions
- 4.7 The chainsaw shall:
- 4.7.1 Be in safe operating condition;
- 4.7.2 Have a chain that minimizes the possibility of a kickback; and
- 4.7.3 Have a device which will effectively stop the chain in the event of a kickback or when the engine is at idle.
- 4.8 Operate the chainsaw in accordance with manufacturer's instructions.
- 4.9 Hold the chainsaw firmly with two hands during operation.
- 4.10 Hold the chainsaw firmly when starting.
- 4.11 Have the chain stopped when not actually cutting.
- 4.12 Be sure that the chain brake is functioning properly and adequately stops the chain.
- 4.13 Check that the chain is sharp, has the correct tension and is adequately lubricated.
- 4.14 Start, hold, carry or store and use of the saw as directed by the manufacturer.
- 4.15 Do not use the chain saw for cutting above shoulder height.
- 4.16 Add fuel in a well-ventilated area and not while the saw is running or hot.
- 4.17 Use an approved safety container to contain the fuel used along with a proper spout or funnel for pouring.

- 4.18 Carry and transport the chain saw with the bar guard in place, the chain bar toward the back and the motor shut off.
- 4.19 Chain saws shall be inspected daily to assure that all handles and guards are in place and tight, that all controls function properly and that the muffler is operative.
- 4.20 Start the saw only on the ground or when otherwise firmly supported.
- 4.21 Clear brush which might interfere with clear footing before starting to cut.
- 4.22 Shut off the saw when carrying it for a distance greater than from tree to tree or when surface is slippery or heavy with underbrush. The saw shall be at idle speed when carried short distances.
- 4.23 Do not use the saw to cut directly overhead or a distance at which the operator no longer has a safe grip on the saw. Always use two hands to operate the saw.
- 4.24 Safety glasses with permanently attached side shields will be worn underneath a steel mesh face shield which will attach to standard hard hats. The brush shield is designed to protect the head and face from debris created by using a chain saw. Employees will wear Kevlar gloves and Kevlar chain saw chaps. Appropriate ear protection shall also be worn.

5.0 Felling Trees Manually

- 5.1 Before cutting begins, survey the work area for dead limbs, the lean of the tree to be cut, wind conditions and the location of other trees.
- 5.2 Remove lodged trees (tree has not fallen to the ground after being separated from its stump) as soon as possible. Never work under a lodged tree.
- 5.3 The distance between workers should be maintained at twice the height of the trees being felled.

6.0 Chipping Operations

- 6.1 Access covers and doors shall not be opened until the drum or disk is at a complete stop.
- 6.2 Infeed and discharge ports shall be designed to prevent employee contact with disc, knives and blower blades.

7.0 Cutting Tools

- 7.1 Wear safety glasses and protective gloves when using cutters.
- 7.2 Choose the proper cutter for the job. Cutters are designed for a specific type, hardness, and size of material.
- 7.3 Inspect the tool for proper working condition.
- 7.4 If tool is designed to have a guard, make sure guards are in place.
- 7.5 Cut materials straight across - keep the material being cut at right angles to the cutting edges of jaws.
- 7.6 Warn those in the area to take precautionary measures to avoid possible injury from flying metal pieces.
- 7.7 Keep cutting tools in good repair.
- 7.8 Adjust and lubricate cutter and moving parts daily if heavily used.
- 7.9 Sharpen jaws according to manufacturer's instructions.
- 7.10 Do not use a cutting tool until you are trained in its proper and safe use.
- 7.11 Do not use cushion grip handles for jobs requiring electrically-insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.
- 7.12 Do not use cutters which are cracked, broken or loose.
- 7.13 Do not exceed the recommended capacity of a tool.
- 7.14 Do not cut diagonally.
- 7.15 Do not rock cutters from side to side when cutting wire.

- 7.16 Do not pry or twist with tool when cutting.
- 7.17 Do not hammer on cutting tools or extend the handle length to achieve greater cutting power.
- 7.18 Do not expose cutters to excessive heat.

8.0 Selection and Use

- 8.1 Select tools that can be used without bending the wrist. Hand tools should allow the operator to grasp, hold, and use the tool with the wrist held straight.
- 8.2 Select the tool with the workplace layout and job design in mind. Sometimes a tool is correct for one operation and incorrect for another.
- 8.3 Use the right tool for the job. Confirm it is the right size and has sufficient power to do the job safely. When there is a choice, select a tool of a low weight.
- 8.4 Select low-vibrating tools, or choose tools with vibration-absorbing handles, like those covered with cork, rubber, plastic or plastic bonded to steel, to reduce hand-arm vibration.
- 8.5 Choose hand tools that have the center of gravity within or close to the handle.
- 8.6 Select tools with rounded and smooth handles that you can grip easily.
- 8.7 If they are available, choose hand tools with double handles to permit easier holding and better manipulation of the tool.
- 8.8 Select tools with a trigger strip, rather than a trigger button. This strip will allow you to exert more force over a greater area of the hand that, in turn, will reduce muscle fatigue.
- 8.9 Confirm that the trigger works easily to reduce the effort needed to operate it.
- 8.10 Confirm that your tool is well maintained and in good repair.
- 8.11 Frequently used tools that weigh more than 1 pound should be counter-balanced.
- 8.12 Hold the tool close to the body. Do not overreach.
- 8.13 Keep good balance and proper footing at all times. This will help operators to control the tool better, especially in response to unexpected situations.
- 8.14 Rest your hands by putting the tool down when you are not using it.
- 8.15 Reduce power to the lowest setting that can complete the job safely. This action reduces tool vibration at the source.
- 8.16 Confirm that cutting tools, drill bits, etc., are kept sharp, clean, and well maintained.
- 8.17 Do not wear gloves, loose clothing or jewelry while using revolving power tools. Tie back long hair or wear appropriate hair protection to prevent hair from getting caught in moving parts of equipment (manufacturer's operating manual for recommended PPE and/or safety issues/concerns).
- 8.18 Do not use a tool unless you have been trained to use it safely and know its limitations and hazards.

9.0 Storage and Handling

- 9.1 All tools shall be stored in a manner to prevent damage and injury. Store tools in a dry, secure location when they are not being used.
- 9.2 Tools shall be properly put away after each use.
- 9.3 Sharp or pointed tools shall be handled only if the sharp/pointed edge is covered, carried in a tool box or other device designed for that purpose, or the sharp/pointed edge is pointed downward, away from the body.

S3NA-305-WI15 Pneumatic Tools Safety Card

1.0 General Requirements

- 1.1 Wear safety glasses.
- 1.2 Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.
- 1.3 Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.
- 1.4 Use only the attachments that the manufacturer recommends for the tools you are using.
- 1.5 Be careful to prevent hands, feet, or body from injury in case the machine slips or the tool breaks.
- 1.6 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible.
- 1.7 Use the proper hose and fittings of the correct diameter.
- 1.8 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.
- 1.9 Choose air-supply hoses that have a minimum working pressure rating of 150 psig or 150% of the maximum pressure produced in the system, whichever is higher.
- 1.10 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.
- 1.11 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.
- 1.12 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).
- 1.13 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.
- 1.14 Do not operate the tool at a pressure above the manufacturer's rating.
- 1.15 Turn off the air pressure to the hose when not in use or when changing power tools.
- 1.16 Do not carry a pneumatic tool by its hose.
- 1.17 Avoid creating trip hazards caused by hoses laid across walkways or curled underfoot.
- 1.18 Do not use compressed air to blow debris or to clean dirt from clothes.

2.0 Pneumatic Nailing and Stapling Tools

- 2.1 Permit only experienced and trained persons to operate pneumatic nailing and stapling tools.
- 2.2 Wear safety glasses or face a shield and, where necessary, use hearing protection.
- 2.3 Inspect a tool before connecting it to air supply:
 - 2.3.1 Check tool safety mechanisms if applicable.
 - 2.3.2 Tighten securely all screws and cylinder caps.
- 2.4 Check correct air supply and pressure before connecting a tool.
- 2.5 Check that the tool is correctly and securely connected to the air supply hose and that it is in good working order, with the safety mechanism operative, before using.
- 2.6 Always handle a tool as if it loaded with fasteners (nails, staples, etc.).
- 2.7 Equip tools with a work-contacting element that limits the contact area to one that is as small as practical.
- 2.8 Make sure that the mechanical linkage between the work-contacting element and trigger is enclosed.

- 2.9 Disconnect a tool from the air supply when the tool is unattended and during cleaning or adjustment. Before clearing a blockage, be sure that depressing the trigger exhausts all air from the tool.
- 2.10 Use only fasteners recommended by the manufacturer.
- 2.11 Permit only properly trained people to carry out tool maintenance.
- 2.12 Do not depress the trigger unless the nosepiece of tool is directed onto a safe work surface.
- 2.13 Do not carry a tool with the trigger depressed.
- 2.14 Do not load a tool with fasteners while the trigger is depressed.
- 2.15 Do not overreach. Keep proper footing and balance.

S3NA-305-WI16 Manual Hand Tools Safety Card

1.0 Hammers

- 1.1 Hammers are designed according to the intended purpose. Select a hammer that is comfortable for you and that is the proper size and weight for the job. Misuse can cause the striking face to chip, possibly causing a serious injury.
- 1.2 Choose a hammer with a striking face diameter approximately ½ inch larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).
- 1.3 Ensure that the head of the hammer is firmly attached to the handle.
- 1.4 Replace loose, cracked or splintered handles.
- 1.5 Discard any hammer with mushroomed or chipped face or with cracks in the claw or eye sections.
- 1.6 Strike a hammer blow squarely with the striking face parallel to the surface being struck. Always avoid glancing blows and over and under strikes. (Hammers with beveled faces are less likely to chip or spall).
- 1.7 Look behind and above you before swinging the hammer.
- 1.8 Watch the object you are hitting.
- 1.9 Hold the hammer with your wrist straight and your hand firmly wrapped around the handle.
- 1.10 Do not use a hammer with a loose or damaged handle.
- 1.11 Do not use handles that are rough, cracked, broken, splintered, sharp-edged or loosely attached to the head.
- 1.12 Do not use any hammer head with dents, cracks, chips, mushrooming, or excessive wear.
- 1.13 Do not use a hammer for any purpose for which it was not designed or intended.
- 1.14 Do not use one hammer to strike another hammer, other hard metal objects, stones or concrete.
- 1.15 Do not redress, grind, weld or reheat-treat a hammer head.
- 1.16 Do not strike with the side or cheek of the hammer.
- 1.17 Inspect pipe wrenches periodically for worn or unsafe parts and replace them (e.g., check for worn threads on the adjustment ring and movable jaw).
- 1.18 Keep pipe wrench teeth clean and sharp.
- 1.19 Face a pipe wrench forward. Turn wrench so pressure is against heel jaw.
- 1.20 Pull, rather than push on the pipe wrench handle. Maintain a proper stance with feet firmly placed to hold your balance.
- 1.21 Do not use a pipe wrench as a hammer, or strike a pipe wrench with a hammer.
- 1.22 Do not use pipe wrenches on nuts and bolts.
- 1.23 Do not use a pipe extender for extra leverage. Get a larger pipe wrench.
- 1.24 Replace pipe cutter wheels which are nicked or otherwise damaged.
- 1.25 Use a 3- or 4-wheeled cutter, if there is not enough space to swing the single wheel pipe cutter completely around the pipe.
- 1.26 Choose a cutting wheel suitable for cutting the type of pipe material required:
 - 1.26.1 Thin wheel for cutting ordinary steel pipe.
 - 1.26.2 Stout wheel for cutting cast iron.
 - 1.26.3 Other wheels for cutting stainless steel, plastic and other materials.

- 1.27 Select the proper hole diameter and correct tap size to tap a hole. The hole should be sized so that the thread cut by the tap will be about 75% as deep as the thread on the tap.
- 1.28 Use a proper tap wrench (with a "T" handle) for turning a tap.
- 1.29 Use lubricant or machine cutting fluid with metals other than cast iron.
- 1.30 Do not permit chips to clog flutes (grooves in the tap that allow metal chips to escape from the hole). The chips may prevent the tap from turning – this may result in the tap breaking if you continue to apply pressure.
- 1.31 Do not use a conventional adjustable wrench for turning a tap – it will cause uneven pressure on the tap that may cause it to break.
- 1.32 Do not attempt to thread hardened steel. This can chip or damage the die.
- 1.33 Do not thread any rod or other cylindrical object that is larger in diameter than the major diameter of the die thread.
- 1.34 Do not use a spiral reamer on a rotating pipe. The reamer may snag and cause serious injury.

2.0 Pliers and Wire Cutters

- 2.1 Pliers are made in various shapes and sizes and for many uses. Use the correct pliers or wire cutters for the job.
- 2.2 Choose pliers or wire cutters that have a grip span of 2½ – 3½ inches to prevent your palm or fingers from being pinched when the tools are closed.
- 2.3 Use adjustable pliers that allow you to grip the work piece firmly while maintaining a comfortable handgrip (i.e., hand grasp is not too wide).
- 2.4 Use tools only if they are in good condition.
- 2.5 Make sure that the cutting edges are sharp. Dull and worn-down cutting edges require many times more force for cutting.
- 2.6 Make sure that the toothed jaws are clean and sharp. Greasy or worn-down jaws can result in compromised safety. Such tools also require increased force to hold the work piece which, in turn, increases the risk of muscular fatigue and repetitive strain injuries.
- 2.7 Oil pliers and wire cutters regularly. A drop of oil on the hinge will make the tools easier to use.
- 2.8 Pull on the pliers; do not push away from you when applying pressure. If the tool slips unexpectedly, you may lose your balance or injure your hand.
- 2.9 Cut at right angles. Never rock the cutting tool from side to side or bend wire back and forth against the cutting edges.
- 2.10 Do not cut hardened wire unless the pliers or wire cutters are specifically manufactured for this purpose.
- 2.11 Do not expose pliers or wire cutters to excessive heat.
- 2.12 Do not bend stiff wire with light pliers. Needle-nose pliers can be damaged by using the tips to bend large wire. Use a sturdier tool.
- 2.13 Do not use pliers as a hammer.
- 2.14 Do not hammer on pliers or wire cutters to cut wires or bolts.
- 2.15 Do not extend the length of handles to gain greater leverage. Use a larger pair of pliers for gripping or a bolt cutter for cutting.
- 2.16 Do not use cushion grip handles for jobs requiring tools with electrically-insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.
- 2.17 Do not use pliers on nuts and bolts; use a wrench.

3.0 Screwdrivers

- 3.1 Screwdrivers are made in various shapes and sizes and for many uses. Use the correct screwdriver for the job.
- 3.2 Choose contoured handles that fit the shank tightly, with a flange to keep the hand from slipping off the tool.
- 3.3 Use a slot screwdriver with a blade tip width that is the same as the width of the slotted screw head.
- 3.4 For cross-head screws, use the correct size and type of screwdriver; a Phillips screwdriver may slip out of a screw head designed for use with the slightly flatter-tipped Pozi-driv screwdriver.
- 3.5 Use a vise or clamp to hold the stock if the piece is small or moves easily.
- 3.6 Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.
- 3.7 If work must be carried out on "live" electrical equipment, use screwdrivers that have insulated handles designed for electrical work and a non-conducting shaft. Remember, most plastic handles are designed for grip and comfort.
- 3.8 Use non-magnetic tools when working near strong magnets (e.g., in some laboratories).
- 3.9 Use a screw-holding screwdriver (with screw-holding clips or magnetic blades) to get screws started in awkward, hard-to-reach areas. Square-tipped screwdrivers (e.g., Robertson) that hold screws with recessed square holes are also useful in such situations.
- 3.10 Use an offset screwdriver in close quarters where a conventional screwdriver cannot be used.
- 3.11 Use a screwdriver that incorporates the following features when continuous work is needed:
 - 3.11.1 A pistol grip to provide for a straighter wrist and better leverage.
 - 3.11.2 A "Yankee drill" mechanism (spiral ratchet screwdriver or push screwdriver) which rotates the blade when the tool is pushed forward.
 - 3.11.3 A ratchet device to drive hard-to-move screws efficiently, or use a powered screwdriver.
- 3.12 File a rounded tip square making sure the edges are straight. A dull or rounded tip can slip out of the slot and cause hand injury or damage to materials.
- 3.13 Store screwdrivers in a rack or partitioned pouch so that the proper screwdriver can be selected quickly.
- 3.14 Do not lean or push on a screwdriver with any more force than necessary to keep contact with the screw. A screw properly piloted and fitted will draw itself into the right position when turned. Keep the shank directly over the screw being driven.
- 3.15 Do not hold the stock in one hand while using the screwdriver with the other. If the screwdriver slips out of the slot you may cut your hand.
- 3.16 Do not hammer screws that cannot be turned.
- 3.17 Do not grind the tip to fit another size screw head.
- 3.18 Do not try to use screwdrivers on screw heads for which they are not designed (e.g., straight blade screwdrivers on Phillips, clutch head, Torx or multi-fluted spline screw heads).
- 3.19 Do not use defective screwdrivers (e.g., ones with rounded or damaged edges or tips; split or broken handles; or bent shafts).
- 3.20 Do not use a screwdriver for prying, punching, chiseling, scoring, scraping or stirring paint.
- 3.21 Do not use pliers on the handle of a screwdriver for extra turning power. A wrench should be used only on the square screwdriver shank designed for that purpose.
- 3.22 Do not expose a screwdriver blade to excessive heat. Heat can affect the temper of the metal and weaken the tool.
- 3.23 Do not use a screwdriver to check if an electrical circuit is live. Use a suitable meter or other circuit testing device.
- 3.24 Do not carry screwdrivers in your pockets.

4.0 Snips

- 4.1 Wear safety glasses and protective gloves when working with snips. Small pieces of metal may go flying in the air and cut edges of metal are sharp.
- 4.2 Snips are made in various shapes and sizes for various tasks. The handle can be like those on scissors with finger and thumb holes or like plier handles. Models are available for cutting in straight lines and in curves to the left or right.
- 4.3 Universal snips can cut in both straight and wide curves.
- 4.4 Straight snips and duckbill snips (flat blade, "perpendicular" to the handle, with pointed tips) are generally designed to cut in straight lines; some duckbill snips are designed for cutting curved lines.
- 4.5 Hawk's bill snips (with crescent-shaped jaws) are used for cutting tight circles.
- 4.6 Aviation snips have compound leverage that reduces the effort required for cutting.
- 4.7 Offset snips have jaws that are set at an angle from the handle.
- 4.8 Select the right size and type of snips for the job; check the manufacturer's specifications about the intended use of the snips (e.g., type of cut - straight, wide curve, tight curve, right or left, and maximum thickness and kind of metal or other material that can be cut).
- 4.9 Use only snips that are sharp and in good condition.
- 4.10 Use snips for cutting soft metal only. Hard or hardened metal should be cut with tools designed for that purpose.
- 4.11 Use ordinary hand pressure for cutting. If extra force is needed, use a larger tool.
- 4.12 Cut so that the waste is on the right if you are right-handed or on the left if you are left-handed.
- 4.13 Avoid springing the blades. This results from trying to cut metal that is too thick or heavy for the snips you are using.
- 4.14 Keep the nut and the pivot bolt properly adjusted at all times.
- 4.15 Oil the pivot bolt on the snips occasionally.
- 4.16 Do not try to cut sharp curves with straight cut snips.
- 4.17 Do not cut sheet metal thicker than the manufacturer's recommended upper limit (e.g., cuts up to 16-gauge cold, rolled steel or 18-gauge stainless steel). Do not extend the length of handles to gain greater leverage.
- 4.18 Do not hammer or use your foot to exert extra pressure on the cutting edges.
- 4.19 Do not use cushion grip handles for tasks requiring insulated handles. They are for comfort primarily and not for protection against electric shocks.
- 4.20 Do not attempt to re-sharpen snips in a sharpening device designed for scissors, garden tools, or cutlery.

5.0 Wood Chisels

- 5.1 Wear safety glasses.
- 5.2 Wood chisels are made in various shapes and sizes and for many uses. Use the correct chisel for the job.
- 5.3 Use the right size of chisel for the job.
- 5.4 Choose smooth, rectangular handles that have no sharp edges and are attached firmly to the chisel.
- 5.5 Ensure that the cutting edge is sharp. Dull chisels can be difficult to control and require more effort to do the job.
- 5.6 Check stock thoroughly for knots, staples, nails, screws, or other foreign objects before chiseling.
- 5.7 Clamp stock so it cannot move.

- 5.8 Adjust your stance so that you do not lose your balance if the tool slips.
- 5.9 Chip or cut away from yourself.
- 5.10 Keep your hands and body behind the cutting edge.
- 5.11 Use a wooden or plastic mallet with a large striking face on all chisels. Only heavy-duty or framing chisels are made of a solid or molded handle that can be struck with a steel hammer.
- 5.12 Make finishing or paring cuts with hand pressure alone.
- 5.13 Place chisels safely within the plastic protective caps to cover cutting edges when not in use.
- 5.14 Replace any chisel that is bent or shows dents, cracks, chips, or excessive wear.
- 5.15 Store chisels in a "storage roll," a cloth or plastic bag with slots for each chisel, and keep them in a drawer or tray.
- 5.16 Replace broken or splintered handles.
- 5.17 Sharpen cutting edges as often as necessary.
- 5.18 Do not use a wood chisel as a pry or a wedge.
- 5.19 Do not use a wood chisel on metal.
- 5.20 Do not use an all-steel chisel with a mushroomed face or a chipped edge. Redress with a file or whetstone.
- 5.21 Do not use a grinder to redress heat-treated tools. Use a whetstone.
- 5.22 Do not use a dull chisel.

6.0 Wrenches

- 6.1 Use the correct wrench for the job - pipe wrenches for pipes and plumbing fittings, and general-use wrenches for nuts and bolts.
- 6.2 Discard any damaged wrenches (e.g., open-ended wrenches with spread jaws or box wrenches with broken or damaged points).
- 6.3 Select the correct jaw size to avoid slippage.
- 6.4 Position your body in a way that will prevent you from losing balance and hurting yourself if the wrench slips or something (e.g., a bolt) suddenly breaks.
- 6.5 Use a box or socket wrench with a straight handle, rather than an off-set handle, when possible.
- 6.6 Ensure that the jaw of an open-ended wrench is in full contact (fully seated, "flat," not tilted) with the nut or bolt before applying pressure.
- 6.7 Face an adjustable wrench "forward," adjust tightly and turn the wrench so pressure is against the permanent or fixed jaw.
- 6.8 Ensure that the teeth of a pipe wrench are sharp and free of oil and debris and that the pipe or fitting is clean to prevent unexpected slippage and possible injuries.
- 6.9 Apply a small amount of pressure to a ratchet wrench initially to ensure that the ratchet wheel (or gear) is engaged with the pawl (a catch fitting in the gear) for the direction you are applying pressure.
- 6.10 Support the head of the ratchet wrench when socket extensions are used.
- 6.11 Pull on a wrench using a slow, steady pull; do not use fast, jerky movements.
- 6.12 Stand aside when work is done with wrenches overhead.
- 6.13 Make sure adjustable wrenches do not "slide" open during use.
- 6.14 Keep tools well maintained (cleaned and oiled).
- 6.15 Clean and place tools and wrenches in a tool box, rack or tool belt after use.
- 6.16 Do not push on a wrench - losing your balance is more likely if the wrench slips.
- 6.17 Do not use a wrench that is bent or damaged.

- 6.18 Do not use worn adjustable wrenches. Inspect the knurl, jaw and pin for wear.
- 6.19 Do not pull on an adjustable wrench that is loosely adjusted.
- 6.20 Do not use pipe wrenches on nuts or bolts.
- 6.21 Do not use pipe wrenches for lifting or bending pipes.
- 6.22 Do not use a wrench on moving machinery.
- 6.23 Do not use the wrong tools for the job. For example, never use pliers instead of a wrench or a wrench as a hammer.
- 6.24 Do not use a makeshift wrench.
- 6.25 Do not insert a shim in a wrench for better fit.
- 6.26 Do not strike a wrench (except a "strike face" wrench) with a hammer or similar object to gain more force.
- 6.27 Do not increase the leverage by adding sleeved additions (e.g., a pipe) to increase tool handle length.
- 6.28 Do not expose a wrench to excessive heat (like from a blow torch) that could affect the temper of the metal and ruin the tool.

7.0 Files/Rasps

- 7.1 Personnel will not use a file as a pry bar, hammer, screwdriver, or chisel.
- 7.2 When using a file or a rasp, grasp the handle in one hand and the toe of the file in the other.
- 7.3 Personnel will not hammer on a file.

8.0 Chisels

- 8.1 Personnel will not use a chisel that has a dull cutting edge.
- 8.2 Personnel will not use chisels that have "mushroomed" striking heads.
- 8.3 Hold a chisel by using a tool holder if possible.
- 8.4 Clamp small work pieces in the vise and chip towards the stationary jaw when working with a chisel.

9.0 Vises

- 9.1 When clamping a long work piece in a vise, support the far end of the work piece by using an adjustable pipe stand, saw horse or box.
- 9.2 Position the work piece in the vise so that the entire face of the jaw supports the work piece.
- 9.3 Personnel will not use a vise that has worn or broken jaw inserts, or has cracks or fractures in the body of the vise.
- 9.4 Personnel will not slip a pipe over the handle of a vise to gain extra leverage.

10.0 Clamps

- 10.1 Personnel will not use the C-clamp for hoisting materials.
- 10.2 Personnel will not use the C-clamp as a permanent fastening device.

11.0 Jacks

- 11.1 Personnel will not exceed the jack's rated lifting capacity as noted on the label of the jack.
- 11.2 Clear all tools, equipment and any other obstructions from under the vehicle before lowering the jack.

S3NA-305-WI17 Small Engine Safety Card

1.0 Objective / Overview

- 1.1 Operate small-engine machines, such as push mowers, weed trimmers, and leaf blowers, in a safe manner.
- 1.2 You should know how to operate and maintain them in a safe manner.
- 1.3 If possible, read the operator's manual. It will contain detailed information on the safe operation and maintenance of the machine. If you do not have a manual, ask if one can be ordered from the manufacturer.

2.0 Safe Operating Guidelines

- 2.1 Do not wear loose or baggy clothing around tools with rotating parts.
- 2.2 Never run the engine indoors, in poorly ventilated areas, or in a location where the exhaust could be drawn into a building through an opening.
- 2.3 Never store engine with fuel in fuel tank inside a building with potential sources of ignition such as hot water and space heaters, clothes dryers, electric motors, etc.
- 2.4 Never remove fuel cap or add fuel when engine is running.
- 2.5 Never start or operate the engine with the fuel fill cap removed.
- 2.6 Refuelling: allow engine to cool; fill in well-ventilated area; and do not smoke while re-fuelling.
- 2.7 Use only properly labelled, CSA approved red gasoline containers to store and dispense fuel.
- 2.8 Do not pour fuel from engine or siphon fuel by mouth.
- 2.9 Never leave the engine unattended while it is running.
- 2.10 Never operate the engine with an unguarded engine shaft.
- 2.11 Do not modify the engine or tamper with the factory setting of the engine governor.
- 2.12 Never operate the engine without a muffler guard in place and avoid touching hot areas of the engine.
- 2.13 Keep all flammable materials away from the muffler and the rest of the engine; do not idle or park the engine in dry grass or ground cover.
- 2.14 When working on the equipment, avoid accidental starts by removing the ignition key, turn off all engine switches, disconnect the battery and disconnect the spark plug, keeping it away from metal part.
- 2.15 Always wear hearing protection when operating an engine.

3.0 Training Requirements

- 3.1 Review of Applicable SOPs.
- 3.2 Demonstrated knowledge on the use of small engine equipment.
- 3.3 Review and follow manufacturers operating guidelines.

4.0 Personal Protective Equipment (Level D PPE)

- 4.1 Always wear safety goggles with shields
- 4.2 Leather or cotton gloves
- 4.3 Long pants and long sleeve shirt
- 4.4 Safety toe work boots

4.5 Hearing protection (earmuffs or earplugs)

5.0 Potential Hazards

5.1 Flying debris

5.2 Hearing loss

5.3 Cuts

5.4 Burns

S3NA-305-WI18 Electric and Battery Hand Tools Safety Card

All electrical tools and equipment must be operated in accordance with the requirements of *S3NA-302-PR Electrical, General*.

1.0 Safe Work Practices

- 1.1 Maintain all electrical tools and cords in good condition and not overloaded.
- 1.2 Do not wear loose or baggy clothing around tools with rotating parts.
- 1.3 The switch on the tool must be in the OFF position before connecting it to a power source.
- 1.4 Verify that the power source is the same voltage and current as indicated on the nameplate of the tool. Using a higher voltage can cause serious injury to the operator as well as burn out the tool.
- 1.5 The tool must have an approved three-wire cord with a three-prong plug so that it can be used only in a properly grounded three-hole receptacle, unless the tool is double insulated to protect the operator from electrical shock.
- 1.6 All outdoor receptacles must be protected by means of a ground fault circuit interrupter* (GFCI or GFI) available in portable or fixed models. Do not use any electric power tools outdoors in a receptacle that is not properly protected.
- 1.7 Report all shocks and/or sparks from electrical tools, no matter how minor. The tool in question should be tagged out and not be used until it has been checked for ground fault.
- 1.8 Maintain electrical cords and appliances in good working order.
 - 1.8.1 Cords and appliances must be CSA approved.
 - 1.8.2 Never carry an electric tool by the cord or disconnect the plug by pulling or jerking on the cord (can damage, loosen, or separate connections).
 - 1.8.3 Check cords frequently for such damage such as kinks, cuts, and cracked or broken outer jackets (any cord that feels more than comfortably warm to the touch should be checked by an electrician for overloading).
- 1.9 Store electrical cords in a clean, dry area off the ground to prevent damage to cord.
- 1.10 Equipment must have proper guards or shields and they must remain in place. If, due to damage or deterioration, the original guard provided on a piece of equipment cannot be put in place, the tool must be removed from service.
- 1.11 Do not modify, remove, or disable any machine guards.
- 1.12 Stand to one side when engaging or disengaging an electrical circuit breaker to avoid electrical flash backs.
- 1.13 It's strongly advisable to use GFCI with all portable electric tools at any time.
- 1.14 A cord should not be pulled or dragged over nails, hooks, or other sharp objects that may cause cuts in the insulation. In addition, cords should never be placed on radiators, steam pipes, walls, and windows. Particular attention should be placed on connections behind furniture, since files and bookcases may be pushed tightly against electrical outlets, severely bending the cord at the plug.
- 1.15 Disconnect electrical equipment before cleaning, adjusting, or applying flammable solutions. If a guard is removed to clean or repair parts, replace it before testing the equipment and returning the machine to service.
- 1.16 Only authorized persons are permitted to activate, de-activate or lockout electrical equipment.
- 1.17 Where there is or may be a danger to a worker, from the inadvertent operation of electrical equipment, then that equipment must be locked out and tagged prior to commencing work.

- 1.17.1 Switch off all appropriate devices (MCC, Distribution Panel, Disconnect).
- 1.17.2 Lock and tag Electrical Supply devices in the "OFF" position.
- 1.17.3 Test to be sure the equipment cannot be operated at the STOP-START switch.
- 1.17.4 Test to be sure electrical equipment is de-energized.
- 1.17.5 After completion of task, remove padlocks and destroy tags.

2.0 Inspection

- 2.1 Inspect tools for any damage prior to each use.
- 2.2 Ensure that the power tool has the correct guard, shield or other attachment that the manufacturer recommends.
- 2.3 Ensure that the tools are properly grounded using a 3-prong plug, are double-insulated (and are labeled as such), or are powered by a low-voltage isolation transformer; this will protect users from an electrical shock.
- 2.4 Check electric tools to ensure that a tool with a 3-prong plug has an approved 3-wire cord and is grounded. The 3-prong plug should be plugged in a properly grounded 3-pole outlet. If an adapter must be used to accommodate a 2-hole receptacle, the adapter wire must be attached to a known, functioning ground. Never remove the third, grounding prong from a plug.
- 2.5 Check the handle and body casing of the tool for cracks or other damage.
- 2.6 If the tool has auxiliary or double handles, check to see that they installed securely.
- 2.7 Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- 2.8 Any tool with a spring-operated trigger switch shall be fully functional.
- 2.9 Check for damaged switches and ones with faulty trigger locks.
- 2.10 Inspect the plug for cracks and for missing, loose or faulty prongs.
- 2.11 If a tool is defective, remove it from service, and tag it clearly "Out of service for repair." Replace damaged equipment immediately – do not use defective tools "temporarily." DO NOT ATTEMPT FIELD REPAIRS.

3.0 Battery Powered Tools

- 3.1 Use only the kind of battery that the tool manufacturer specifies for the battery-powered tool that you are using.
- 3.2 Recharge a battery-powered tool only with a charger that is specifically intended for the battery in that tool.
- 3.3 Remove the battery from the tool or ensure that the tool is switched off or locked off before changing accessories, making adjustments, or storing the tool.
- 3.4 Store a battery pack safely so that no metal parts, nails, screws, wrenches and so on can come in contact with the battery terminals; this could result in shorting out the battery and possibly cause sparks, fires or burns.

4.0 Using Electric Tools

- 4.1 Switch off the tools before connecting them to a power supply.
- 4.2 If a power cord feels more than comfortably warm or if a tool is sparking excessively, have it checked by an electrician or other qualified person.
- 4.3 Disconnect the power supply before making adjustments or changing accessories.
- 4.4 Remove any wrenches and adjusting tools before turning on a tool.

- 4.5 Inspect the cord for fraying or damage before each use. Tag defective tools clearly with an "Out of Service" tag and replace immediately with a tool in good running order.
- 4.6 During use, keep power cords clear of tools and the path that the tool will take.
- 4.7 Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.
- 4.8 Use only approved extension cords that have the proper wire size for the length of cord and power requirements of the electric tool that you are using. This will prevent the cord from overheating.
- 4.9 For outdoor work, use outdoor extension cords marked "W-A" or "W."
- 4.10 Suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.
- 4.11 Eliminate octopus connections: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in overcurrent protection.
- 4.12 Pull the plug not the cord when unplugging a tool. Pulling the cord causes wear and may adversely affect the wiring to the plug - an electrical shock to the operator may result.
- 4.13 Keep power cords away from heat, water, oil, sharp edges and moving parts. They can damage the insulation and cause a shock.
- 4.14 Avoid accidental starting by ensuring the tool is turned off before you plug it in. Also do not walk around with a plugged-in tool with your finger touching the switch.
- 4.15 Do not bypass the ON/OFF switch and operate the tools by connecting and disconnecting the power cord.
- 4.16 Do not disconnect the power supply of the tool by pulling or jerking the cord from the outlet.
- 4.17 Do not leave a running tool unattended. Do not leave it until it has been turned off, has stopped running completely, and has been unplugged.
- 4.18 Do not use electric tools in wet conditions or damp locations unless tool is connected to a ground fault circuit interrupter (GFCI).
- 4.19 Do not expose electric power tools to rain or wet conditions; wet tools increase the likelihood of getting an electric shock.
- 4.20 Avoid body contact with grounded surfaces like refrigerators, pipes and radiators when using electric powered tools; this will reduce the likelihood of shock if the operator's body is grounded.
- 4.21 Do not plug several power cords into one outlet by using single-to-multiple outlet adapters or converters ("cube taps").
- 4.22 Do not use light duty power cords.
- 4.23 Do not connect or splice extension cords together to make a longer connection: the resulting extension cord may not be able to provide sufficient current or power safely.
- 4.24 Do not carry electrical tools by the power cord.
- 4.25 Do not tie power cords in knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.
- 4.26 Never break off the third prong on a plug: replace broken 3-prong plugs and make sure the third prong is properly grounded.
- 4.27 Never use extension cords as permanent wiring; use extension cords only as a temporary power supply to an area that does not have a power outlet.
- 4.28 Do not walk on or allow vehicles or other moving equipment to pass over unprotected power cords. Cords should be put in conduits or protected by placing planks on each side of them.
- 4.29 Do not brush away sawdust, shavings or turnings while the tool is running. Never use compressed air for cleaning surfaces or removing sawdust, metal turnings, etc.
- 4.30 Do not operate tools in an area containing explosive vapors or gases.
- 4.31 Do not clean tools with flammable or toxic solvents.

- 4.32 Do not surprise or touch anyone who is operating a tool. Startling a tool operator could end up causing an accident or injury.

5.0 Belt Sanders

- 5.1 Wear safety glasses.
- 5.2 Make sure the sander is switched "OFF" before connecting the power supply.
- 5.3 Disconnect power supply before changing a sanding belt, making adjustments, or emptying dust collector.
- 5.4 Inspect sanding belts before using them. Replace those belts that are worn or frayed.
- 5.5 Install sanding belts that are the same widths as the pulley drum.
- 5.6 Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.
- 5.7 Secure the sanding belt in the direction shown on the belt and the machine.
- 5.8 Keep hands away from a sanding belt.
- 5.9 Use two hands to operate sanders – one on a trigger switch and the other on a front handle knob.
- 5.10 Keep all cords clear of sanding area during use.
- 5.11 Clean dust from a motor and vents at regular intervals.
- 5.12 Do not use a sander without an exhaust system or a dust collector present that is in good working order. Empty the collector when 1/4 full. The dust created when sanding can be a fire and explosion hazard. Proper ventilation is essential.
- 5.13 Do not exert excessive pressure on a moving sander. The weight of the sander supplies adequate pressure for the job.
- 5.14 Do not work on unsecured stock unless it is heavy enough to stay in place. Clamp the stock into place or use a "stop block" to prevent movement.
- 5.15 Do not overreach. Always keep proper footing and balance.
- 5.16 Do not cover the air vents of the sander.

6.0 Drills

- 6.1 Wear safety glasses.
- 6.2 Keep drill air vents clear to maintain adequate ventilation.
- 6.3 Always keep drill bits sharp.
- 6.4 Keep all cords clear of the cutting area during use. Inspect for frays or damage before each use.
- 6.5 Disconnect power supply before changing or adjusting bit or attachments.
- 6.6 Tighten the chuck securely. Remove chuck key before starting drill.
- 6.7 Secure workpiece being drilled to prevent movement.
- 6.8 Slow the rate of feed just before breaking through the surface.
- 6.9 Drill a small "pilot" hole before drilling large holes.
- 6.10 For small pieces, clamp stock so work will not twist or spin. Do not drill with one hand while holding the material with the other.
- 6.11 Do not use a bent drill bit.
- 6.12 Do not exceed the manufacturer's recommended maximum drilling capacities.
- 6.13 Do not use a hole saw cutter without the pilot drill.
- 6.14 Do not use high speed steel (HSS) bits without cooling or using lubrication.
- 6.15 Do not attempt to free a jammed bit by starting and stopping the drill. Unplug the drill and then remove the bit from the work piece.

- 6.16 Do not reach under or around stock being drilled.
- 6.17 Do not overreach. Always keep proper footing and balance.
- 6.18 Do not raise or lower the drill by its power cord.

7.0 Planers

- 7.1 Wear safety glasses.
- 7.2 Disconnect the planer from the power supply before making any adjustments to the cutter head or blades.
- 7.3 Use blades of the same weight and set at the same height.
- 7.4 Ensure that the blade-locking screws are tight.
- 7.5 Remove adjusting keys and wrenches before turning on power.
- 7.6 Support the material (stock) in a comfortable position that will allow the job to be done safely and accurately.
- 7.7 Check stock thoroughly for staples, nails, screws, or other foreign objects before using a planer.
- 7.8 Start a cut with the infeed table (front shoe) resting firmly on the stock and with the cutter head slightly behind the edge of the stock.
- 7.9 Use two hands to operate a planer - one hand on the trigger switch and the other on a front handle.
- 7.10 Do not put your finger or any object in a deflector to clean out chips while a planer is running.
- 7.11 Disconnect the power supply when stopping to dump out chips.
- 7.12 Do not set a planer down until blades have stopped turning.
- 7.13 Keep all cords clear of cutting area.

8.0 Routers

- 8.1 Wear safety glasses.
- 8.2 Disconnect the power supply before making any adjustments or changing bits.
- 8.3 Ensure that the bit is securely mounted in the chuck and the base is tight.
- 8.4 Put the base of the router on the work, template or guide. Make sure that the bit can rotate freely before switching on the motor.
- 8.5 Secure stock. Never rely on yourself or a second person to support or hold the material. Sudden torque or kickback from the router can cause damage and injury.
- 8.6 Before using a router, check stock thoroughly for staples, nails, screws or other foreign objects.
- 8.7 Keep all cords clear of cutting area.
- 8.8 Always hold both hands on router handles, until a motor has stopped. Do not set the router down until the exposed router bit has stopped turning.
- 8.9 Do not overreach. Keep proper footing and balance.
- 8.10 When inside routing, start the motor with the bit above the stock. When the router reaches full power, lower the bit to two times the required depth.
- 8.11 When routing outside edges, guide the router counter clockwise around the work.
- 8.12 When routing bevels, moldings and other edge work, make sure the router bit is in contact with the stock to the left of a starting point and is pointed in the correct cutting direction.
- 8.13 Feed the router bit into the material at a firm, controlled speed.
- 8.14 With softwood, you can sometimes move the router as fast as it can go. With hardwood, knotty and twisted wood, or with larger bits, cutting may be very slow.

- 8.15 The sound of the motor can indicate safe cutting speeds. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise.
- 8.16 When the type of wood or size of the bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.
- 8.17 To decide the depth of cut and how many passes to make, test the router on scrap lumber similar to the work.

9.0 Circular Saws

- 9.1 Wear safety glasses and hearing protection.
- 9.2 Check the retracting lower blade guard to make certain it works freely.
- 9.3 Ensure that the blade that you have selected is sharp enough to do the job. Sharp blades work better and are safer.
- 9.4 Check the saw for proper blade rotation.
- 9.5 Set the depth of the blade, while the saw is unplugged, and lock it at a depth so that the lowest tooth does not extend more than about 1/8 inch beneath the wood.
- 9.6 Keep all cords clear of cutting area.
- 9.7 Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.
- 9.8 Check the retracting lower blade guard frequently to make certain it works freely. It should enclose the teeth as completely as possible, and cover the unused portion of the blade when cutting.
- 9.9 Check that the retracting lower blade guard has returned to its starting position before laying down the saw.
- 9.10 Keep upper and retracting lower blade guard clean and free of sawdust.
- 9.11 Disconnect power supply before adjusting or changing the blade.
- 9.12 Allow the saw to reach full power before starting to cut.
- 9.13 Use two hands to operate saws - one on a trigger switch and the other on a front knob handle.
- 9.14 Keep the motor free from accumulation of dust and chips.
- 9.15 Select the correct blade for stock being cut and allow it to cut steadily. Do not force it.
- 9.16 Secure work being cut to avoid movement.
- 9.17 Do not hold or force the retracting lower guard in the open position.
- 9.18 Do not place your hand under the shoe or guard of the saw.
- 9.19 Do not over tighten the blade-locking nut.
- 9.20 Do not twist the saw to change, cut or check alignment.
- 9.21 Do not use a saw that vibrates or appears unsafe in any way.
- 9.22 Do not force the saw during cutting.
- 9.23 Do not cut materials without first checking for obstructions or other objects such as nails and screws.
- 9.24 Do not carry the saw with a finger on the trigger switch.
- 9.25 Do not overreach. Keep proper footing and balance.
- 9.26 Do not rip stock without using a wedge or guide clamped or nailed to the stock.

10.0 Other Saws

- 10.1 Wear safety glasses.
- 10.2 Disconnect power supply before changing or adjusting blades.

- 10.3 Use lubricants when cutting metals.
- 10.4 Keep all cords clear of cutting area.
- 10.5 Position the saw beside the material before cutting and avoid entering the cut with a moving blade.
- 10.6 Make sure guards, if present, are installed and are working properly.
- 10.7 Remember sabre saws cut on the upstroke.
- 10.8 Secure and support stock as close as possible to the cutting line to avoid vibration.
- 10.9 Keeps the base or shoe of the saw in firm contact with the stock being cut.
- 10.10 Select the correct blade for the material being cut and allow it to cut steadily. Do not force it. Clean and sharp blades operate best.
- 10.11 Set the blade to go no further than 1/8 to 1/4 inch deeper than the material being cut.
- 10.12 Do not start cutting until the saw reaches its full power.
- 10.13 Do not force a saw along or around a curve. Allow the machine to turn with ease.
- 10.14 Do not insert a blade into or withdraw a blade from a cut or lead hole while the blade is moving.
- 10.15 Do not put down a saw until the motor has stopped.
- 10.16 Do not reach under or around the stock being cut.
- 10.17 Maintain control of the saw always. Avoid cutting above shoulder height.
- 10.18 **External Cuts**
- 10.18.1 Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.
- 10.18.2 Hold the saw firmly down against the material and switch the saw on.
- 10.18.3 Feed the blade slowly into the stock, maintaining an even forward pressure.
- 10.19 **Internal Cuts**
- 10.19.1 Drill a lead hole slightly larger than the saw blade. With the saw switched off, insert the blade in the hole until the shoe rests firmly on the stock.
- 10.19.2 Do not let the blade touch the stock until the saw has been switched on.

S3NA-306-PR Highway and Road Work

1.0 Purpose and Scope

- 1.1 To address potential hazards that may occur during highway construction and during work within the right of way of a public or private roadway.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Personal Protective Equipment (PPE):** Safety clothing and equipment worn by workers in traffic areas to provide protection and heightened visibility from physical hazards including moving vehicles and construction equipment.
- 2.2 **Traffic areas:** Any work area where workers are located within 20 feet of moving traffic, existing or anticipated.
- 2.3 **Traffic Control Plan:** A written document containing drawings and text that describes the physical controls to be established to isolate workers from moving vehicles.
- 2.4 **WOF:** Workers on foot.

3.0 Attachments

- 3.1 S3NA-306-FM Equipment Checklist

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Project/Lead Manager or Resident Engineer** is responsible for administering the procedure and for determining the measures and configuration of the temporary traffic control zone in accordance with specifications for workers, motorists, and pedestrians and the protection of AECOM employees within the contract. The Lead Manager will also see that employees assigned to work in traffic areas are trained in the use of traffic control systems and PPE.
- 4.1.2 **Site Safety Coordinator** is responsible to the lead manager for the implementation of safety and the internal traffic control plan within a highway construction/demolition worksite. The Site Safety Coordinator will
 - Be responsible for traffic safety coordination on office projects.
 - Be appointed by each office that has any field work involving AECOM staff working in or near traffic. This is not a dedicated role and may be a committee member.
 - Receive training in the requirements of the governing transportation authority and the applicable OH&S legislation through training sanctioned by the respective authorities.
 - Be involved in conducting hazard assessments, developing the mitigating strategies and Safe Job Procedures, and reviewing their implementation for any project where traffic is identified as a hazard to our team members.

4.2 Personal Protective Equipment

- 4.2.1 High visibility safety vest /apparel
- 4.2.2 Retro-reflective stripes (for night work)
- 4.2.3 Protective headwear (hard hat)
- 4.2.4 Two-way radio or other means of effective communication
- 4.2.5 Traffic Accommodation equipment, as required by the traffic protection plan:

- A rooftop beacon light for the vehicle, where required
- Pylons, Glo-posts, flags, barricades and/or flagging tape, warning lights, flashing light boards
- Signage
- Flagging equipment, as required:
 - Daytime:
 - Flag person's "Stop and Slow" paddle
 - A blaze orange flag person's vest over white coveralls
 - Safety head protection (hard hat)
 - Drinking water
 - Bug repellent and/or sun screen as conditions warrant
 - Optional radio communication (if required)
 - Night time (additional requirements):
 - A retro-reflective "Stop and Slow" paddle
 - A flashlight fitted with a red signaling baton
 - Flashing yellow beacons set up in advance of the flag person

4.3 **Restrictions**

- 4.3.1 Applicable legislated requirements governing all aspects of traffic safety, including directing traffic, signage, PPE, traffic control devices in temporary construction, maintenance and utility work zones, will be reviewed in preparation for the site-specific traffic accommodation.
- 4.3.2 No personnel will be allowed onto the site without first reviewing the project-specific traffic protection plan.

4.4 **Training**

- 4.4.1 All staff will receive on-site orientation to the hazards and controls.
- 4.4.2 Only staff with appropriate flag person training will act as a flag person.

4.5 **Traffic Control Plan**

- 4.5.1 Transportation incidents and workers struck by vehicles or mobile equipment account for many fatal construction work injuries. Workers in highway construction activities including flagging, demolition, surveying, utility, clean-up, emergency responders, and others in areas where traffic exists are exposed to being struck by moving vehicles. Work zones are used to move traffic in an approved direction and are typically identified by signs, cones, barrels, and barriers.
- 4.5.2 The procedures appropriate for work in traffic areas will vary depending on the work environment. Very simple procedures are needed in an inactive parking lot, and more complex procedures are needed when working in a construction zone on a highway. Each AECOM project team shall prepare a project HASP or SWP addressing traffic controls and worker protection appropriate for the team's project and exposures. Plans shall address the following if applicable:
- Attenuator vehicles
 - Closures within a closure
 - Communications
 - Driving: seatbelts and rollover protection should be used on equipment and vehicles as stated by the manufacturer
 - Night operations and work within traffic controls
 - PPE
 - Sanitation

- Traffic control plans and permits
 - Training
 - Work zone protections: various styles of concrete, water, sand, collapsible barriers, crash cushions, and truck mounted attenuators are available to limit motorist intrusions into the construction work zone
 - Worker: heavy equipment interface
- 4.5.3 A Traffic Control Plan will be completed for the movement of vehicles in areas where workers are conducting other tasks.
- 4.5.4 Drivers, workers on foot (WOF), and pedestrians will be able to see and understand the routes they are to follow.
- 4.5.5 Where there are several projects, coordinated vehicle routes and communication between contractors will reduce vehicular struck-by incidents.
- 4.5.6 Hazard identification and plan development shall be performed in accordance with this procedure. The plans shall include the identification of the responsibility for personnel and implementation of the safety program under highway construction activities.
- 4.5.7 Other requirements for supporting activities such as excavations, heavy equipment usage, personal protective equipment, etc. shall be applicable and addressed in accordance with other Standard Operating Procedures.
- A traffic protection plan will be an integral part of the Health and Safety Plan (HASP) or Safe Work Plan (SWP) whenever staff will be exposed to the hazards of vehicular traffic during project work (this may include surveys, drilling and soils inspections, bridge or overpass inspections, inspection of roadway construction projects).
 - Work duration, road width, and traffic volume are some of the key considerations to be contemplated when designing a traffic protection plan. The traffic protection plan will address the specific vehicular hazards and describe the measures that will be implemented to protect employees.
 - Traffic accommodation plans will be developed in consultation with a qualified supervisor or manager experienced in traffic control. In addition, a supervisor will be designated to oversee the implementation of the protection plan until work is completed.
 - OH&S regulations and associated standards or guidebooks provide instruction on the use of traffic control devices in temporary construction, maintenance, and utility work zones for worker and motorist safety and to minimize the disruption of traffic flow.
 - Schedule work to avoid periods of heavy traffic.
 - Alert traffic of work ahead, by placing signs or cones well ahead of the work area.
 - If the work area is being managed under a Traffic Control Plan or Traffic Accommodation Plan, obtain copies of these plans before commencing work.
 - Traffic accommodation that is adequate in good weather conditions and daylight may not be adequate under adverse weather conditions and/or hours of darkness. Reassess the accommodation based on conditions.
 - Traffic accommodation will be planned to provide safe conditions for the protection and safe passage of motorists, pedestrians, and employees at all work sites. It will include all areas located within the traveled portion of a roadway including shoulders, ditches, and boulevards.
- 4.6 **Short-Term Traffic Protection**
- 4.6.1 Always wear the appropriate PPE to maintain your visibility to vehicular traffic. Wear a tear-away fluorescent reflective vest (and retro-reflective stripes on the arms and legs for night work or during periods of limited visibility) at all times.
- 4.6.2 Pull your vehicles off as far to the right of the traveled portion of the road as possible. Confirm that the shoulder of the highway or street where you will park your vehicle is wide enough to allow for safe access to and egress from the vehicle.
- 4.6.3 Always park your vehicle at least 30 metres from the flag person station. The vehicle should be positioned between the flag person and the work crew.

- 4.6.4 Activate the four-way flashers for your vehicle prior to exiting the vehicle.
- 4.6.5 Plan an escape route prior to exiting the vehicle.
- 4.6.6 Load and unload materials or equipment from the passenger side of the vehicle.
- 4.6.7 Avoid turning your back to oncoming traffic.
- 4.6.8 Be aware of mobile equipment that may be operating in the work area.
- 4.6.9 Do not enter onto the traveled portion of the road except to cross the road. Road crossings should be made at a 90 degree angle to the direction of the road.

4.7 **Long-Term Traffic Protection**

- 4.7.1 Traffic accommodation will be provided BEFORE the work starts and will be maintained until the work is completed. This may mean 24 hours a day, 7 days a week.
- 4.7.2 Generally, for long-term duration work activities that are performed at construction projects, the Constructor for the project is required to develop a traffic protection plan.
- 4.7.3 If AECOM has assumed the role of Constructor for the project, the traffic protection plan will be developed and implemented prior to the commencement of work activities at the project.
- 4.7.4 If AECOM is not the Constructor for the project, the traffic protection plan for the project will be developed by our Client or a Constructor designated by the Client.
- 4.7.5 The traffic protection plan should be reviewed with AECOM employees during orientation to the Project. If the traffic protection plan is not discussed at the project-specific orientation, employees should discuss the issue with the Site Supervisor or Client contact for the Project.

4.8 **Signage**

- 4.8.1 Standard highway signs for information, speed limits, and work zones will assist drivers in identifying designated traffic paths.
- 4.8.2 Provide appropriate instructional signage such as: EVACUATION ROUTE; DO NOT ENTER; REDUCED SPEED AHEAD; ROAD CLOSED; and NO OUTLET.
- 4.8.3 Using standard highway signs for internal construction worksite traffic control will assist workers in recognizing the route they are to use at the construction site.
- 4.8.4 Traffic Signs
 - Signage will be of acceptable standards, in good condition, clean, legible, and suited to the purpose.
 - Signage will be secured or weighted.
 - Routinely inspect signage for placement, cleanliness, and physical damage.
 - Cover road traffic control signage when no activity is present.

4.9 **Traffic Control Devices**

- 4.9.1 Standard traffic control devices, signals, and message boards will instruct drivers to follow a path away from where work is being done.
- 4.9.2 The authority in charge will determine the approved traffic control devices such as cones, barrels, barricades, and delineator posts that will be used as part of the traffic control plan.
- 4.9.3 These standard devices should also be used inside the work zone.

4.10 **Work Zone Protections**

- 4.10.1 Various styles of concrete, water, sand, collapsible barriers, crash cushions, and truck-mounted attenuators shall be used to limit motorist intrusions into the construction work zone, as appropriate.
- 4.10.2 All AECOM staff shall be made aware of controls established by the Contractor.
- 4.10.3 AECOM staff shall wear the required safety equipment at all times including a hard hat, work boots, eye protection, and a high-visibility safety vest as a minimum and shall observe all project rules and requirements.

- 4.10.4 In the absence of a contractor, when AECOM staff are in the field alone—e.g., investigations, surveys—all appropriate DOT traffic control standards and devices shall be observed and placed in position.
- 4.10.5 The work zone shall be made safe by its separation from traffic.
- 4.11 **Flagging**
- 4.11.1 Flaggers and others providing temporary traffic control will wear high visibility clothing with a background of fluorescent yellow-green or orange-red and white, silver, yellow-green, orange, or yellow retro-reflective material.
- 4.11.2 In areas of traffic movement, PPE will make the worker visible for at least 1,000 feet so that the worker can be seen from any direction and will make the worker stand out from the background. Check the label or packaging to confirm that the garments are performance Class 2 or 3 (class requirement may be project-specific).
- 4.11.3 Drivers should be warned in advance with signs that there will be a flagger ahead.
- 4.11.4 Flaggers should use STOP/SLOW paddles, paddles with lights, or flags (flags should be used only in emergencies.). The STOP sign should be octagonal with a red background and white letters and border. The SLOW sign should be octagonal with an orange background and black letters and a border.
- 4.11.5 Flag Persons
- A traffic control person (flag person) will stand in a safe position, preferably on the driver's side of the lane under control, be clearly visible, have an unobstructed view of approaching traffic, and be positioned at least 25 m (80 ft) away from the work area unless circumstances or space requirements, such as working at or near an intersection, dictate otherwise.
 - Flag persons will be trained and competent and will use appropriate PPE.
 - Flag persons will be instructed in traffic control and flagging procedures, will be provided with sufficient breaks, and will not be permitted to work alone for extended periods as per local regulations.
 - Flag persons will not get involved in needless conversation and will stay alert at their points of duty until relieved.
 - Except for brief flagging operations, or in an emergency, "Flag Person Ahead" signs will be posted in advance of each flag person's station. Such signs will be removed promptly when the flagging operation terminates.
- 4.12 **Lighting**
- 4.12.1 Flagger stations should be illuminated. Lighting for workers on foot and equipment operators is to be at least 5 foot-candles or greater.
- 4.12.2 Where available lighting is not sufficient, flares or chemical lighting should be used.
- 4.12.3 Glare affecting workers and motorists should be controlled or eliminated.
- 4.13 **Training**
- 4.13.1 Flaggers should be trained/certified and will use the signaling methods required by the authority in charge.
- 4.13.2 WOF, equipment operators, and drivers in internal work zones need to know the routes that construction vehicles will use.
- 4.13.3 Equipment operators and signal persons need to know the hand signals used on the worksite.
- 4.13.4 Operators and WOF need to know the visibility limits and the "blind spots" for each vehicle on site.
- 4.13.5 WOF should wear high visibility safety garments designated as Class 1, 2 or 3.
- 4.13.6 Workers should be made aware of the ways in which shift work and night work may affect their performance.

4.14 Driving

- 4.14.1 Seatbelts and rollover protection will be used on equipment and vehicles as stated by the manufacturer.
- 4.14.2 When pulling off to the side of the road, AECOM personnel will park their vehicles at minimum of 20 feet or the width of two traffic lanes from moving traffic.

4.15 Night Operations and Work Within Traffic Controls

- 4.15.1 Night work on roadways should not be done unless absolutely necessary and unless the work area is adequately lit.
- 4.15.2 Operations with night activities will have a written plan that addresses the safety issues of working at night. The plan will address, but is not limited to:
- Reflectivity
 - All equipment used in the work zone shall have DOT-approved reflective material placed to increase the visibility of the equipment.
 - All reflective surfaces shall be cleaned as required so that the reflectivity of the material is not degraded. Any areas of reflective surface that is damaged or obscured will be replaced.
 - Personnel working at night will have reflective tape on their hardhats and will wear retro-reflective vests at a minimum. The reflective bands on vests will be vertical and horizontal around the entire upper body.
 - Additional measures such as white disposable coveralls, reflective bands, and personal battery-operated strobe lights may be used when practical.
 - Illumination
 - Whenever feasible and practical, light plants will be used to illuminate the work area.
 - On mobile operations, additional lighting on equipment may be used to illuminate the work area.
 - All equipment shall, at a minimum, have working strobe or warning beacon lights.
 - All equipment shall have working lights confirmed through daily visuals.
 - All flag persons will be placed in illuminated areas only.
 - All lighting is to be checked after setup to confirm that it is not blinding approaching traffic or other equipment in the work zone.
 - Hazard Analysis and Communication
 - Prior to the start of any night operation, a detailed Hazard Analysis will be made addressing the possible hazards of night work. The Hazard Analysis will be reviewed with the crews and updated as needed. At the start of each shift, the Daily Safety Reminder will be used to reaffirm the provisions of the night work requirements as found in the hazard analysis and this policy.
 - The hazard analysis should also provide for:
 - The selection of a competent person responsible for maintaining surveillance on the work area to alert other workers of vehicles encroaching on the work zone.
 - A method to signal workers when vehicles encroach on the work zone.
 - A system to account for workers at all times, which may include a buddy system.
 - Emergency communication or warning signals used by a worker such as a radio, signal horn, or whistle, which will be used to call for help.

4.16 Attenuator Vehicles

- 4.16.1 Although not required, it is good construction practice to place an attenuator truck or pick-up truck (minimum) immediately ahead of workers in a work zone.
- 4.16.2 The vehicle of choice should be placed to provide the best protection for workers.
- 4.16.3 The tires should be placed so that when struck the vehicle will turn away from workers.

4.17 Closures within a Closure

4.17.1 On occasion, satellite operations may be performed under full freeway traffic closures. For this type of work, special precautions referred to as a "closure within a closure" is to be implemented in accordance with the following:

- Posted speed limits within closures should be set at 15 miles per hour.
- Signs are to be installed approximately 250 feet in advance of and behind the work zone to alert drivers who may approach from either direction of the upcoming work zone.
- The work area is to be completely delineated with Type 1 barricades (candlesticks).
- Any vehicle used for AECOM field work shall be equipped with a functioning rotating beacon placed on the roof of the vehicle.

5.0 Records

5.1 Traffic Protection Plans and completed Equipment Checklists will be maintained in project files.

6.0 References

6.1 The following standards apply to traffic accommodation equipment.

Association	Standard
Transportation Association of Canada	Manual of Uniform Traffic Control Devices for Canada (1998)

S3NA-306-FM Equipment Checklist

Name of Contractor:

Location:

Project #:

Date:

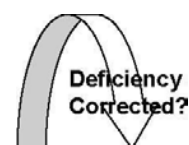
Time:

Weather:

Person Conducting Inspection:

Title:

*Note: As you conduct your inspection you should be able to answer each question with a **YES**. If the answer to any question is **NO**, this deficiency should be corrected as soon as possible.*



	YES	NO	OK	N/A
Are accident prevention signs, tags clearly visible?	☐	☐	☐	☐
Are danger signs used where immediate hazards exist?	☐	☐	☐	☐
Are caution signs used to warn against potential hazards or to caution against unsafe practices?	☐	☐	☐	☐
Are exit signs posted at all exit locations?	☐	☐	☐	☐
Are proper visual warning signs posted prior to (in advance of) the work area?	☐	☐	☐	☐
Are flaggers provided with signs, signals, and barricades to provide the necessary protection?	☐	☐	☐	☐
Are flaggers using red lights when signaling during periods of darkness?	☐	☐	☐	☐
Are flaggers wearing highly visible warning garments?	☐	☐	☐	☐
Are the flaggers trained in proper flagging procedures?	☐	☐	☐	☐
Are warning garments worn at night reflectorized?	☐	☐	☐	☐
Are highly visible flags used by the flaggers at least 18 inches square?	☐	☐	☐	☐
Are barricades used to totally obstruct the passage of people and vehicles to protect the work area?	☐	☐	☐	☐
Do barricades meet the requirements set forth in the Manual of Uniform Traffic Control Devices? (MUTCD)	☐	☐	☐	☐

COMMENTS:

S3NA-307-PR Housekeeping, Worksite

1.0 Purpose and Scope

- 1.1 This procedure provides AECOM's work practices as well as personal hygiene and work site sanitation standards for housekeeping.
- 1.2 Applies to all AECOM North America-based staff and field worksites.

2.0 Terms and Definitions

- 2.1 None

3.0 Attachments

- 3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Project Manager (Field Task Manager, Supervisor)** is responsible for the procedure's implementation and the details of addressing housekeeping policy within the construction/demolition worksite.
- 4.1.2 **SH&E Department** personnel will monitor, assess, and report on project housekeeping when visiting locations.
- 4.1.3 **Employees** are responsible for reporting any areas of concern to the Site Supervisor for prompt resolution as well as for maintaining worksites that are free from debris, clutter, and slipping or tripping hazards.

4.2 Smoking, Eating, and Drinking

- 4.2.1 Eating and drinking will be permitted in designated areas at AECOM project sites and as specified on client sites. Smoking will be permitted only in areas designated in compliance with applicable local laws, regulations, legislation, and ordinances, by the Field Supervisor and situated in locations that are not in the immediate vicinity of activities associated with work site activities. Additionally, Field Supervisor will designate each smoking area giving primary consideration to those personnel who do not smoke.
- 4.2.2 Personnel involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER-controlled work areas).
- 4.2.3 Site personnel will first wash hands and face after completing work activities and prior to eating or drinking.

4.3 Water Supply

- 4.3.1 Water supplies will be available for use on site and will comply with the following requirements:
- 4.3.2 **Potable Water:** An adequate supply of drinking water will be available for site personnel consumption. Potable water can be provided in the form of approved well or city water, bottled water, or drinking fountains. Where drinking fountains are not available, individual use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from nonpotable water sources.
- 4.3.3 **Nonpotable Water:** Nonpotable water will not be used for drinking purposes. Nonpotable water may not be used for hand washing or other personal hygiene activities but may be used for other types of cleaning activities. All containers/supplies of nonpotable water used will be properly identified and labeled as such.

4.4 Toilet Facilities

- 4.4.1 Toilet facilities will be available for site personnel and visitors. Should subcontractor personnel be located on-site for extended periods, it may become necessary to obtain temporary toilet facilities.

Exceptions to this requirement will apply to mobile crews where work activities and locations permit transportation to nearby toilet facilities.

- 4.4.2 A minimum of one toilet will be provided for every 20 site personnel, with separate toilets maintained for each sex, except where there are less than five total personnel on site. For mobile crews where work activities and locations permit use of nearby toilet facilities (e.g., gas station, or rest stop), on-site facilities are not required.

4.4.3 Washing Facilities

- 4.4.4 Hand and Face: Site personnel will wash hands and face after completing work activities and prior to breaks, lunch, or completion of workday.

- 4.4.5 Personal Cleaning Supplies: Cleaning supplies at AECOM project sites will consist of soap, water, and disposable paper towels or items of equal use/application (e.g., anti-bacterial gels, wipes, etc.).

4.5 **Clothing and Personal Protective Equipment (PPE)**

- 4.5.1 All PPE will be kept clean at all times and maintained in accordance with the manufacturer's, AECOM's, and applicable regulatory, legislative, or provincial requirements.

4.5.2 General Work Areas

- 4.5.3 At all times work areas will be kept free of dirt and debris that may impact the safety of site personnel and visitors. All trash receptacles will be emptied regularly.

4.5.4 Break Areas and Lunchrooms

Site personnel will observe the following requirements when using break areas and lunchrooms at AECOM project sites:

- 4.5.5 All food and drink items will be properly stored when not in use.
- 4.5.6 Food items will not be stored in personal lockers for extended periods in order to prevent the potential for vermin infestation.
- 4.5.7 Perishable foods will be refrigerated whenever possible.
- 4.5.8 All waste food containers will be discarded in trash receptacles.
- 4.5.9 All tables, chairs, counters, sinks, and similar surfaces will be kept clean and free of dirt, waste food, and food containers at all times.
- 4.5.10 Refrigerators used to store food items will be maintained at 45 degrees Fahrenheit and emptied of all unclaimed food items weekly. Refrigerators used to store food will be labeled as such so that only food and drinks are stored within the refrigerator.
- 4.5.11 Routine cleaning of refrigerators will also be performed on a regular basis.

4.6 **Vermin Control**

- 4.6.1 Every enclosed workplace shall be constructed, equipped, and maintained, so far as reasonably practicable, to prevent the entrance or harborage of rodents, insects, and other vermin.
- 4.6.2 A continuing and effective extermination program shall be instituted where the presence of rodents, insects, or other vermin is detected.

4.7 **General Housekeeping**

- 4.7.1 All work areas shall be kept clean to the extent that the nature of the work allows.
- 4.7.2 Every work area shall be maintained, so far as practicable, in a dry condition. Where wet processes are used, drainage shall be maintained and platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footwear shall be provided.
- 4.7.3 Protruding objects or placement of materials on paths or foot traffic areas present a problem with regard to slips, trips, falls, and puncture wounds. Personnel will use a reasonable amount of effort to keep slip, trip, and fall hazards to a minimum.
- 4.7.4 Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal.
- 4.7.5 At no time will debris or trash be intermingled with waste PPE or contaminated materials.

- 4.7.6 Material and equipment must be placed, stacked, or stored in a stable and secure manner. Stacked material or containers must be stabilized as necessary by interlocking, strapping, or other effective means of restraint to protect the safety of workers.
- 4.7.7 An area in which material may be dropped, dumped, or spilled must be guarded to prevent inadvertent entry by workers or protected by adequate covers and guarding.
- 4.7.8 Floors, platforms, ramps, stairs, and walkways available for use by workers must be maintained in a state of good repair and kept free of slipping and tripping hazards. If such areas are taken out of service, the employer must take reasonable means for preventing entry or use.
- 4.7.9 Hazardous areas not intended to be accessible to workers must be secured by locked doors or equivalent means of security and must not be entered unless safe work procedures are developed and followed.

4.8 **Worksite Offices and Trailers**

Worksite offices and trailers will be maintained in accordance with *S3NA-103-PR Housekeeping, Office*.

5.0 **Records**

- 5.1 None

6.0 **References**

- 6.1 None

S3NA-308-PR Manual Lifting, Field

1.0 Purpose and Scope

- 1.1 This procedure provides the requirements for use when performing manual materials handling activities (e.g., lifting/handling of items or materials).
- 1.2 This procedure applies to all field staff for AECOM North America-based operations.

2.0 Terms and Definitions

- 2.1 **Manual Materials Handling:** Moving or handling things by lifting, lowering, pushing, pulling, carrying, holding, or restraining.
- 2.2 **Team Handling:** Team handling occurs when more than one person is involved during the lift.

3.0 Attachments

- 3.1 S3NA-308-WI Manual Lifting Safe Work Practices

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 The **Project Manager** will effectively implement the procedure, providing resources as required, and providing direction on proper lifting/handling techniques.
- 4.1.2 The **Region SH&E Manager** will assist in identifying activities with a high potential for lifting/handling strains/injuries as well as the associated mitigation strategies and training on proper lifting/manual materials handling techniques.
- 4.1.3 **Employees** are responsible for reviewing and following *S3NA-308-WI Manual Lifting Safe Work Practices*.

4.2 Mechanical Controls

- 4.2.1 Mechanical equipment or assistance such as dollies, carts, come-alongs, or rollers are preferable to be used whenever possible rather than the employee physically moving materials.
- 4.2.2 Mechanical assistance will be of proper size, have wheels sized for the terrain, and be designed to prevent pinching or undue stress on wrists.
- 4.2.3 Objects to be moved will be secured to prevent falling and properly balanced to prevent tipping.

4.3 Administrative Controls

- 4.4 When significant, sustained lifting work is required, it is desirable to rotate employees to spread the work load among several people and thereby avoid fatigue.
- 4.5 Rotation is not simply performing a different job but instead is performing a job that utilizes a completely different muscle group from the ones that have been overexerted.

5.0 Records

- 5.1 None

6.0 References

- 6.1 OSHA Technical Manual: http://www.osha.gov/dts/osta/otm/otm_vii/otm_vii_1.html
- 6.2 National Safety Council: www.nsc.org

S3NA-308-WI Manual Lifting Safe Work Practices

1.0 General

1.1 Before Performing a Lift:

- 1.1.1 Check to see if mechanical aids such as hoists, lift trucks/dollies, or wheelbarrows are available.
- 1.1.2 Do not lift if you are not sure that you can handle the load safely.
- 1.1.3 Confirm that, based on your own physical capabilities and medical limitations, you can lift the load without overexertion. Get help with heavy or awkward loads.
- 1.1.4 Confirm that the load is “free” to move.
- 1.1.5 Check that the planned destination of the load is free of obstacles and debris.
- 1.1.6 Confirm that the path to the planned destination of the load is clear. Grease, oil, water, litter, and debris can cause slips and falls.
- 1.1.7 Particular handling and lifting techniques are needed for different kinds of loads or materials being handled (for example, compact loads, small bags, large sacks, drums, barrels, cylinders, and sheet materials like metal or glass). See Section 2.0 for additional guidance.

1.2 General Tips for Lifting

- 1.2.1 Prepare for the lift by warming up the muscles.
- 1.2.2 Make certain that your balance is good. Feet should be shoulder width apart, with one foot beside and the other foot behind the object that is to be lifted.
- 1.2.3 Bend the knees; do not stoop. Keep the back straight, but not vertical. There is a difference. Tucking in the chin straightens the back.
- 1.2.4 Grip the load with the palms of your hands and your fingers. The palm grip is much more secure. Tuck in the chin again to make certain your back is straight before starting to lift.
- 1.2.5 Use your body weight to start the load moving, then lift by pushing up with the legs. This makes full use of the strongest set of muscles.
- 1.2.6 Keep the arms and elbows close to the body while lifting.
- 1.2.7 Carry the load close to the body. Do not twist your body while carrying the load. To change direction, shift your foot position and turn your whole body.
- 1.2.8 Watch where you are going!
- 1.2.9 To lower the object, bend the knees. Do not stoop. To deposit the load on a bench or shelf, place it on the edge and push it into position. Confirm that your hands and feet are clear when placing the load.

1.3 Engineering Controls:

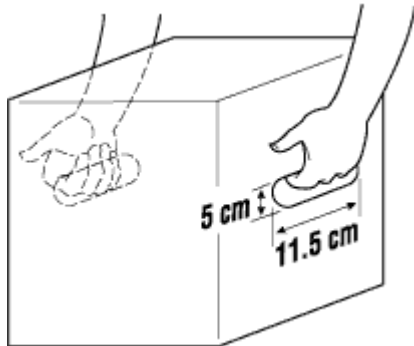
- 1.3.1 Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity.
- 1.3.2 Alter the task to eliminate the hazardous motion and/or change the position of the object in relation to the employee's body—such as adjusting the height of a pallet or shelf.
- 1.3.3 Work methods and stations should be designed to minimize the distance between the person and the object being handled.
- 1.3.4 High-strength push-pull requirements are undesirable, but pushing is better than pulling. Material handling equipment should be easy to move, with handles that can be easily grasped in an upright posture.
- 1.3.5 Workbench or workstation configurations can force people to bend over. Corrections should emphasize adjustments necessary for the employee to remain in a relaxed upright stance or fully supported seated posture. Bending the upper body and spine to reach into a bin or container is highly

undesirable. The bins should be elevated, tilted, or equipped with collapsible sides to improve access.

- 1.3.6 Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving employees closer to parts and conveyors.

- 1.3.7 Store heavy objects at waist level.

- 1.4 Whenever possible, utilize hand holds or other lifting attachments on objects being handled:**



- 1.4.1 Use the “hook grip” on loads with cut-out handholds.
- 1.4.2 Curl your fingers around the edge.
- 1.4.3 Do not hold the load with your fingertips.
- 1.4.4 Use containers with handles located more than halfway up the side of the container.
- 1.4.5 Use the “ledge grip” to handle regularly shaped objects without handles.



- 1.4.6 Use vacuum lifters to handle sheet materials or plates.
- 1.4.7 Hold the object with hands placed diagonally.
- 1.4.8 Wear gloves where practical.

2.0 Specific Handling Techniques

The following guidance will be used when performing manual materials handling for various types of materials.

2.1 Square or Rectangular Objects

- 2.1.1 Place one foot slightly in front of the other.
- 2.1.2 Squat as close to the object as possible.
- 2.1.3 Grasp one of the top corners away from the body and the opposite bottom corner closest to the body.
- 2.1.4 Tilt the object slightly away from the body, tilt forward at the hips, keep the back straight, and tuck in the chin.
- 2.1.5 Test to confirm that the object is loose from floor and will lift without snagging.
- 2.1.6 Straighten the legs, keeping the backbone straight, pull the object into the body, and stand up slowly and evenly without jerking or twisting.

2.1.7 If turning or change of direction is required, turn with feet without twisting the torso and step in the direction of travel.

2.1.8 To set an object down, reverse the sequence, being sure not to trap the bottom hand between the object and the surface on which the object is set.

2.2 Cylindrical Objects

2.2.1 When lifting/moving round or cylindrical objects, the objects should be rolled wherever possible. Rolling must be controlled by chute, tagline, or other means of limiting acceleration. Workers must not be positioned downhill from rolled objects. Use of the legs for pushing and tagline control of rolled objects must be stressed.

2.2.2 Cylindrical objects, such as drums that must remain upright, are to be handled manually by slightly tilting the object, using the legs for control, and balancing the object on the bottom edge. The handler then walks besides the object, with the object tilted toward the body, positioning the hands on the top edge away from the body and moving so they do not cross, thus maintaining balance and a steady, controlled, forward motion. Motion must be controlled so that ceasing to walk and moving the hands will stop forward motion.

2.2.3 Use carts or tracks to transport cylinders. Make sure that two people transport a cylinder if carts cannot be used, use lifting straps to improve grip.

- Technique for one person lifting a cylinder onto a platform:
 - Roll the cylinder to within 3 feet of the platform.
 - Position the forward foot around the cylinder, the back foot about 1 foot behind the cylinder.
 - Bend knees slightly.
 - Place one hand on the valve protective cap, the other hand underneath the cylinder about 1 foot from the ground.
 - Tilt the cylinder onto the thigh of the back leg.
 - Balance the cylinder on the thigh by pressing down with the back hand while lifting the cylinder with the forward hand.
 - Extend both knees to initiate forward movement of the cylinder and continue by pushing up and forward with the arms until the cylinder is located on the platform.
 - Climb on the platform.
 - Straddle the cylinder at the valve end.
 - Grasp the valve protective cap of the cylinder with both hands between the thighs.
 - Lean forward and straighten the knees to set the cylinder upright.

2.3 Bags and Sacks

2.3.1 The best way to handle a bag depends on its size, weight, and how far it is to be carried. When lifting, remember to

- Straddle the end of the bag.
- Bend the hips and knees.
- Keep the back straight.
- Grasp the bag with both hands under the closer end. Keep elbows inside the thighs.
- Lean forward, straightening the knees to set the bag upright.
- Readjust the straddle position moving feet closer to the bag.
- Readjust the grasp, with one hand clasping the bag against the body and the other under it.
- Stand up by thrusting off with the back leg and continuing in an upward and forward direction.
- Thrust the bag up with the knee while straightening the body.
- Put the bag on the shoulder opposite the knee used to thrust the bag up.
- Stabilize the bag on the shoulder.

- Move off without bending sideways.
- 2.3.2 Avoid unloading a bag from the shoulder directly to floor level. Use an intermediate platform or get help from a coworker.
- Stand close to the platform.
 - Place one foot in front of the platform.
 - Bend hips and knees.
 - Keep the back straight.
 - Ease the bag off the shoulder and put it upright on the platform.
 - Pull the bag slightly over the edge of the platform.
 - Stand close to the platform with the bag touching the chest.
 - Clasp the bag against the body with one hand, the other hand holding bottom of the bag.
 - Step back.
 - Bend hips and knees, keeping back straight.
 - Ease the bag onto the floor.
- 2.3.3 Bulkier sacks are easier to carry on your back. Lift the sack onto your back from a platform:
- Move the sack to the edge of the platform.
 - Put your back against the sack.
 - Grasp with both hands on the upper corners of the sack.
 - Ease the sack onto the back, bending hips and knees before taking the weight.
 - Keep the back straight.
 - Stand up and straighten the hips and knees.
 - Stabilize the sack.
 - Move away without bending sideways.
- 2.3.4 Two-person handling of a sack:
- Position one person on either side of the sack.
 - Squat with one foot balancing behind the sack.
 - Keep back straight.
 - Grasp with the outer hand on the upper corner, the other hand holding the bottom of the sack.
 - On one person's command:
 - Stand up and straighten the hips and knees.
 - Move toward the stack.
 - Put the sack on the stack.
- 2.4 Sheet Materials**
- 2.4.1 When lifting sheet materials:
- Stand close to the pile of sheets in a walking stance.
 - Grasp sheet firmly at the midpoint of its long side with the closer hand.
 - Pull sheet up and toward the body.
 - Change grip using your other hand and put your fingers on top of the sheet.
 - Pull sheet up to the vertical position and to the side until one half is off the pile.
 - Grasp the lower edge of the sheet with the free hand and support the hand by placing it on your knee.
 - Stand up without bending or twisting body.

- Whenever moving sheet materials, be cognizant of wind conditions.

2.4.2 To carry sheets:

- Use drywall carts to carry sheet materials.
- Get help from another person where carts are not available.
- Apply carrying handles for manual carrying.
- Always use gloves and carrying handle for glass and other materials with sharp edges.

2.4.3 Use team lifting and carrying where other solutions are inappropriate.

- Remember that the combined strength of the team is less than the sum of individual strength.
- Select team members of similar height and strength.
- Assign a leader to the team.
- Determine a set of commands to be used such as "lift," "walk," "stop," and "down." Make sure that everyone knows what to do when they hear the command.
- Follow the commands given by the team leader.
- Practice team lifting and carrying together before attempting the task.

2.5 Material Storage

2.5.1 When storing materials on site:

- Store materials at a convenient height.
- Leave the lowest shelf unused if necessary.
- Use vertically mobile shelves to avoid bending and overhead reaching.
- Use bin racks for storing small items.
- Store heavy and frequently used materials at waist height.
- Do not store materials at floor level.
- Use hand trucks with elevating devices in storage and loading areas.
- Use trucks with a tilting device to avoid bending.
- Use elevating platforms to avoid overhead reaching.

S3NA-309-PR Mobile or Heavy Equipment

1.0 Purpose and Scope

- 1.1 Outline the safe working requirements for working with and near mobile equipment and heavy equipment operation.
- 1.2 This procedure applies to all AECOM North America based employees and operations.

2.0 Terms and Definitions

- 2.1 **Heavy equipment:** All excavating equipment include scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.
- 2.2 **Operator:** Any person who operates the controls while the heavy equipment in is motion or the engine is running.
- 2.3 **Ground personnel/workers:** Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

3.0 Attachments

- 3.1 S3NA-309-FM1 Certification of Machinery and Mechanized Equipment
- 3.2 S3NA-309-FM2 Heavy Machinery Pre-Operation Checklist
- 3.3 S3NA-309-WI Brokk180 Safety Card

4.0 Procedure

- 4.1 For work under AECOM's control, Project Managers are responsible for ensuring all equipment is in good working order and all equipment operators are qualified on the piece of machinery they are assigned.
- 4.2 Staff will confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.
- 4.3 The operator of mobile equipment is the only worker permitted to ride the equipment unless the equipment is a worker transportation vehicle.
- 4.4 A person will not operate mobile equipment unless the person has received adequate instruction and training in the safe use of the equipment, has demonstrated to a qualified supervisor or instructor competency in operating the equipment.
- 4.5 The operator of mobile equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment

4.6 Communication

- 4.6.1 Communication between site supervisors/managers, heavy equipment operators, and other site personnel is a key method of preventing serious injury or death during heavy equipment operations.
- 4.6.2 The following outline the communication requirements during heavy equipment operations:
 - Site supervisors/managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
 - Site supervisors/managers shall inform all ground personnel before changes are made in the locations of designated work areas.
 - Prior to work initiating onsite the site supervisor/manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
 - Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.

- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (i.e., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a guide shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

4.7 **Ground Personnel**

4.7.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.7.2 The following outline the clearance requirements during heavy equipment operations:

- Ground personnel shall always yield to heavy equipment.
- Ground personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment.
- A job-specific hazard analysis that identifies any special precautions shall be completed and communicated to all AECOM personnel.
- Site supervisors/managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas. Designated areas shall include boundaries and travel routes for heavy equipment. Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
- When feasible, site supervisors/managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground personnel shall never stand between two pieces of heavy equipment or other objects (i.e., steel support beams, trees, buildings, etc.).
- Ground personnel shall never stand directly below heavy equipment located on higher ground.
- If working near heavy equipment, ground personnel shall stay out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
- Ground personnel shall never work near heavy equipment.
- Personnel shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Personnel shall not talk on a cell phone while standing or walking on a roadway or other mobile equipment path.

4.7.3 At a minimum, all ground personnel and operators outside of heavy equipment shall wear the following:

- High visibility, reflective (Class 2) safety vest that is visible from all angles and made of fluorescent material and orange, white, or yellow reflective material (confirm that vest is not faded or covered with outer garments, dirt, etc.).
- Retro-reflective striping for arms and legs (night work)
- ANSI-CSA approved hard hat
- ANSI-CSA approved safety glasses with side shields
- ANSI-CSA approved work boots (unless project requirements are more stringent)
- ANSI-CSA approved hearing protection as needed
- Appropriate work clothes (i.e., full length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

4.8 Prior to work commencing

- 4.8.1 All mobile equipment will be regularly inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.
- 4.8.2 The operator will report defects and conditions affecting the safe operation of the equipment to the supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.
- 4.8.3 Exposed moving parts on mobile equipment which are a hazard to the operator or to other workers will be guarded and if a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.
- 4.8.4 An approved Underwriter's Laboratories (UL) 4A40BC fire extinguisher should be present on all mobile equipment.
- 4.8.5 Inform the operators of the equipment that AECOM employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, mobile equipment has the 'right of way'.
- 4.8.6 Where the operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.
- 4.8.7 Mobile equipment in which the operator cannot directly or by mirror or other effective device see immediately behind the machine will have an automatic audible warning device which activates whenever the equipment controls are positioned to move the equipment in reverse, and if practicable, is audible above the ambient noise level.

4.9 Operation

- 4.9.1 The operator of mobile equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment.
- 4.9.2 A supervisor will not knowingly operate or permit a worker to operate mobile equipment which is, or could create, an undue hazard to the health or safety of any person.
- 4.9.3 The operator of mobile equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement such as by setting the parking brake, placing the transmission in the manufacturer's specified park position, and by chocking wheels where necessary.
- 4.9.4 The operator will maintain the cab, floor and deck of mobile equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.
- 4.9.5 If mobile equipment has seat belts required by law or manufacturer's specifications, the operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.
- 4.9.6 When approaching or crossing the intended path of travel of mobile equipment, establish eye contact with the operator of the mobile equipment and confirm that it is safe to proceed.
- 4.9.7 Have vehicle headlights on at all times when driving in the area.
- 4.9.8 Park motor vehicles off the haul roads, or away from the work areas.
- 4.9.9 Do not wear loose clothing where there is a danger of entanglement in rotating equipment.
- 4.9.10 Do not enter the swing area of machines such as cranes, mobile drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so.
- 4.9.11 Stay out of the blind areas around mobile equipment and never assume that the equipment operators have seen them or are aware of their presence.
- 4.9.12 Maintain a distance of 60 cm (2 ft.) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, the area will be barricaded or guarded to prevent access.
- 4.9.13 Vibration from moving traffic or mobile equipment can cause excavations or spoil piles to become unstable. Be aware of the risk and keep clear.
- 4.9.14 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.
- 4.9.15 All heavy equipment shall be operated at safe speeds.

- 4.9.16 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.
- 4.9.17 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.
- 4.9.18 When feasible, operators shall travel with the "load trailing", if the load obstructs the forward view of the operator.
- 4.9.19 Slow down and sound horn when approaching a blind curve or intersection. Flagmen equipped with 2-way radio communications may be required to adequately control traffic.
- 4.9.20 Operators shall remain in cab while heavy equipment is being loaded.
- 4.9.21 Equipment shall be shut down prior to and during fueling. Do not smoke or use electrical devices while fueling. Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.
- 4.9.22 Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended. Buckets and blades are to be placed on the ground and with hydraulic gears in neutral. Heavy equipment parked on slopes shall have the wheels chocked.
- 4.9.23 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.
- 4.9.24 Never exit heavy equipment while it is in motion.
- 4.9.25 Passengers shall only ride in heavy equipment designed for occupancy of passengers.
- 4.9.26 Never ride on the outside of a piece of heavy equipment (e.g., tailgates, buckets, steps, etc.).
- 4.9.27 Site vehicles will be parked in a designated parking location away from heavy equipment.
- 4.9.28 Operators shall never push/pull "stuck" or "broken-down" equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.
- 4.9.29 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.
- 4.9.30 Equipment left unattended at night adjacent to traveled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (or the regulatory requirement for the work location) to the active roadway.
- 4.9.31 Pneumatic-tired earthmoving haulage equipment, with a maximum speed exceeding 15 miles per hour, shall be equipped with fenders on all wheels.
- 4.9.32 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not exceeded.
- 4.9.33 Steering or spinner knobs shall not be attached to steering wheels.
- 4.9.34 High lift rider industrial trucks shall be equipped with overhead guards.
- 4.9.35 When ascending or descending grades in excess of 5%, loaded trucks shall be driven with the load upgrade.
- 4.9.36 All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded when exposed to contact by persons or when they otherwise create a hazard.
- 4.9.37 All hot surfaces of equipment, including exhaust pipes or other lines, shall be guarded or insulated to prevent injury and fire.
- 4.9.38 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.
- 4.9.39 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.
- 4.9.40 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.
- 4.10 **Utilities**

- 4.10.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc.
- 4.10.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:
- Always be aware of surrounding utilities.
 - Confirm all equipment (i.e., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath of aboveground utilities.
 - Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc.

4.11 **Training**

- 4.11.1 The operator or other qualified supervisor will provide all on-site personnel with an orientation to the mobile equipment and its associated hazards and controls.
- 4.11.2 Only designated, qualified personnel shall operate heavy equipment.
- 4.11.3 Operators shall have all appropriate local, state, or federal licenses or training to operate a designated piece of heavy equipment.
- 4.11.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an AECOM operator in which case a practical evaluation is needed. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

4.12 **Inspection and Maintenance**

- 4.12.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel during work hours.
- 4.12.2 Maintenance records will be maintained on the site or project for mobile equipment.
- 4.12.3 Servicing, maintenance and repair of mobile equipment will not be done when the equipment is operating, unless continued operation is essential to the process and a safe means is provided.
- 4.12.4 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use. Operators shall not operate heavy equipment that has not been cleared for use. All machinery and mechanized equipment will be certified to be in safe operating condition (certification form attached) by a competent individual seven days prior to on-site operation, and is valid for one year.
- 4.12.5 All heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the site supervisor/manager immediately. Inspection records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use the Heavy Equipment Pre-Operation Inspection Checklist (attached).
- 4.12.6 Defective heavy equipment shall be immediately taken out of service until repaired.

4.13 **Fueling and batteries**

- 4.13.1 A well-ventilated area shall be used for refueling.
- 4.13.2 Only the type and quality of fuel recommended by the engine manufacturer shall be used.
- 4.13.3 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.
- 4.13.4 No one shall spill fuel on hot surfaces. Any spillage should be cleaned before starting an engine.
- 4.13.5 Spilled fuel shall be cleaned with cotton rags or cloths; do not use wool or metallic cloth.
- 4.13.6 Open flames, lighted smoking materials, or sparking equipment shall remain well away from the fueling area.
- 4.13.7 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.
- 4.13.8 Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

- 4.13.9 The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.
- 4.13.10 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.
- 4.13.11 Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent buildup of a static charge.
- 4.13.12 Batteries shall be serviced in a ventilated area while wearing appropriate PPE.
- 4.13.13 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first.
- 4.13.14 When installing a battery, the battery shall be connected ground post last.
- 4.13.15 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.
- 4.13.16 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.
- 4.13.17 Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water.
- 4.13.18 Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention sought immediately.
- 4.13.19 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around battery by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least 25 feet away from battery-charging stations.

5.0 Records

- 5.1 Inspection records shall be maintained with the equipment.

6.0 References

- 6.1 S3NA-205-PR Equipment Inspections & Maintenance

S3NA-309-FM1 Certification of Machinery and Mechanized Equipment

1.0 General Guidelines

- 1.1 Subcontractor equipment shall comply with all applicable requirements for motor vehicles and material handling heavy equipment contained in 29 CFR 1926 Subpart O. Heavy equipment includes, but is not limited to, drill rigs, front end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

2.0 Equipment Safety Inspections

- 2.1 The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.
- 2.1.1 All machinery and mechanized equipment will be certified to be in safe operating condition (using the attached form) by a competent individual seven days prior to onsite operation. This certification is valid for one year.
- 2.1.2 Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.
- 2.1.3 Inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.
- 2.1.4 Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist or on equivalent subcontractor forms.
- 2.1.5 Exhaustive preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the subcontractor's internal policies, schedules, and equipment SOPs.
- 2.1.6 Only designated qualified persons shall operate machinery and mechanized equipment.
- 2.1.7 The contractor shall maintain records of tests and inspections at the site and shall make the records available upon request of the designated authority; the records shall become part of the official project file.
- 2.1.8 Equipment found to not be in safe operating condition or to have a deficiency that affects the safe operation of the equipment shall immediately be taken out of service and its use shall be prohibited until safe conditions have been corrected.
- 2.1.9 All equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.
- 2.1.10 Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.

TO: AECOM

DATE:

FROM:

Project Name:

Project Location:

1. This form provides certification of machinery and mechanized equipment to be used on the referenced project for the following work:

Description of equipment work:	
Project site:	
Subcontractor providing equipment: Address:	
Dates (duration) of equipment work:	

2. Inspection and certification of machinery and mechanized equipment, as required by AECOM, has been made prior to but within seven calendar days in advance of use on the project site. Recertification will be required for equipment that is used on the project site for more than one year.

Identification of equipment (make, model, serial no.)		Date of Certification
1		
2		
3		

3. The above listed equipment has been inspected and tested as indicated above, and is CERTIFIED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

Name		Title	
Company			
Signature		Date	

4. If there are any questions regarding this certification, please contact the following AECOM representative:

S3NA-309- FM2 Heavy Equipment Pre-Operation Checklist

Project Name/Location:																
Number/Name:									Make/Model:							
Hour meter reading:																
Check the following as appropriate	Operator Name/Date			Operator Name/Date			Operator Name/Date			Operator Name/Date			Operator Name/Date			
	SAT	UNSAT	N/A	SAT	UNSAT	N/A	SAT	UNSAT	N/A	SAT	UNSAT	N/A	SAT	UNSAT	N/A	
1. Operator qualified																
2. Overhead guard (ROPS)																
3. Horn																
4. Lights																
5. Parking brake																
6. Service brakes																
7. Steering																
8. Oil level																
9. Hydraulic oil level																
10. Radiator fluid level																
11. Major fluid leaks																
12. Windows																
13. Backup alarm																
14. Tires (visual)																

15. Seat belts															
16. Fuel leaks															
17. Fire extinguisher															
18. Fuel lines secure															
19. Electrical lines															
20. Exhaust components															
Comments/Remarks:															

S3NA-309-WI Brokk180 Safety Card

1.0 Objective/Overview

The Brokk 180 is an electric-powered hydraulic device used for demolishing concrete structures and refractory linings as well as excavating. This machine includes attachments designed exclusively for demolishing work (e.g., grapple, bucket, hydraulic hammer, etc.). By using the remote control unit, an operator can move the machine and attachments in different directions and speeds from afar.



2.0 Safe Operating Guidelines

- 2.1 Prior to use, complete a pre-operation inspection to determine if the unit is in safe working condition.
- 2.2 Position the unit to safely perform the intended task, then deploy the outriggers to stabilize the unit.
- 2.3 Confirm that the operator knows what the lifting capacity is; do not exceed the lifting capacity.
- 2.4 Complete a subsurface utility clearance prior to excavating.
- 2.5 Establish a minimum 15-foot clearance around the unit.
- 2.6 Do not allow debris to build-up around the unit. Maintain good housekeeping practices.
- 2.7 Prior to removing debris from under the boom, stop, disengage the unit, and position the boom so that the attachment is at rest on the ground.
- 2.8 Personnel operating the unit with the remote control device will be properly trained and certified by a competent person.
- 2.9 The operator will be able to maintain line of sight visual contact with the unit at all times to assess hazards and site security.
- 2.10 Maintenance in excess of preventive maintenance activities (e.g., lubrication, replenishing fluids, etc.) will be performed by manufacturer personnel ONLY.
- 2.11 All operations will comply with the manufacturer's recommended policies.

3.0 Potential Hazards

- 3.1 Flying debris.
- 3.2 Crush/impact/pinch from extendable boom, tracks, and tipping over.
- 3.3 Electrocution from subsurface utilities (when excavating).
- 3.4 Hearing loss.

4.0 Training Requirements

- 4.1 Review of applicable SOPs.
- 4.2 Complete knowledge and understanding of remote control functions.
- 4.3 Review and follow manufacturers' recommended policies and practices.

5.0 Personal Protective Equipment (Level D ensemble)

- 5.1 Reflective traffic safety vest.
- 5.2 Hearing protection (ear plugs and/or ear muffs).
- 5.3 Leather gloves.

6.0 Other Safety Tips

- 6.1 Never stand under a raised boom.
- 6.2 Maintain a clearance of 15 feet around the unit while operating.
- 6.3 Pay close attention to power cords for potential tripping hazard and equipment entanglement.
- 6.4 Maintain line of sight visual contact with unit at all times (especially when operating from a distance).

S3NA-310-PR Rigging, Hoisting, Cranes, and Lifting Devices

1.0 Purpose and Scope

- 1.1 Establishes the minimum requirements for rigging, hoisting, and crane operations.
- 1.2 This procedure applies to all AECOM North America- based employees and operations.

2.0 Terms and Definitions

- 2.1 **ASME:** American Society of Mechanical Engineers
- 2.2 **Assembly/Disassembly Director(A/D Director):** An individual who meets this subpart's requirements for an A/D director, irrespective of the person's formal job title or whether the person is nonmanagement or management personnel. Assembly/disassembly will be directed by a person who meets the criteria for both a competent person and a qualified person or by a competent person who is assisted by one or more qualified persons. If the assembly/disassembly is being performed by only one person, that person will meet the criteria for both a competent person and a qualified person. For purposes of this standard, that person is considered the A/D director.
- 2.3 **Crane:** Any power-operated equipment that can hoist, lower, and horizontally move a suspended load.
- 2.4 **Critical lifts:** Hoisting operations in which a critical item or load is hoisted or moved, or in which a noncritical item is hoisted or moved in an area where critical systems or equipment could be affected. Critical lifts are lifting operations that exceed 75 percent of the crane's rated capacity or any activity involving a part, component, assembly, or piece of equipment ("item") whose dropping, upset, or collision could cause or result in the following:
 - Damage that would result in serious economic consequences.
 - Damage that would result in an unacceptable delay to schedule or other significant deleterious programmatic impact (such as the loss of vital data).
 - Undetectable damage that would jeopardize the future operations or safety of a facility.
 - A significant release of hazardous material to the environment or the creation of an undesirable condition.
 - Personnel injury or significant adverse health impact, either onsite or offsite.
- 2.5 **Controlling Entity:** An employer that is a prime contractor, general contractor, construction manager or any other legal entity that has the overall responsibility for the construction of the project, including planning, quality, and completion.

3.0 Attachments

- 3.1 S3NA-310-FM1 Crane Pre-Operation Inspection
- 3.2 S3NA-310-FM2 Critical Lift Checklist

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Project Managers (includes Supervisors)** are responsible for confirming that all aspects of this procedure are followed and adhered to on all AECOM sites and locations for critical lifts for which AECOM is the controlling entity.

4.2 General Requirements

- 4.2.1 AECOM personnel will not operate powered cranes and/or tuggers without approval from the **Project Manager, Region SH&E Manager, and legal.**

4.2.2 Some AECOM project sites may require the setup and use of tower cranes, hydraulic cranes, boom trucks, or helicopters to facilitate movement of equipment or materials on the site or project. The hazards and controls associated with these activities will be documented on the Project Safety Plan and communicated to all site personnel before work commences.

4.2.3 Prior to mobilization, **PMs** will confirm that cranes and crane operators, signal persons, and riggers are certified/qualified and that a Crane Pre-Operational Inspection Checklist (see *S3NA-310-FM1 Crane Pre-Operation Inspection* or its equivalent) is completed and reviewed prior to each use/shift.

4.3 **Assembly/Disassembly**

4.3.1 Prior to assembly of any cranes, all crews will confirm:

- Their tasks.
- The hazard associated with their tasks.
- Hazardous locations they need to avoid.

4.3.2 Should a crew member change a task then that crew member will be instructed that the above requirement will be met.

4.3.3 No assembly/disassembly of cranes shall be performed underneath power lines.

4.4 **Addressing Specific Hazards**

4.4.1 The assembly/disassembly director supervising the operation will address the following hazards associated with the operation:

- Site and ground bearing conditions will be adequate for safe operation and to support the equipment.
- Blocking material will be sufficient in size, amount, condition, and method of stacking to sustain loads and maintain stability.
- Proper location of blocking. When used to support lattice booms or components, blocking will be appropriately placed to protect the structural integrity of the equipment and prevent dangerous movement and collapse.
- Verifying assist crane loads. Loads that will be imposed on the assist crane at each phase will be verified before operations begin.
- Boom and jib pack points. The attachment points of rigging to a boom/ boom sections, or to jib/jib sections, will be suitable for preventing structural damage and for facilitating safe handling of the components.
- The center of gravity will be identified, if necessary, for the method used for maintaining stability.
- Measures designed to prevent unintended dangerous movement will be used where there is insufficient information.
- Stability upon pin removal. Boom sections, boom suspension systems, and components will be rigged or supported to maintain stability upon the removal of the pins.
- Snagging. Suspension ropes and pendants will not be able to catch on the boom or jib connection pins or cotter pins (including keepers and locking pins).
- Struck by counterweights. The potential for unintended movement from inadequately supported counterweights and from hoisting counterweights.
- Boom hoist brake failure. The brake will be tested prior to each time reliance is to be placed on the boom hoist brake to prevent boom movement.
- If found to be insufficient, a boom hoist pawl, other locking/back-up braking device, or another method of preventing dangerous boom movement (such as blocking or using an assist crane) from a boom hoist failure will be used.
- Loss of backward stability. Backward stability before swinging upward, during travel, and when attaching or removing equipment components.
- Wind speed and weather. The effect of wind speed and weather on the equipment.

4.5 **Prerequisites and Physical Qualifications**

- 4.5.1 Operators, riggers, and inspectors shall meet the minimum requirements established by this procedure as it relates to their work.
- 4.5.2 As part of this procedure, all site-specific training shall be in accordance with procedure *S3NA-209-PR Project Hazard Assessment and Planning* and 29 CFR Part 1926.1400 Cranes and Derricks in Construction.
- All sling and hoist systems used on AECOM sites will be operated, inspected, and maintained in compliance with regulations.
 - AECOM will only employ qualified/certified licensed equipment operators, signal persons, and riggers (for cranes, helicopters, etc.).

4.6 Personal Protective Equipment

- 4.6.1 All AECOM personnel operating lifting or hoisting equipment and/or functioning as riggers or signal persons shall wear a reflective equipment.
- Hard hats
 - Steel-toed boots
 - Reflective vest
- 4.6.2 Class II high visibility vest in addition to their normal personal protective Power Line Safety gear.
- 4.6.3 All cranes shall maintain the following minimal clearance distance from power lines.

Voltage (nominal, kV, alternating current)	Minimum clearance distance (feet)
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1000	45
Over 1000	As established by the utility owner/operator.

4.7 Training Programs

- 4.7.1 Power Line Safety Training
- Each operator and crew member assigned to work with the equipment will be trained on Power Line Safety.
 - Spotter: Workers as dedicated spotters will be trained to enable them to effectively perform their task under section 29 CFR 1926. 1430(g) as applicable in the US.
 - Fall Protection: Any AECOM employee will be trained who may be exposed to fall hazards while on or hoisted when exposed to a fall greater than 6 feet.
 - Crush/Pinch points: All AECOM employees who work with the equipment shall be trained to keep clear of holes and crush/pinch points (i.e., work area controls).

4.8 Basic Operator Training

- 4.8.1 Topics to be included in the basic certification criteria operator training programs shall include as a minimum the requirements listed below:
- The individual knows the information necessary for safe operation of the specific type of equipment the individual will operate, including the following:

- The controls and operating/performance characteristics.
- Use of and the ability to calculate (manually or with a calculator) load/capacity information on a variety of configuration of the equipment.
- Procedure for preventing and responding to power line contact.
- Technical knowledge:
 - Wire rope.
 - Rigging devices and their use.
 - Technical limitations of protective measure against electrical hazards.
 - The effects of load share and load transfer in multi-crane lifts.
 - Basic crane terms.
 - The basics of machine power flow systems.
 - The significance of the instruments and gauge reading.
 - The effects of thermal expansion and contraction in hydraulic cylinders.
 - Background information necessary to understand preoperation and inspection requirements.
 - How to use the safety devices and operation aids required under 29 CFR 1926.1415 and 1416.
 - How to calculate net capacity for every possible configuration of the equipment using the manufacturer's load chart.
 - How to use manufacturer-approved attachments and their effect on the equipment.
 - How to obtain dimensions, weight, and center of gravity of the load.
 - The effect of dynamic loading from wind, stopping and starting, impact loading, and moving with the load.
 - The effects of side loading.
 - The principles of backward stability.
 - Site information.
 - How to identify the suitability of the supporting ground.
 - Proper use of mats, blocking/cribbing, outriggers, stabilizers, or crawlers.
 - Identification of site hazards.
 - How to review operation plans with supervisors and other workers.
 - How to determine if there is adequate room for extension of cralers or outriggers/stabilizers and counterweights.
 - How to pick up, carry, swing, and place the load smoothly and safety on rubber tires and on outriggers/stabilizer or crawlers.
 - Proper procedure and methods of reeving wire ropes.
 - How to react to change in conditions.
 - How to shut down and secure the equipment properly while leaving it unattended.
 - Know how to apply the manufacturers' specification for operating in various weather conditions and understand how environmental conditions affect the safe operation of the equipment.
 - How to properly lever the equipment.
 - How to verify the weight of the load and rigging prior to initiating the lift.
 - How to determine where the load is to be picked up and placed and how to verity the radii.
 - Know basic rigging procedures.

- How to carry out the shift inspection.
- Know that the following operations require specific procedures and skill levels:
 - Multi crane lifts.
 - Hoisting personnel.
 - Clamshell/dragline operations.
 - Pile driving and extracting.
 - Demolition operations.
 - Operations on water.
 - Multi drum operation.
- Know the proper procedure for load control and the use of handheld tag lines.
- Know the emergency response site procedures.
- Any necessary repairs or adjustments needed for the equipment will be communicated to all affected employees at the beginning of the shift.
- Other topics identified by the training or operating organizations.

4.9 **Basic Training for Signal Person**

4.9.1 Topics to be included in the basic certification criteria signal person training programs shall include as a minimum the requirements listed below:

- Know and understand the type of signal used.
- Know and understand the standard method of hand signaling.
- Have a basic understanding of equipment operation and limitations, including the crane dynamics involved in swinging and stopping loads and boom deflection from hoisting load.
- Demonstrate that the signal person meets the requirements of 29 CFR 1926, 1400 through an oral or written test and through a practical test.

4.10 **Basic Training for Special Equipment Operators**

4.10.1 Operators of special equipment will first complete training requirements for the most applicable equipment category, such as overhead, gantry, and polar cranes; hoists; or mobile cranes. The operator of special equipment will then complete any additional classroom instruction required specific to that equipment, and will complete an on-the-job (OJT) training program for the special equipment.

4.11 **Rigger Training Programs**

4.11.1 It is recommended that training for riggers be divided into two categories:

- Training for personnel who do rigging as a major part of their job assignment.
- Training for personnel who do simple rigging jobs as an incidental part of their job assignment.

4.11.2 Topics in both categories shall include the same basics but the depth of detail shall match the job assignment.

4.11.3 Topics shall include the requirements listed below:

- Equipment operating characteristics, capabilities, and limitations.
- Use and inspection of slings, wire rope, chain, and synthetic fiber.
- Effect of sling angles on resultant sling loads.
- Restriction on use of come-alongs.
- Determination of load weights, load-weight calculations, and individual sling loads.
- Use of load-indicating devices.
- Safe work practices.
- Hand signals and communications between the signal person and operator.

- Use and inspection of all major rigging accessories or assemblies.
- Critical lift classifications and requirements.
- Use of spreader bars and other below-the-hook lifting devices.

4.12 **Crane Inspection Training**

4.12.1 Inspector training shall be established to train personnel in the inspection categories listed below.

- Overhead, gantry, and polar cranes.
- Monorail, jib, and other hoists.
- Mobile cranes.
- Wire rope.
- Rigging and rigging hardware.
- Special equipment.

4.13 **Inspector Training Subcategories**

4.13.1 To meet the needs of the discipline, the training may divide these categories into subcategories. For example, an inspector may be trained to inspect only mechanical portions of monorail hoists.

4.14 **Scope of Inspector Training**

4.14.1 Inspector training shall include basic inspection techniques and the application of manufacturer-supplied information, OSHA, ASME, and acceptance/rejection criteria.

4.15 **Testing and Examination**

4.15.1 Testing Phases

- Testing for operator, rigger, and inspector classifications shall include, as a minimum, a written examination comprised of questions covering training topics and a practical examination to demonstrate knowledge of equipment operating characteristics and practical application. A qualified instructor shall grade the practical examination. Documentation of training shall be maintained on site.

4.15.2 Examination Scores

- Scope standards shall be set for each examination by the training organization. The minimum passing score shall depend on the subject, testing technique, and test difficulty. A candidate may be given additional opportunities to take and pass the examination if the materials have been reviewed and the employee tests satisfactorily.

4.16 **Qualification, Requalification, or Disqualification**

4.16.1 Training Certificate

- After the training, testing, and OJT (if required) is successfully completed, a certificate shall be issued to the operator, rigger, or inspector. The operator's certificate shall list the equipment the operator is qualified to operate.

4.16.2 Qualification Period

- Operator, signal person, rigger, and inspector qualifications may be dependent on state or local regulations.

4.16.3 Refresher Training

- AECOM will provide refresher training on relevant topics for each employee based on the employee's conduct or an evaluation of the employee's knowledge or another indication that retraining is warranted. If for any reason the employee's manager determines that the employee should be disqualified, the manager shall write a letter of disqualification. This written statement of disqualification shall state the reason for disqualification and when, or if, the employee will be eligible to requalify.

4.17 **Critical Lift Procedure**

4.17.1 Critical Lift Plan

- Prior to commencing any critical lift activity, the PM will confirm that a Crane Pre-Operational Inspection Checklist and a Critical Lift Checklist (see attachments) are prepared for all critical lifts.
- 4.17.2 Critical Lift Plan Approval
- The Crane Operator and the Rigging Site Supervisor will review and approve the Critical Lift Plan (procedure); on projects that AECOM controls, the SH&E Department will also review and approve the Critical Lift Plan.
 - Revisions to the procedure will be reviewed and approved in the same manner as the original procedure.
- 4.17.3 Pre-Lift Meeting
- Before the Critical Lift is performed, a safety meeting with participating personnel will be held. During this meeting, the relevant portions of the applicable Task Hazard Analysis (THA) will be covered, the Critical Lift procedure will be reviewed, and questions/concerns related to personnel involved in the lift and operation of equipment will be resolved. The safety meeting will be documented on a Tailgate Safety Briefing Form as required by *S3NA-210- PR Project Safety Meetings*.
- 4.17.4 Critical Lift Plan Documentation
- Once completed, the SH&E Department will maintain copies of the Critical Lift Plan. Documentation of a critical lift will include the following:
 - The Critical Lift Checklist, recording job completion with approval signatures.
 - Documentation of the safety meeting including, at a minimum, the meeting date and list of attendees.
 - Any additional documentation deemed appropriate by the SH&E Department or other responsible personnel (e.g., lessons learned).
- 4.17.5 Preparing for Rigging & Hoisting
- The passing of loads over client facility equipment, trailers, public roads, and sidewalks shall only be done if the necessary precautions have been taken for the safety of all workers and other persons.
 - When operating conditions are such that the boom of the crane swings over property lines or operating transportation systems for the site or project, the owners of adjacent properties or systems shall be consulted. A diagram should be prepared detailing the proposed swing paths for the crane.
 - All rigging equipment, fittings, and devices will be of adequate strength for the application. All components will be capable of supporting at least five times the maximum load to which they may be subjected. If the load exceeds 85 percent of the equipment capacity or involves multi-lifts, hoisting and rigging operations will be approved by a professional engineer.
 - At no time is the operator of the equipment to perform lifts that exceed the load rated capacity of the equipment.
 - Only loads that have been properly rigged or have been placed in containers designed for hoisting may be lifted.
 - Loads should only be rigged for hoisting by qualified persons.
 - Inspect all slings before each use and maintain them in good condition. All ropes, hardware, and other fittings will be inspected regularly for wear, cracks, severe corrosion, kinks, bird caging, broken strands, burn marks, chemical damage, deformation, or other signs of obvious damage.
 - Use slings of proper reach. Never shorten a line by twisting or knotting or with chain slings. Never use bolts and nuts.
 - Estimate the center of gravity or point of balance. The lifting device should be positioned immediately above the estimated center of gravity.
 - Select shackle and sling sizes that exceed the minimum working load limits.
 - The signaller will be properly identified and will understand proper signaling techniques.

- Hoisting areas will be secured with a barrier in areas where public access is a concern. Appropriate warning signage will be posted to indicate that overhead work is being performed in the area.
- Wire ropes will be lubricated to reduce friction between wires and strands.
- Tag lines will be used to control loads.
- When two or more slings are to be connected to a hook, a shackle should be used.

4.18 **During Transport of the Load**

- When being assisted by a signal person ("spotter"), the equipment operator will maintain continuous communication with the signal person. If communication with the signal person is lost, the operator will not continue until communication has been restored.
- All personnel will be clear of the load being lifted and the load will be double-checked to ensure that it is secure before it is lifted.
- No one shall be permitted to ride the lifting hook, ball, or load.
- At no time are loads to be passed over any workers or other persons.
- No one shall pass under any part of a suspended load. Always try to anticipate the movement of the load and avoid entering the swing path of the load.
- Prepare a place to land the load and lower the load gently to keep it stable before slackening the sling or chain.
- Stay clear of loads when slings are being pulled out from underneath.
- Loose loads will be blocked before unhooking.
- If you are using a sling, a significant amount of electrical charge is generated by a helicopter and rain or light blowing snow can increase this electrical charge. To avoid receiving a stunning (but not harmful) shock, the hookup person (who is trying to unhook the load) should resist reaching up to the machine or the cable as it hovers over the load. It is important to let the load or the cable ground itself first. Under some conditions the current can arc up to 20 centimeters.

5.0 **Records**

- 5.1 All training records shall be maintained in accordance with *S3NA-003-PR SH&E Training*.
- 5.2 All inspection records will be maintained on site with the machine.

6.0 **References**

- 6.1 29 CFR Part 1926.1400 – Cranes and Derricks in Construction
- 6.2 S3NA-003-PR SH&E Training
- 6.3 S3NA-202-PR Competent Person Designation
- 6.4 S3NA-309-PR Mobile or Heavy Equipment
- 6.5 S3NA-406-PR Electrical Lines, Overhead
- 6.6 S3NA-408-PR Elevated Work Platforms and Aerial Lifts
- 6.7 S4NA (US)-413-PR1 Process Safety Management

S3NA-310-FM1 Crane Pre-Operation Inspection

PROJECT INFORMATION	
Project Name:	
Project/Contract Number:	Date:
Site Safety Coordinator:	Crane Operator:
Crane Model No:	Crane Manufacturer:
Crane Number:	Hours:
GENERAL REQUIREMENTS	
1. Safety Manager has reviewed and accepted work platform use	☐ Yes ☐ No
2. Job Hazard Analysis completed and attached.....	☐ Yes ☐ No
3. Critical Lift Checklist completed and attached	☐ Yes ☐ No
4. Area barricaded or otherwise secured from unauthorized personnel entrance.....	☐ Yes ☐ No
CRANE REQUIREMENTS	
5. Load lines are capable of supporting 5 times maximum intended load (10 times for rotation-resistant wire rope)	☐ Yes ☐ No
6. Total weight of loaded platform and related rigging does not exceed 50 percent of rated capacity per boom angle and radius.....	☐ Yes ☐ No
7. Crane does not have live boom; load line hoist is regulated with a device other than the hoist brake that regulates lowering speed.	☐ Yes ☐ No
8. Crane has a positive acting anti-two-block device that deactivates hoisting action	☐ Yes ☐ No
9. Boom angle indicator is functional and readily visible to the operator	☐ Yes ☐ No
RIGGING REQUIREMENTS	
10. Wire rope, shackles, and other rigging hardware are capable of supporting 5 times the maximum intended load.....	☐ Yes ☐ No
11. Lifting bridles are four legs of equal length connected by common ring.....	☐ Yes ☐ No
12. All eyes in wire rope slings are fabricated with thimbles	☐ Yes ☐ No
13. Shackle bolts are secured against displacement (pinned or moused)	☐ Yes ☐ No
14. Safety line passes through the eye of each bridle leg and is attached above the headache ball or to the crane hook.....	☐ Yes ☐ No
15. Hook throat opening has been closed by pinning, bolting, or mousing safety latch.....	☐ Yes ☐ No
16. Rigging is dedicated for platform use and is not used for any other purpose when not hoisting personnel.....	☐ Yes ☐ No
PLATFORM REQUIREMENTS	
17. Platform is posted with its weight and rated load capacity or maximum intended load	☐ Yes ☐ No
18. A grab rail is installed inside the entire perimeter of the platform.....	☐ Yes ☐ No
19. Access gates, if installed, do not swing outward and have a device to prevent accidental opening	☐ Yes ☐ No
20. In addition to hard hats, employees are afforded overhead protection by the platform when exposed to falling objects.....	☐ Yes ☐ No
21. All edges exposed to employee contact are smoothed to prevent injury from punctures or lacerations.....	☐ Yes ☐ No
PLATFORM LOADING	
22. The platform is not loaded in excess of its rated capacity	☐ Yes ☐ No
23. The number of employees does not exceed the number required for the work to be performed.....	☐ Yes ☐ No
24. The platform is not used to hoist tools or materials except for those necessary for employees to perform the work.....	☐ Yes ☐ No
25. Personnel, tools, and materials are evenly distributed within the platform	☐ Yes ☐ No

PROOF-TESTING, TRIAL LIFT, AND INSPECTION

26. The platform and rigging has been proof tested to 1.25 times the rated capacity (minimum duration, 5 minutes) ☐ Yes ☐ No
27. After proof testing, the platform has been inspected for deficiencies ☐ Yes ☐ No
28. Loaded at least to anticipated weight, a trial lift from the ground to each location the platform is to be hoisted and positioned has been conducted (may be done concurrently with proof testing and must be repeated if the crane is repositioned). ☐ Yes ☐ No
29. After trial lift and prior to hoisting employees, an inspection has been made to ensure that the hoist rope is free of kinks, that multiple lines (if used) are not twisted around each other, that the primary attachment is centered over the platform, and that the load rope is properly stated on drums and sheaves. ☐ Yes ☐ No

OTHER

30. Tag lines are attached and ready for use, or a determination has been made that the use of tag lines creates an unsafe condition ☐ Yes ☐ No
31. A pre-lift meeting with all affected employees has been conducted ☐ Yes ☐ No
32. There is no adverse weather condition, winds are less than 15 mph, and there is no electrical storm activity or heavy rain ☐ Yes ☐ No
33. Employees will remain in continuous sight of and in communication with the operator or signal person. If radios are used, they have been tested..... ☐ Yes ☐ No
34. Employees have been tied off with full body harness above the headache ball, or to the load block ☐ Yes ☐ No

Remarks:

Crane Inspector:

Print Name Signature Organization Date

Site Safety Representative:

Print Name Signature Organization Date

Project Manager:

Print Name Signature Organization Date

S3NA-310-FM2 Critical Lift Checklist

A critical lift is any lift that exceeds 75% of the crane's rated capacity, involves more than one crane, involves unusual or severe hazards, or any lift the PM identifies as Critical.

ADMINISTRATIVE INFORMATION:	
PROJECT NAME:	
PROJECT MANAGER (PM):	DATE:
SUBCONTRACTOR NAME:	SUBCONTRACTOR PM:
SUPERVISOR IN CHARGE:	CRANE OPERATOR:
SIGNAL PERSON 1:	SIGNAL PERSON 2:
CRITICAL LIFT REQUIREMENTS:	
1. <u>LIFT CONDITIONS:</u> a. Crane pad level, firm & stable ☐ Yes ☐ No b. Has longest lift radius been identified ☐ Yes ☐ No c. Have special hazards been identified ☐ Yes ☐ No i. Power lines ☐ Yes ☐ No ii. Obstructions in lift path ☐ Yes ☐ No iii. Location of utilities and structures ☐ Yes ☐ No iv. Weather conditions ☐ Yes ☐ No d. Has a lift sequence been established and reviewed ☐ Yes ☐ No e. Are personnel clear of lift area ☐ Yes ☐ No	
2. <u>LOAD CONDITIONS:</u> a. Is exact load weight known ☐ Yes ☐ No _____ Pounds b. Is weight of rigging known ☐ Yes ☐ No _____ Pounds c. Is the weight of the load block and line known ☐ Yes ☐ No _____ Pounds d. Has the center of gravity of the load been established ☐ Yes ☐ No e. Is rigging adequate and in good condition ☐ Yes ☐ No	
3. <u>COMMUNICATIONS:</u> a. Have hand signals been reviewed ☐ Yes ☐ No b. Has location of spotters been established ☐ Yes ☐ No c. If radios are used: ☐ Yes ☐ No i. Have they been tested from location of use ☐ Yes ☐ No ii. Is frequency clear of other radio traffic ☐ Yes ☐ No	
4. <u>CONDITION OF CRANE (CHECKED BY OPERATOR):</u> a. Is pad blocking adequate and substantial ☐ Yes ☐ No b. Is the crane level ☐ Yes ☐ No c. Are ropes and pendants in good condition ☐ Yes ☐ No d. Are adequate parts of line being used ☐ Yes ☐ No e. Is line revved properly ☐ Yes ☐ No f. Are controls in good working condition to insure smooth operation ☐ Yes ☐ No g. Is the load within chart limits for the above conditions ☐ Yes ☐ No h. What is the boom length i. What is the maximum boom angle j. What is the maximum load radius	
5. <u>PRE-LIFT MEETING:</u> Has a pre-lift meeting been conducted with all persons involved to review this information ☐ Yes ☐ No	
6. <u>LIFT DIAGRAM (INCLUDE CRANE SETUP, RADIUS, LOAD, ETC.):</u> 	

APPROVAL SIGNATURES:	
SUBCONTRACTOR SUPERVISOR IN CHARGE:	SUBCONTRACTOR PM:
AECOM PROJECT MANAGER:	AECOM SAFETY REPRESENTATIVE:

S3NA-313-PR Wildlife, Plants and Insects

1.0 Purpose and Scope

- 1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as “biological hazards”.
- 1.2 This procedure applies to all AECOM North America (NA) based employees and operations.

2.0 Terms and Definitions

- 2.1 **Field Work:** Field work is defined as any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance (OM&M), biological surveys, and other work that meets the definition of field work.
- 2.2 **Poisonous:** Capable of harming or killing by or as if by poison; toxic or venomous.
- 2.3 **Phase I Environmental Site Assessment:** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of CERCLA defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called “All Appropriate Inquiry” or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.
- 2.4 **Phase II Environmental Site Assessment:** Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

3.0 Attachments

- 3.1 S3NA-313-FM Tick Test Request Form
- 3.2 S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart
- 3.3 S3NA-313-WI2 Ticks
- 3.4 S3NA-313-WI3 Poisonous Spider Identification
- 3.5 S3NA-313-WI4 Mosquito Borne Diseases
- 3.6 S3NA-313-WI5 Plants of Concern
- 3.7 S3NA-313-WI6 Wild Parsnip Identification
- 3.8 S3NA-313-WI7 Configuration Clothing for Protection against ticks and insects
- 3.9 S3NA-313-WI8 Insect Repellent Active Ingredient Product Information
- 3.10 S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application
- 3.11 S3NA-313-WI10 Bird Droppings Safe Work Practices
- 3.12 S3NA-313-WI11 Large Carnivores
- 3.13 S3NA-313-WI12 Bear Safety
- 3.14 S3NA-313-WI13 Small Mammals
- 3.15 S3NA-313-WI14 Snakes
- 3.16 S3NA-313-WI15 Alligators

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Project Managers and Supervisors

- **Project Managers** and **Supervisors** responsible for managing field work will work with employees conducting the work to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- If biological hazards are identified as an exposure risk in the workplace, control measures that may be applied at the project site will be implemented to reduce the potential for employees to be exposed to injuries and illnesses while working.
- If the exposures cannot be eliminated or managed with engineering controls, the **Project Manager** or **Supervisor** will approve the use of PPE and protective repellents and lotions and ensure that exposed employees have and use these products.

4.1.2 District Operations Manager

- Approve the costs associated with the PPE and materials necessary to protect employees from the biological hazards covered by this Procedure.
- During the performance of project site visits, managers will assess the precautions being taken against the requirements of this Procedure.

4.1.3 Region SH&E Manager

- Participate in incident reporting and investigations when appropriate.
- Work with office SH&E Department and project Safety Professionals, provide training and guidance to employees consistent with this procedure.
- Assist project teams in identifying hazards and selecting appropriate control measures.

4.1.4 Operational Managers

- Assure implementation of this procedure in their regions and offices.
- Participate in incident reporting and investigations when appropriate.

4.1.5 Employees

- Participate in required training on this procedure.
- Participate in the development of THAs for the project, identify control measures to limit exposure and request PPE, repellents, and protective lotions required by this Procedure.
- Obtain approval from **Project Managers** and/or **Supervisors** to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting as detailed within the Procedure.
- Participate in incident reporting and investigations when appropriate.

4.2 Overview

4.2.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM **employees**. Note that this discussion is not a fully encompassing list of hazards and as part of the Task Hazard Analysis conducted by the project team, additional consideration must be given to other biological hazards.

4.2.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this Procedure.

4.2.3 If additional biological hazards are identified, the project team should contact the **Region SH&E Manager** to discuss the hazards and identify effective control measures that can be implemented at the project site.

4.3 Planning and Hazard Assessment

- 4.3.1 The AECOM project team shall ensure that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this SOP are integrated into the project planning process and conveyed to AECOM employees conducting the field work. This information shall be communicated in the site specific Safe Work Plan (SWP), Health and Safety Plan (HASP), the THA, pre-project kickoff meetings, and tailgate meetings at the project site.
- 4.3.2 It is important to note that the precautions to be taken by AECOM **employees** to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the project-specific hazard assessments in accordance with *S3NA-511-PR Heat Stress*.
- 4.3.3 During the preparation of the project specific Safe Work Plan (SWP), HASP and project specific THA, **Project Managers, Supervisors**, and the project staff will determine what biological hazards might be encountered during the project and will prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.
- 4.3.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40°F for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.
- 4.3.5 The hazard assessments must also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.
- 4.3.6 **Employees** in the field where biological hazards exist will not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the affected employees shall stop work and not proceed until the THA has been amended and protective measures implemented.
- 4.3.7 A decision flow chart and table for determining the potential for biological hazards in US states has been provided in *S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart Hazard Assessment (US States)*.

4.4 Restrictions

- 4.4.1 Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements.

4.5 Employee Sensitivity

- 4.5.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin, therefore it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Staff should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.
- 4.5.2 **Employees** also need to consider whether they are sensitive to the use of insect repellents.

4.6 Personal Protective Equipment

- 4.6.1 The selection of Personal Protective Equipment is dependent on the hazard present and a PPE Hazard Analysis should be conducted to determine situation specific PPE required. (refer to SOP *S3NA-208 Personal Protective Equipment Program*)
- 4.6.2 At a minimum, in addition to any project specific PPE, long sleeves and pants should be worn on field projects where the risk of biological encounter exists.
- 4.6.3 PPE for insects should include sunscreen, bug nets, bug jackets, or insect repellent. Socks should be pulled over pant legs and rubber boots should be worn where the threat of exposure is anticipated.

- 4.6.4 Epi-pens¹ or other personal medication should be carried by those staff that are aware that anaphylactic shock is a possibility for them.

4.7 Remedies

- 4.7.1 If you suspect exposure to an irritant, identify the cause including obtaining a specimen if possible. Document the occurrence as a safety precaution if the exposure should lead to complications.

- 4.7.2 Go to a doctor or call WorkCare for advice if necessary.

4.8 Training

- 4.8.1 Field staff must learn to recognize organisms that represent a threat in the regions in which they work – experienced field staff must provide on the job training to assist staff with hazard recognition.

- 4.8.2 Staff who have severe allergic reactions are strongly recommended to notify their project manager, field supervisor, and co-workers of the potential for a reaction and demonstrate what medication they might need and how it is administered.

4.9 Insects

- 4.9.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, Fire Ants and European Fire Ants.

- 4.9.2 Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.

- 4.9.3 Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will insert mouthparts to drink blood. The most serious concern is a possibility of contracting Lyme disease which is spread by the Black-legged or Deer Tick. The larger Wood Ticks are widespread in the west but these rarely carry diseases. Occasionally a tick can cause Tick Paralysis if it is able to remain feeding for several days. Full recovery usually occurs shortly after the tick is removed.

- 4.9.4 The Fire Ant (southern and western US) and the European Fire Ant (northeastern US and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.10 Ticks

- 4.10.1 Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and therefore most related illnesses.

- 4.10.2 The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in S3NA-313-WI2 *Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.

- 4.10.3 When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.

- 4.10.4 To remove ticks that are embedded in skin, use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out.

¹ Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self administer the dose.

- 4.10.5 Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If noted, report to medical help for inoculation.
- 4.10.6 If possible, submit any ticks found or captured to the following laboratories for species identification.
- Canada – National Microbiology Laboratory (NML) (Phone: (204) 789-2000; email: ticks@phac-aspc.gc.ca). The NML will conduct diagnostic testing for the Lyme disease agent as well as several other disease-causing agents. The NML results will not only benefit anyone bit by the tick, but will also assist the NML in their goal to accurately map the distribution of the tick species and associated diseases in Canada.
 - US – IGeneX, Inc. (Phone: (800) 832-3200; www.igenex.com). IGeneX will test the tick for the presence of the Lyme bacteria. They also test ticks for *Babesia microti* and/or *Babesia duncani* (formerly WA-1), Ehrlichia, Bartonella henselae and Rickettsia (Rocky Mountain Spotted Fever). These diseases are also carried by ticks. The testing request form is attached as *S3NA-313-FM Tick Test Request Form*.
- 4.10.7 If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.
- 4.11 **Chiggers**
- 4.11.1 Chiggers are mite larvae, approximately ½ mm in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.
- 4.11.2 Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.
- 4.12 **Spiders**
- 4.12.1 Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.
- 4.12.2 Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the US and others outside the US inject a toxin that causes extensive tissue damage and intense pain.
- 4.12.3 Additional information on spider identification can be found in attachment *S3NA-313-WI3 Poisonous Spider Identification*.
- 4.13 **Mosquitoes**
- 4.13.1 Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus. Positive cases of West Nile Virus have been confirmed throughout North America since 2007.
- 4.13.2 Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death, so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus.
- 4.13.3 When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.
- 4.13.4 CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk to employees working in outdoor environments. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:
- Eastern Equine encephalitis (EEE)
 - Western Equine encephalitis (WEE)
 - West Nile Virus
 - St. Louis encephalitis (SLE)
 - La Crosse (LAC) encephalitis

- 4.13.5 Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3NA-313-WI4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.
- 4.14 **Bees and Hornets**
- 4.14.1 Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, and even on open ground. The flying/stinging insects are not specifically included in the scope of this procedure and the PPE and other protective measures are not normally effective against aggressive, flying insects. Avoid reaching into areas where visibility is limited.
- 4.14.2 If stung by a wasp or bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.
- 4.14.3 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.
- 4.15 **Poisonous Plants**
- 4.15.1 Poisonous plants including poison ivy, oak and sumac, which contain the oil urushiol that produces a rash, can lead to dermatitis and infections. Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the affected area, increasing susceptibility for an infection. It should be noted that each time an employee is exposed to urushiol the severity of the reaction increases. In cases that involve severe rashes, medical treatment may be necessary to control the rash.
- 4.15.2 Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves. See *S3NA-313-WI6 Wild Parsnip Identification* for additional information and photos of wild parsnip.
- 4.15.3 Plants that field staff should recognize and take precautions to avoid include: Poison Sumac, Poison Ivy (terrestrial and climbing), Poison Oak, Giant Hogweed² (or Giant Cow Parsnip), Wild Parsnip, Devil's Club and Stinging Nettle. Many others are extremely poisonous to eat (e.g., Poison Hemlock; Water Parsnip) – do not eat anything that has not been identified.
- 4.15.4 See *S3NA-313-WI5 Plants of Concern* for information on locations where some of these poisonous plants are found in the US.
- 4.15.5 Of the toxic plants in the cashew family, Poison Ivy (*Rhus radicans*) is most widespread occurring across southern Canada. It is usually a low sprawling shrub or ground cover but in southwestern Ontario it also grows as a thick woody vine that grows high into the tree canopy. Poison Oak (*Rhus diversiloba*) is a low shrub that grows only in southwestern British Columbia and Poison Sumac (*Rhus vernix*) is a tall shrub that grows in southern Ontario but is quite rare. All of these plants possess urushiol oils in nearly all parts of the plant. Touching the plant causes an itchy skin rash that shows up several days following contact. People have a wide range of reactions which in severe cases can lead to oozing blisters on large parts of the body. Some people apparently never react and others may develop an allergy after no reaction after years of frequent contact.
- 4.15.6 Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the Giant Hogweed (*Heracleum mantegazzianum*), a garden that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 5 m in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by Meadow Parsnip (*Pastinaca sativa*) and Cow Parsnip (*Heracleum lanatum*). Meadow Parsnip can be very abundant on disturbed sites.
- 4.15.7 Nettles, particularly Stinging Nettle (*Urtica dioica*) and Wood Nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.

² *Phytophotodermatitis* producer: keep skin covered and wash well after exposure

- 4.15.8 Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. Fragile Prickly Pear cactus (*Opuntia fragilis*) is common in semi arid areas of the southern Prairie Provinces and interior British Columbia. Pieces will break off and imbed into one's ankle by scarcely brushing them. Devils Club (*Oplopanax horridum*) can form dominant understorey in humid forests among the western mountains. It contains semi-soft spines on the stems that will break off in the skin causing considerable irritation for days. In some areas of Ontario, Prickly-ash (*Zanthoxylon americanum*) a tall shrub with sturdy spines, sometimes forms dense single stands that are nearly impenetrable.
- 4.15.9 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying not to eat any berries or plants if you are not absolutely sure of their identity.
- 4.15.10 Of all the plants, Giant Hogweed presents the most serious health risk. Field staff should learn to recognize and avoid it if encountered.
- 4.15.11 Employees who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will then forward the report to the **Regional SH&E Manager**.
- 4.16 **Additional Biological Hazards**
- 4.16.1 Additional Work Instructions are provided for protection and prevention from the following:
- S3NA-313-WI11 Large Carnivores
 - S3NA-313-WI12 Bear Safety
 - S3NA-313-WI13 Small Mammals
 - S3NA-313-WI14 Snakes
 - S3NA-313-WI15 Alligators
- 4.17 **Habitat Avoidance, Elimination, and/or Control**
- 4.17.1 Ticks, Spiders and Insects
- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the project site of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks, spiders, and poisonous plants during the clearing process.
 - AECOM projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the AECOM **project manager** shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
 - When projects must be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures outlined in this SOP shall be prescribed.
 - Mosquitoes breed in stagnant water and typically only travel a quarter mile from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. **Project Managers** and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
 - If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.
- 4.17.2 Poisonous Plants
- If poisonous plants are identified in the work area, **employees** will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other **employees** to avoid the designated area. If **employees** decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the **Project Manager** and/or Client to gain approval.

- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion will need to occur with the **Project Manager** and Client to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- AECOM **employees** shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure including PPE is prepared in advance and approved by the **Region SH&E Manager**. If a SWP or HASP is prepared for the project, the clearing procedure should be included and the required PPE specified.

4.17.3 Bird Droppings

- Bird excrement may be encountered due to the nesting of pigeons and other birds and winged animals (e.g., bats) on or in structures. Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3NA-313-WI10 Bird Droppings Safe Work Practices*.

4.18 Personal Precautions and Personal Protective Measures

4.18.1 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Wear protective clothing.
- When working in areas where there may be small insects that “hitchhike” (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins.

4.18.2 PPE

- The following recommendations may be considered by the project team to determine if the use of PPE is necessary for the type of work planned: Disposable gloves may be cotton, leather, or synthetic materials and must not be reused after removing.
- Clearing activities present the greatest risk of employee exposure but reduce the risks once completed. Recommendation – AECOM employees actively participating in clearing will use full protection from ticks and insects during the clearing activities including insect repellents, Tyvek® coveralls, and gloves.
- If the foliage being cleared includes poisonous plants, exposed skin will be treated with a dermal barrier cream such as Tecnu®’s Oak ‘n Ivy Armor or Enviroderm’s Ivy Block and either a full face respirator or a half face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.
- Work in habitats with direct exposure to ticks, mosquitoes, and poisonous plants is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from biological hazards including insect repellents, Tyvek® coveralls or full length clothing, poisonous plant barrier creams and wipes, and gloves.
- Work in habitats with direct exposure to ticks and mosquitoes and no exposure to poisonous plants is likely and the scope of work typically does allow for worksite control measures like vegetative clearing: Recommendation – Protection including insect repellents and Tyvek® coveralls or full length clothing.
- Work in habitats with direct exposure to poisonous plants and no exposure to ticks or insects is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from poisonous plants including insect repellents, Tyvek® coveralls or full length clothing, poisonous plant barrier creams and wipes, and gloves.
- Industrial/Commercial/Office Facilities – Direct contact with biological hazards is considered unlikely or low risk: Recommendation – PPE for biological hazards are not required; however, Tyvek coveralls and insect repellent should be available if exposure to spiders, flying insects, or other biological hazards is encountered.
- Work in areas where no biological hazards are expected because of the local environment, winter weather, or property development: Recommendation – PPE for biological hazards is not required;

however, Tyvek® coveralls and insect repellent should be available if exposures to spiders, flying insects, or other biological hazards are encountered.

- The following precautions and protective measures shall be implemented by AECOM **employees** conducting field work where the biological hazards covered by this SOP exist:

4.18.3 Insects, Spiders, and Ticks

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Application of insect repellent to clothing and/or exposed skin.
- Routine personal checks.
- Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If stung by an insect or bitten by a spider or tick, attempt to identify the attacker and notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite, or any swelling or numbness beyond the site of the bite.
- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the Centers for Disease Control and Prevention for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, **employees** can apply DEET to their skin and let dry prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.18.4 Poisonous Plants

- **Employees** working in areas where poisonous plants exist shall wear either long sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. **Employees** must not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants will be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.
- Employees who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will forward the report to the RSHEM.
- For dermatitis caused by Poison Ivy, Poison Oak, or Poison Sumac, calamine lotion is effective.

4.19 Selection and Configuration of Field Clothing

4.19.1 At a minimum, **employees** will wear long legged pants and long sleeve shirts or Tyvek® coveralls to reduce the amount of exposed skin when biological hazards are identified at the work site. Gloves will also be worn consistent with the recommendations of the site-specific SWP, HASP and/or THA to minimize hand exposure.

4.19.2 Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically-treated clothing will be taped to the work boots.

4.19.3 See *S3NA-313-WI7 Configuration Clothing for Protection* against ticks and insects for illustrations and instructions for configuring, taping, and tucking clothing.

4.19.4 Chemical Treatment of Field Clothing

- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the Centers for Disease Control and Prevention for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, **employees** can apply DEET to their skin prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.19.5 Permethrin

- When selected as part of a project's PPE requirements, the AECOM **Project Manager** shall ensure that field teams wear clothing treated with the chemical Permethrin, which is an insecticide with repellent properties registered with the U.S. Environmental Protection Agency (EPA), and recommended by the CDC. Information regarding the toxicity and product safety of Permethrin is provided in *S3NA-313-WI8 Insect Repellent Active Ingredient Product Information*. Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) employee treatment of their personal clothing using 0.5% Permethrin spray. AECOM strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3NA-208-PR Personal Protective Equipment Program* and with the approval of your **Supervisor**. For more information visit the AECOM NA SH&E website.
- The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for 5 wash cycles.
- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that must be applied directly to the skin.. Costs for clothing shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as a department expense. **Supervisor** or **Department Manager** approval is required prior to purchase.
- If an employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they must either: 1) wear Tyvek® coveralls taped to the boots, 2) full length clothing consisting of long legged pants and long sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an organic alternative to their work clothing.

4.19.6 Manual Treatment of Field Clothing

- If clothing pre-treated with Permethrin is not available or not purchased prior to field work, employees may manually treat their clothing with Permethrin spray. The outer surfaces of all external clothing to be worn during field work should be treated with 0.5% Permethrin spray a minimum of 2 to 4 hours prior to field work (boots, trousers, shirt, jackets, rain gear; refer to Section 4.16 for selection of field clothing) in accordance with recommendations provided by the New York State Department of Health presented in *S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application*. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. Clothing treatment will last for approximately 5 wash cycles (check the specific instructions for the product used.)

4.19.7 Lemon Eucalyptus

- Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.

4.19.8 Purchase of PPE and Repellents and Lotions

- Costs for clothing, repellents, lotions, and other PPE shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as a department expense. **Supervisor** or **Department Manager** approval is required prior to purchase.
- Material Safety Data Sheets (MSDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a MSDS should be obtained for the products used and placed into the office MSDS library and site-specific health and safety plans. Selected MSDSs are available on the AECOM NA SH&E web site.

4.20 **Personal Hygiene and Body Checks**

- 4.20.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.
- 4.20.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.
- 4.20.3 **Employees** will shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3NA-313-WI2 Ticks*, the tick should be preserved with the date and location of the bite noted, and retained for identification if medical treatment is needed as described in Section 4.13.1 of this Procedure.
- 4.20.4 The presence of an imbedded tick, rash, or abnormal reactions will be reported as an SH&E Incident to the **Project Manager** or **Supervisor** who will forward the report to the **RSHEM** for follow up.

5.0 **Records**

- 5.1 None

6.0 **References**

- 6.1 Public Health Agency of Canada (<http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php>) on Ticks and Lyme Disease in Canada
- 6.2 Public Health Agency of Canada (<http://www.phac-aspc.gc.ca/wn-no/index-eng.php>) on West Nile Virus
- 6.3 United States Center for Disease Control (CDC) (<http://www.cdc.gov/ncidod/dvbid/lyme/index.htm>) on Lyme Disease
- 6.4 New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents. <http://www.health.state.ny.us/nysdoh/westnile/pdf/2737.pdf>
- 6.5 Spectrum Brands, 2007. Personal Insect Repellent Products. http://www.spectrumbrandshomeandgarden.com/CorpNav/AboutSpectrum/ProductCategories/insect_repellent.htm
- 6.6 U.S. Centers for Disease Control and Prevention, 2004. Tick Management Handbook. <http://www.cdc.gov/ncidod/dvbid/lyme/resources/handbook.pdf>
- 6.7 U.S. Environmental Protection Agency, 2006. Permethrin Facts: Preregistration Eligibility Decision Fact Sheet. http://www.epa.gov/oppsrrd1/reregistration/REDs/factsheets/permethrin_fs.htm
- 6.8 U.S. National Pesticide Information Center, 1997, National Pesticide Telecommunications Network Fact Sheet for Permethrin. <http://npic.orst.edu/factsheets/permethrin.pdf>
- 6.9 U.S. Environmental Protection Agency, 2005. New Pesticide Fact Sheet, Picaridin <http://www.epa.gov/opprd001/factsheets/picaridin.pdf>

S3NA-313-FM Tick Test Request Form



IGeneX, Inc.
795 San Antonio Road
Palo Alto, CA 94303
800/832-3200
www.igenex.com

TICK TEST REQUEST FORM

Revised: JUNE 2008

TO SEND A TICK:

- Place ticks (up to 20) in a small tube or plastic baggy with a small piece of moist cotton.
 - Place container in a sealed plastic bag.
 - Fill out lower portion of this form.
 - Place form, check and sealed plastic bag in padded envelope or box.
 - Send to IGeneX, Inc. and mark front of envelope or box with "TT".
 - IGeneX does not "TYPE" or determine the species of the ticks. If you want to "TYPE" your tick, please contact your local Vector Control Center.
 - Once your tick(s) have been processed, the tick can not be returned to you.
 - For Multiple Ticks: up to 20 ticks will be tested together at one time unless indicated otherwise.
- If ticks are tested separately, the charge is per tick. Please test my ticks separately. Yes ☐

Please test the tick by PCR for:

☐	Test 140	Lyme Disease (B. burgdorferi)	\$65.00
☐	Test 689	Babesiosis (B microti and/or B duncani)	\$65.00
☐	Test 148	Ehrlichiosis (Ehrlichia)	\$65.00
☐	Test 290	Bartonella henselae	\$65.00
☐	Test 975	Rickettsia	\$65.00

Name and Address of Sender:

If you would like results faxed or called, please indicate below. Otherwise, results will be mailed by USPS.

____ Please fax my completed results to:
() -

Phone: () _____

____ Please call me with my results at:
() -

☐ Check enclosed payable to IGeneX, Inc.

☐ Please charge my credit card for the above tests:

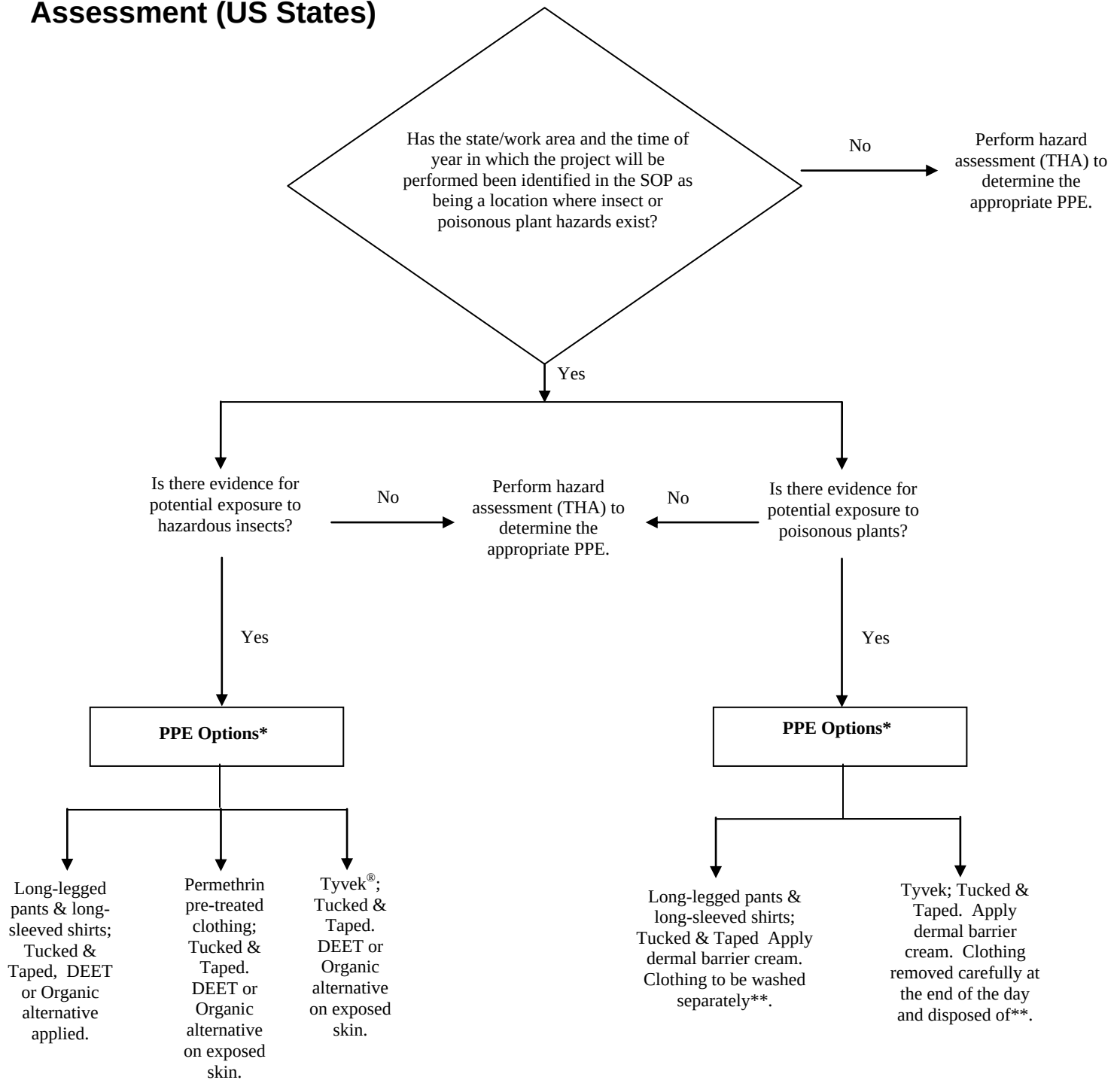
☐ Visa ☐ Mastercard ☐ Discover

Card Number: _____

Exp. Date _____

Signature _____

S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart Hazard Assessment (US States)



* indicates that when both insect and poisonous plant hazards are recognized hazards at a project site, the most conservative combination of the available PPE choices will be selected.

** indicates that clothing that has been known or suspected to have come in contact with poisonous plants must be washed before it can be worn again. Similarly, Tyvek® that has been known or suspected to have come in contact with poisonous plants will be disposed of rather than reused during a subsequent day or project.

State by State Guideline for Exposure

States	Tick-Borne Diseases	Mosquito-Borne Diseases	Poisonous Plants
Alabama	Year Round Low Risk	Year Round	Year round
Alaska	No Risk	No Risk	No Risk
Arizona	No Risk	March - July	March - November
Arkansas	March - November	March - November	March - November
California	Low Risk	March - November	Year Round
Colorado	Low Risk	March - November	No Risk
Connecticut	March - November	Low Risk March - November	March - November
Delaware	March - November	Low Risk March - November	March - November
Florida	Year Round Low Risk	Year Round	Year round
Georgia	Year Round Low Risk	Year Round	Year round
Hawaii	No Risk	No Risk	No Risk
Idaho	No Risk	Low Risk March - November	No Risk
Illinois	March - November	March - November	March - November
Indiana	March - November	March - November	March - November
Iowa	March - November	March - November	March - November
Kansas	Low Risk	March - November	March - November
Kentucky	March - November	March - November	March - November
Louisiana	Year Round Low Risk	Year Round	Year round
Maine	March - November	March - November	March - November
Maryland	March - November	Low Risk	March - November
Massachusetts	March - November	March - November	March - November
Michigan	March - November	March - November	March - November
Minnesota	March - November	March - November	March - November
Mississippi	Year Round	Year Round	Year round
Missouri	March - November	March - November	March - November
Montana	Low Risk March - July	Low Risk March - July	No Risk
Nebraska	Low Risk	Low Risk	Low Risk
Nevada	Low Risk March - July	Low Risk March - July	Low Risk March - November
New Hampshire	March - November	March - November	March - November
New Jersey	March - November	March - November	March - November
New Mexico	No Risk	Low Risk March - July	No Risk
New York	March - November	March - November	March - November
North Carolina	March - November	March - November	March - November
North Dakota	No Risk	March - November	No Risk
Ohio	Low Risk March - November	March - November	March - November
Oklahoma	March - November	Low Risk March - November	March - November
Oregon	Low Risk March - November	Low Risk March - November	March - November
Pennsylvania	March - November	March - November	March - November
Puerto Rico	???	Low Risk March - November	Year round
Rhode Island	March - November	Low Risk March - November	March - November
South Carolina	March - November	Low Risk March - November	March - November

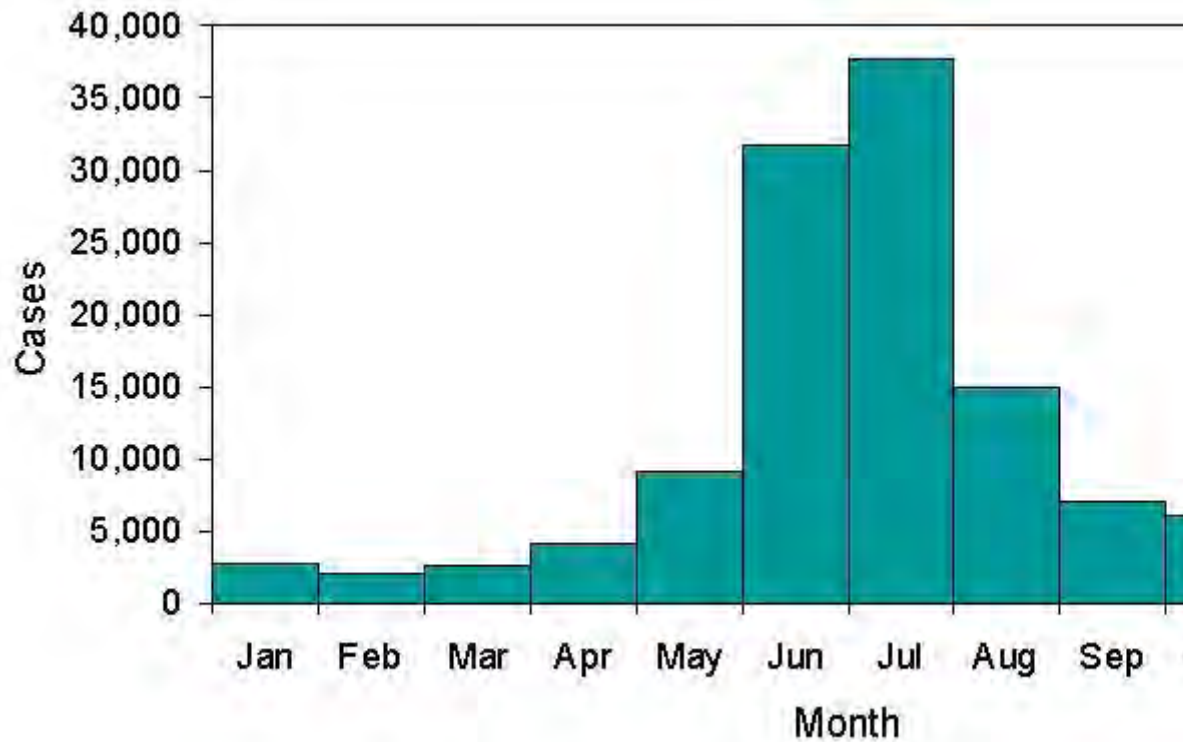
States	Tick-Borne Diseases	Mosquito-Borne Diseases	Poisonous Plants
South Dakota	Low Risk March - November	March - November	March - November
Tennessee	March - November	March - November	March - November
Texas	Year Round Low Risk	Year Round	Year round
Utah	Low Risk March - July	Low Risk March - July	No Risk
Vermont	March - November	Low Risk March - November	March - November
Virginia	Low Risk March - November	March - November	March - November
Washington	Low Risk March - November	Low Risk March - November	March - November
West Virginia	Low Risk March - November	March - November	March - November
Wisconsin	March - November	March - November	March – November
Wyoming	No Risk March - July	Low Risk March - July	No Risk

S3NA-313-WI2 Ticks

1.0 Background

- 1.1 The Public Health Agency of Canada (PHAC) works with the provinces, health authorities and other experts on research to define and monitor the occurrence of the ticks that carry *Borrelia burgdorferi*, the bacterium that causes Lyme disease. In Canada, the blacklegged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western blacklegged tick (*Ixodes pacificus*) are the species known to transmit this disease-causing agent, as well as other less common agents.
- 1.2 In Quebec, blacklegged tick populations are becoming established in parts of the Monteregie and Estrie regions in the southeast of the province. In Ontario, populations can be found in Long Point; Point Pelee National Park; Rondeau Provincial Park; Turkey Point; Prince Edward Point National Wildlife Area and St. Lawrence Islands National Park in the Thousand Islands region of eastern Ontario. In Nova Scotia, blacklegged tick populations are found in the Lunenburg, Bedford and Shelburne areas. An established population has also been found in the southeastern corner of Manitoba. Western blacklegged ticks, on the other hand, are found in British Columbia; they are fairly widely distributed but populations are largest in the lower mainland, on Vancouver Island, and in the Fraser Valley.
- 1.3 Although the distribution of blacklegged ticks in Canada appears to be limited, surveillance indicates that some of the established populations are spreading within certain areas of southern Canada. The potential expansion of localized tick populations makes it difficult to precisely define the geographic limits of any given population; however, people living in or visiting areas adjacent to established tick populations may have a greater chance of contact with blacklegged ticks. Although current evidence does not suggest a widespread distribution of blacklegged tick populations in Canada, the establishment of new populations appears to be an ongoing process. Hence, it is desirable to continue surveillance and to take precautions to reduce tick contact.
- 1.4 The rate of infection of ticks with the bacterium that causes Lyme disease varies. Infection rates are typically higher in adult ticks compared to the other stages (nymphs and larvae). Despite the lower rates of infection, people are most likely to acquire Lyme disease from a nymph because this stage is so small (see Figure 2) and thus more likely to go unnoticed and feed for a sufficient amount of time for the Lyme disease bacterium to be transmitted (24-36 hours). Infection rates are often greater in tick populations that have been established for long periods of time (such as Long Point) compared to newly established ones. As many as 60 percent of the adult ticks at Long Point are infected; however, infection rates in adults are more often between 10 and 25 percent at the other localities where ticks are established. Partly because of differences in the types of hosts that they feed upon, infection rates of the Lyme disease agent in *Ixodes pacificus* are much lower (1-3 percent) than *Ixodes scapularis*.
- 1.5 While there is a higher risk of coming in contact with infected blacklegged ticks in areas where populations are established, there is also a low risk of Lyme disease being contracted almost anywhere in Canada because migratory birds transport infected ticks over large geographic distances. Surveillance data indicates that about 12 percent of the ticks detected outside of areas where tick populations are established, and likely transported there on migratory birds, are infected with the agent of Lyme disease.
- 1.6 Source: <http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php>

Figure 1

Reported Cases of Lyme Disease by Month of Illness Onset United States, 1992-2004

Lyme disease patients are most likely to have illness onset in June, July, or August and less likely to have illness onset from December through March.

Lyme disease likelihood = April through November http://www.cdc.gov/ncidod/dvbid/lyme/ld_rptmthofill.htm

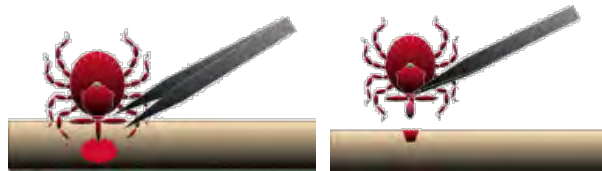
2.0 Tick removal tips from CDC

<http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm>

3.0 To Remove Attached Ticks



- 3.1 Use fine-tipped tweezers or notched tick extractor, and protect your fingers with a tissue, paper towel, or latex gloves (see figure). Persons should avoid removing ticks with bare hands.
- 3.2 Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your health care provider if illness occurs.)
- 3.3 After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.
- 3.4 Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms. Skin accidentally exposed to tick fluids can be disinfected with iodine scrub, rubbing alcohol, or water containing detergents.
- 3.5 Save the tick for identification in case you become ill. This may help your doctor make an accurate diagnosis of potential diseases by determining what type of tick it is. Place the tick in a sealable plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.



4.0 Devices Designed for Removing Ticks

- 4.1 [The Tick Tool](http://www.ticktool.com/index.html) - <http://www.ticktool.com/index.html>

5.0 Folklore Remedies Don't Work

- 5.1 Folklore remedies, such as the use of petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva or regurgitate gut contents, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided.

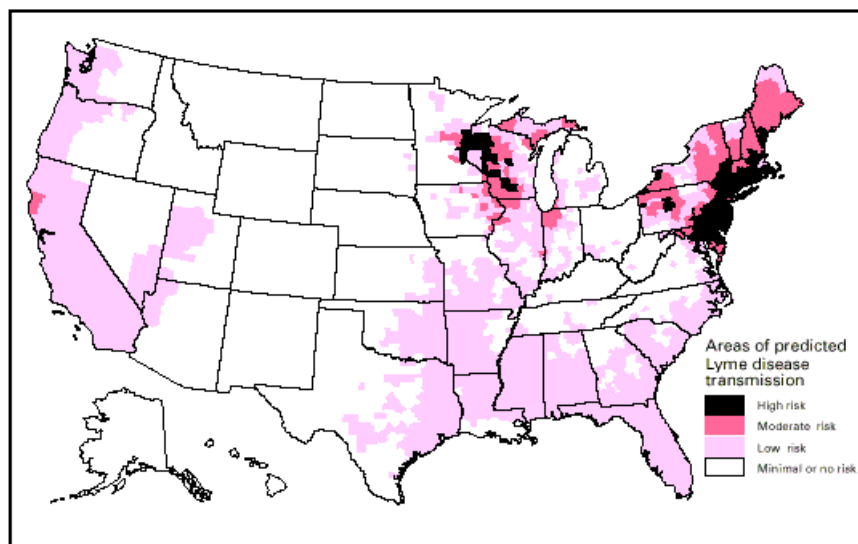
Information Regarding Common Tick-Borne Diseases and Tick Removal Procedures

Table 1
Common Tick-Borne Diseases in the U.S. and Information Resources

Disease	Tick Species	CDC Informational Web Pages
Lyme disease	• Black-legged or deer tick • Western black legged tick	http://www.cdc.gov/ncidod/dvbid/lyme/
Ehrlichiosis	• Lone star tick • Black-legged or deer tick • Western black legged tick	http://www.cdc.gov/Ncidod/dvrd/ehrlichia/Index.htm
Rocky Mountain spotted fever	• American dog tick • Rocky Mountain wood tick • Brown dog tick	http://www.cdc.gov/ncidod/dvrd/rmsf/index.htm

6.0 Distribution

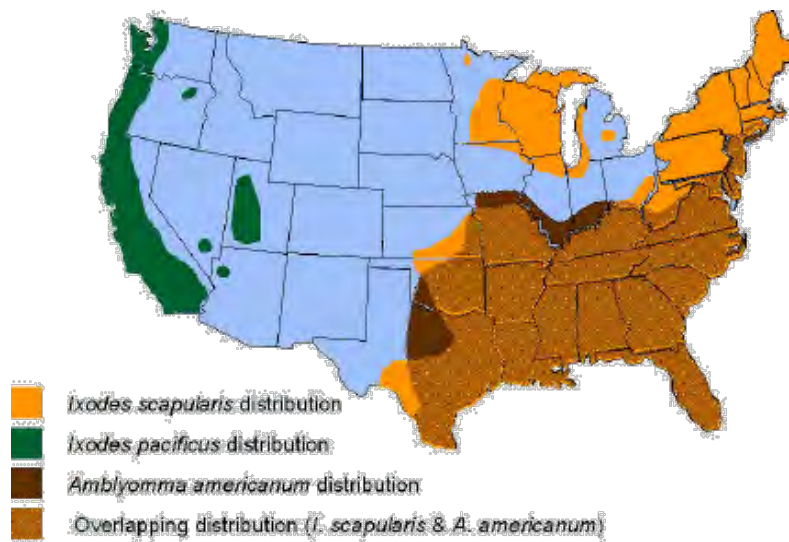
Figure 2
Distribution Map for Lyme Disease Risk, U.S.



Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. Risk categories are defined in the accompanying text. Information on risk distribution within states and counties is best obtained from state and local public health authorities.

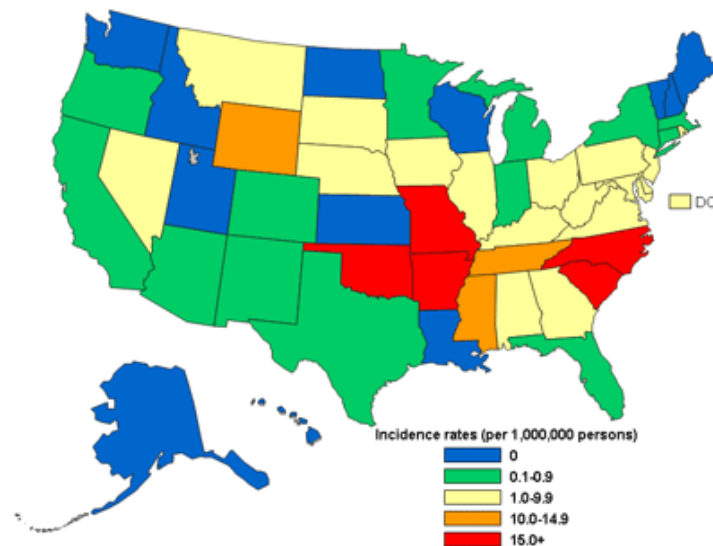
Source: CDC, <http://www.cdc.gov/ncidod/dvbid/lyme/riskmap.htm>

Figure 3
Distribution Map of Vector
Tick Species for Human Ehrlichiosis, U.S.



Source: CDC, <http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm>

Figure 4
Distribution Map of Annual Incidence
of Rocky Mountain Spotted Fever, U.S



Data for calendar year 2002

Source: CDC, <http://www.cdc.gov/ncidod/dvrd/rmsf/Epidemiology.htm>

S3NA-313-WI3 Poisonous Spider Identification

Black Widow Spider

- Abdomen usually shows hourglass marking.
- The female is 3-4 centimeters in diameter.
- Have been found in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light, local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.



Brown Spiders (Recluse)

- Central and South U.S., although in some other areas, as well.
- ¼-to-½-inch-long body and the size of silver dollar.
- Hides in decaying wood, baseboards, ceilings, cracks, and undisturbed piles of material.
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.



Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If bitten by a spider, attempt to identify the spider, notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or any swelling or numbness beyond the site of the bite.

Additional USA Spider Identification charts are available at <http://www.termite.com/spider-identification.html>

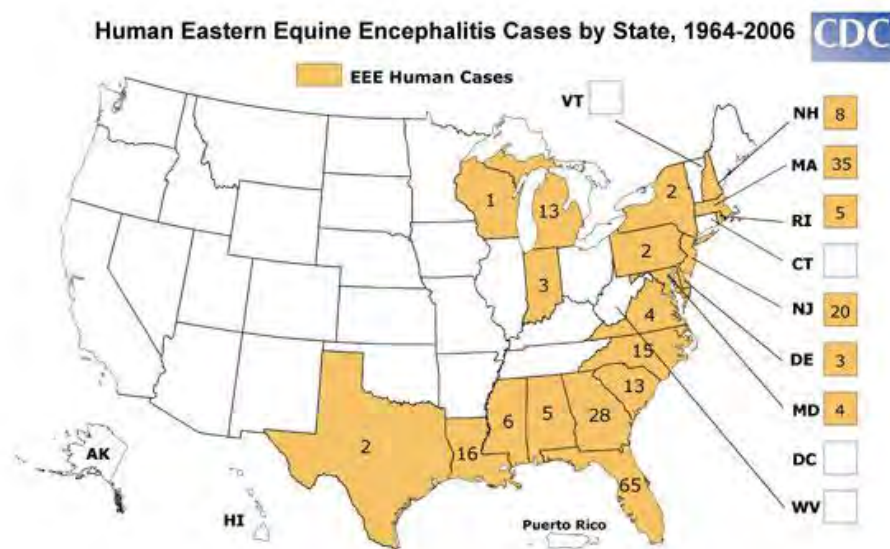
S3NA-313-WI4 Mosquito-Borne Diseases

1.0 Background

- 1.1 CDC data indicates that mosquito-borne illnesses, including encephalitis, are a health risk to employees working in outdoor environments.
- 1.2 Mosquitoes pose a risk of causing infection with various forms of encephalitis and other diseases in AECOM employees. This section will focus on the transmission of encephalitis. West Nile encephalitis is an infection of the brain that is caused by a virus known as the West Nile virus.
- 1.3 If other mosquito-borne diseases are identified in the project area, the local Public Health Department and CDC should be consulted to determine what diseases are present and exposure prevention recommendation.
- 1.4 According to the CDC, arboviral encephalitis is a virus that is "maintained in nature through biological transmission between susceptible vertebrate hosts by blood feeding arthropods", e.g., mosquitoes. It exists in various forms in global distribution, and in four primary forms in the U.S.: 1) eastern equine encephalitis (EEE), 2) western equine encephalitis (WEE), 3) St. Louis encephalitis (SLE), and 4) La Crosse (LAC) encephalitis; all of which are transmitted by mosquitoes.
- 1.5 Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water. Typically, mosquitoes will fly only a quarter of a mile (400 meters) from their breeding location.

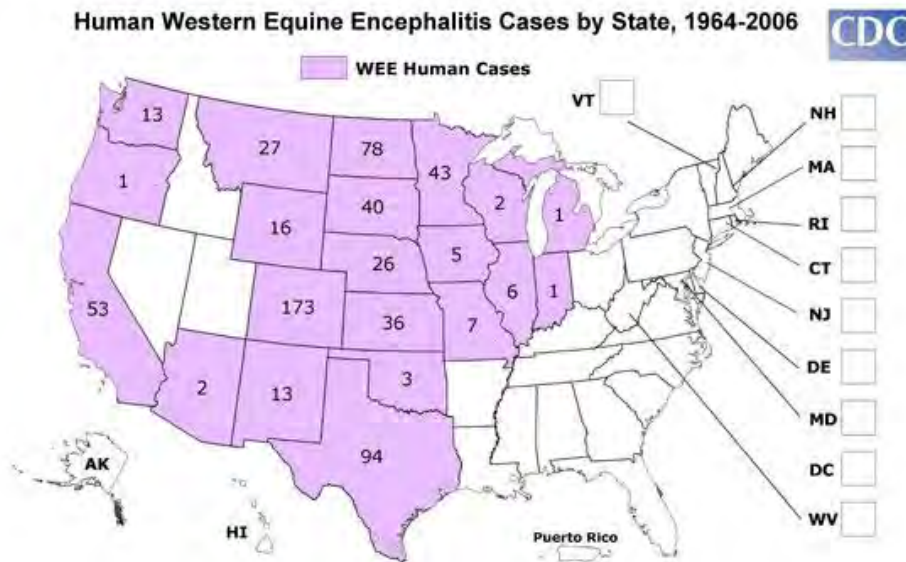
2.0 Distribution

Figure 1
Distribution Map for EEE Cases



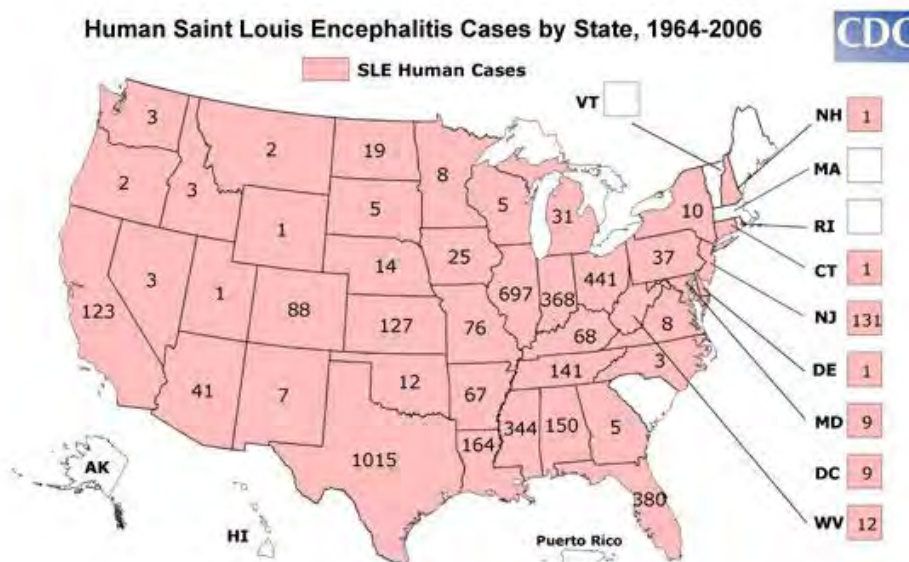
Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/EEE_Map.jpg

Figure 2
Distribution Map for WEE Cases



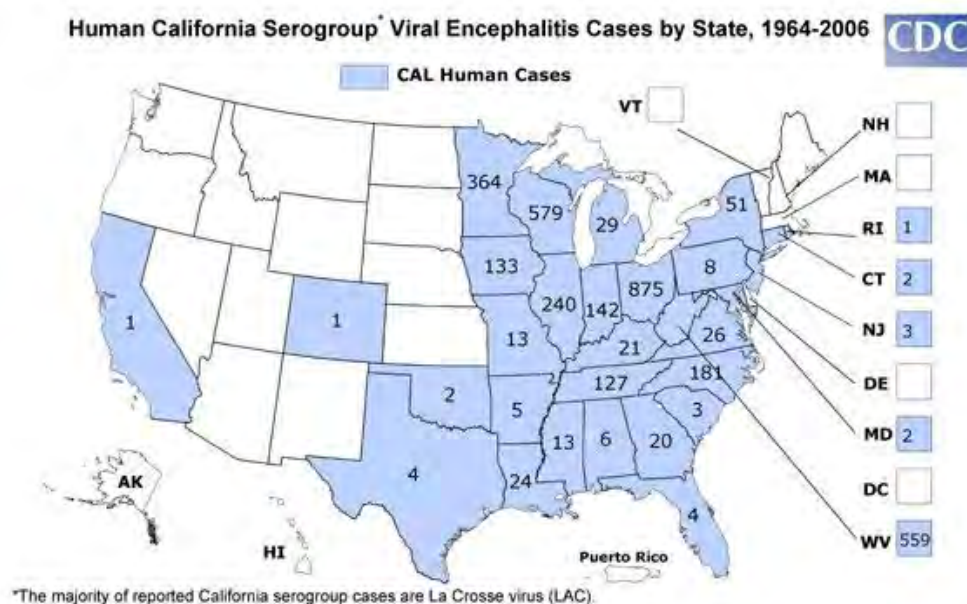
Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/WEE_Map.jpg

Figure 3
Distribution Map for SLE Cases



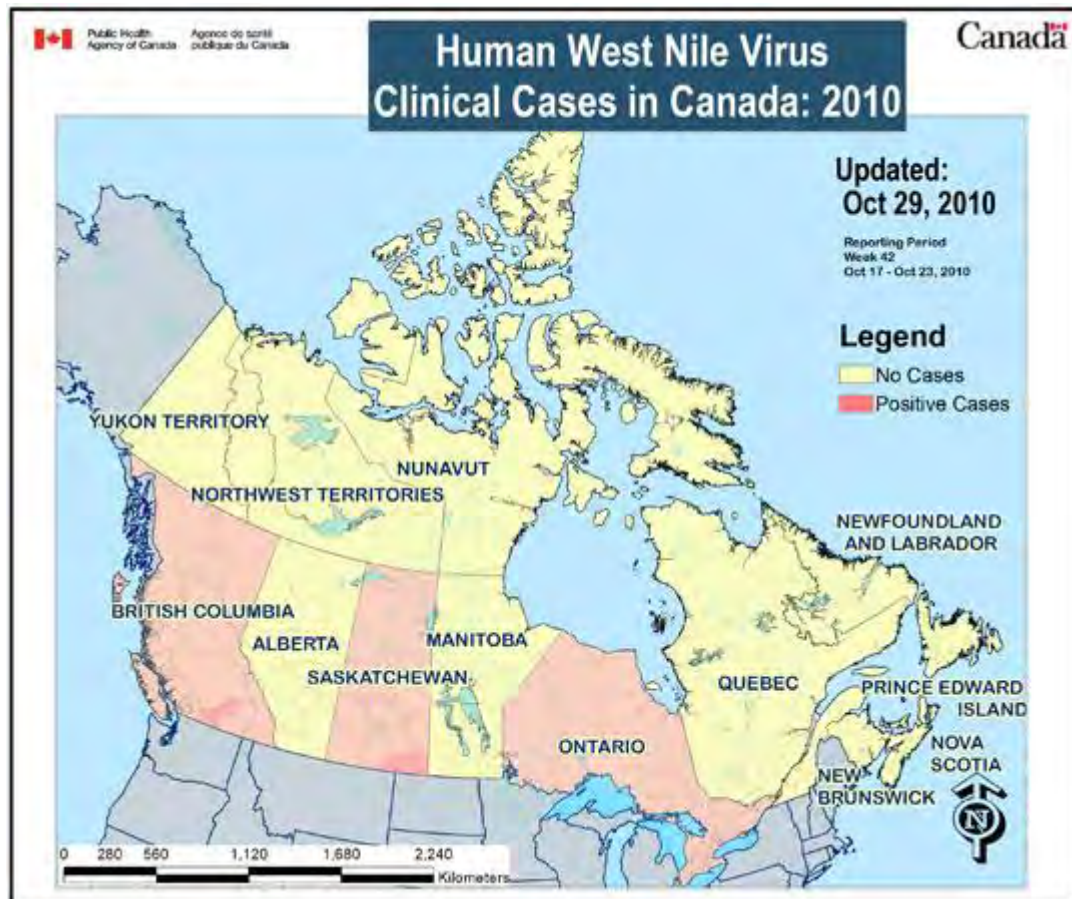
Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/SLE_Map.jpg

Figure 4
Distribution Map for LAC Cases



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/LAC_Map.jpg

Canadian Mosquito Borne Diseases



Source: <http://www.eidgis.com/wnvmonitorca/>

Disease	Distribution
California encephalitis	Canada-wide
Western equine encephalitis	Western Canada
Eastern equine encephalitis	Quebec, Ontario
St Louis encephalitis	Ontario, Quebec, Manitoba, Saskatchewan
Cache Valley	Ontario, Manitoba, Saskatchewan, Alberta

Source: [Paediatr Child Health. 2000 May-Jun; 5\(4\): 206-212.](#)

S3NA-313-WI5 Plants of Concern

1.0 Background

- 1.1 Poison ivy, oak and sumac (poisonous plants) pose a significant threat to AECOM employees due to the dermatitis that results from exposure to the oil on these plants, called urushiol.
- 1.2 Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the infected area, increasing susceptibility for an infection to result from the rash.
- 1.3 It should be noted that each time an employee is exposed to urushiol, it increases the severity of the reaction they will have in subsequent exposures.

2.0 Treatment

- 2.1 In cases that involve severe rashes, medical treatment may be necessary to control the rash.
- 2.2 Employees that develop a rash as a result of exposure to poison ivy, oak or sumac should report the exposure immediately to their Supervisor, Project Manager and RSHEM.

Figure 1

Distribution Map for Poison Ivy

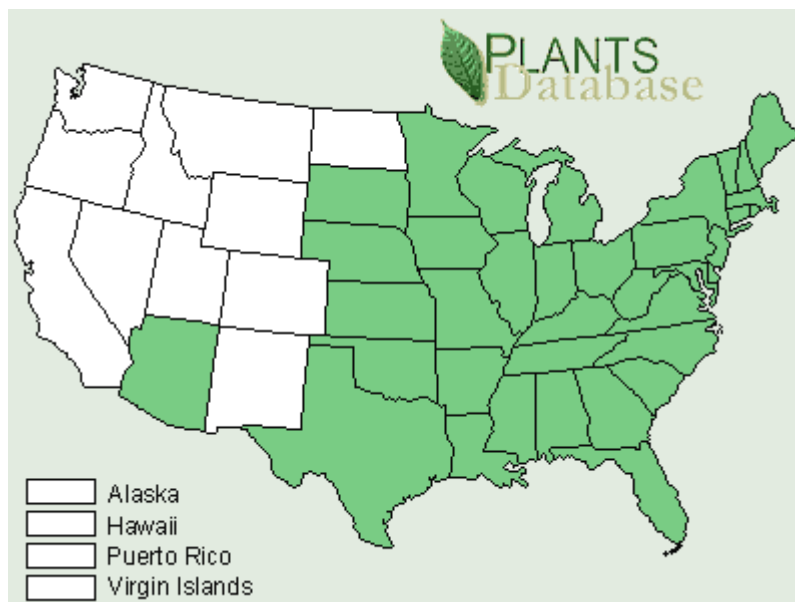
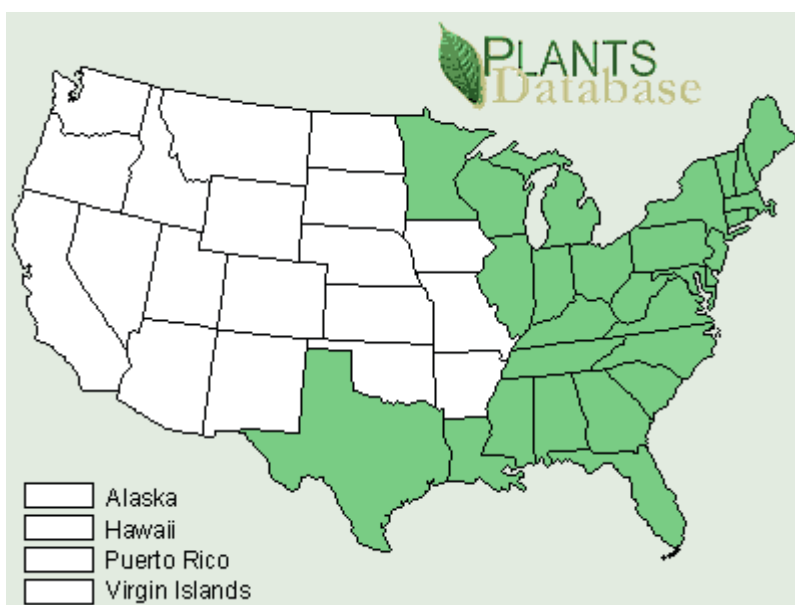


Figure 2
Distribution Map for Poison Oak



Figure 3
Distribution Map for Poison Sumac



Source for Figures 1, 2, and 3: <http://www.tecnuextreme.com/plant-map.htm>

S3NA-313-WI6 Wild Parsnip Identification

1.0 Background

- 1.1 Wild Parsnip (also known as Poison Parsnip) looks similar to a large carrot plant and is found in open places along roadsides and in waste places throughout the United States and Canada.
- 1.2 This plant produces a compound that causes severe blistering and discoloration after being exposed to sunlight—a condition known as photodermatitis. That is, when the skin comes in contact with this plant's juice and then is exposed to UV light, a severe burn develops.

2.0 Hazard

- 2.1 Everyone can get burned by wild parsnip. Unlike poison ivy, you don't need to be sensitized by a prior exposure. However, wild parsnip is only dangerous when the juice from broken leaves or stems gets on your skin—therefore, you can touch and brush against the undamaged plant without any danger.
- 2.2 If one gets some of the sap of Hogweed (or Meadow Parsnip or Cow Parsnip) in contact with skin, it is critical that they stay out of the sun for 8 hours. If one needs to remove the plant they should be completely covered with overalls, gloves, hat and safety glasses.

More information can be found at www.co.becker.mn.us/dept/soil_water/wild_parsnip.aspx



S3NA-313-WI7 Configuration Clothing for Protection Against Ticks and Insects

1.0 Configuration of Clothing

- 1.1 Loose-cuff trousers must be tucked into socks, wrapped with duct tape (or equivalent) completely around the cuff of the sock up on to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse-wrapped with “sticky” side out (see figure below).



S3NA-313-WI8 Insect Repellent Active Ingredient Product Information

1.0 Application of Insect Repellent

- 1.1 Immediately prior to the commencement of work in the field, an AECOM-approved insect repellent shall be applied to exposed skin, and to the outer surface of pant leg cuffs tucked into socks, shirt tails tucked into pants at the waist, and shirt cuffs.
- 1.2 Table 1 provides a list of AECOM-approved insect repellent active ingredients; employees may utilize any brand containing the minimum concentration of active ingredients as listed.
- 1.3 All products are registered with the EPA and recommended by the CDC.
- 1.4 Employees should select the AECOM approved repellent which is best for them based on skin sensitivity/allergies, and personal preference, but be aware that reapplication frequency will be greater for Picaridin and lemon eucalyptus products.
- 1.5 Employees shall carefully read and comply with manufacturer recommendations and instructions on product labels prior to application. Repellent shall not be applied beneath clothing to minimize the potential for irritation and/or allergic reaction.
- 1.6 The chemical N,N-diethyl-*m*-toluamide (DEET) shall not be applied to Nomex™ fire retardant clothing as it reduces the effectiveness of the fabric.

Table 1
Approved Insect Repellents

Active ingredient and minimum concentration	Products Available	Approximate Duration of Effectiveness	Notes and Web Link to Product Safety Information
Permethrin (0.5%)	-Repel® Permanone -Coulston's Duranon™	2 weeks ¹	-Application to clothing and equipment only
DEET (23.8%)	-Deep Woods Off!® -Repel® Sportsmen Formula®	5 hours ²	-Cannot be applied to Nomex™ fabric
Picaridin (7%)	-Cutter Advanced™	4 hours ³	-Protection equivalent to approximately 10% DEET
Oil of Lemon Eucalyptus (30%)	-Repel® Lemon Eucalyptus	2 hours ²	-Protection equivalent to approximately 7% DEET -Natural, plant based product

¹ – New York State Department of Health, 2007

² – Fradin and Day, 2002

³ – Spectrum Brands, 2007

- 1.7 Repellent shall be reapplied multiple times daily over the course of the day at a frequency identified during the hazard assessment based on manufacturers' recommendations, the approximate effective period provided in Table 1, and other factors such as perspiration, precipitation, etc.
- 1.8 All approved repellents are available at most department or sporting goods stores.

Insect Repellent Active Ingredient Product Information

Product Safety Information

Facts about the repellants recommended by AECOM are available by clicking on the embedded link.

National Pesticide Telecommunications Network Fact Sheet: Permethrin and Picaridin

Picaridin



Permethrin



DEET



Lemon Eucalyptus



S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application

1.0 Application Recommendations

- 1.1 Source: New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents. <http://www.health.state.ny.us/nysdoh/westnile/pdf/2737.pdf>
- 1.2 Products containing permethrin are for use on clothing only—not on skin. Permethrin kills ticks and insects that come in contact with treated clothes. It is effective for two weeks or more if the clothing is not laundered.

2.0 Treat Clothing Only– DO NOT APPLY TO SKIN.

- 2.1 Read carefully and follow manufacturer's recommendations for application.
- 2.2 If you accidentally get the product on your skin, immediately wash with soap and water.
- 2.3 Apply to clothing in a well-ventilated outdoor area, protected from wind.
- 2.4 Only spray Permethrin products on the outer surface of clothing and shoes before you put them on - do not apply to clothing while it is being worn. Only spray enough product to lightly moisten the outer surface of the fabric causing a slight color change or darkening; do not saturate clothing. Do not exceed recommended spraying times. Pay special attention while treating socks, trouser cuffs and shirt cuffs to ensure proper coverage. Hang the treated clothing outdoors and allow clothing to dry for at least two hours (four hours under humid conditions) before wearing.
- 2.5 Do not treat clothing more than once every two weeks. Launder treated clothing separately from other clothing at least once before retreating.
- 2.6 Keep treated clothes in a separate bag. Those who frequent tick or mosquito habitats should consider having a set of clothes, preferably long-sleeved shirt, pants and socks that are used only in such settings. These clothes can be treated with a Permethrin-containing product according to the label directions, worn only when needed, and then placed in a separate bag when not in use. In hot weather, when long-sleeved shirt and pants may be uncomfortable, pants and jackets made of insect netting (either untreated or treated with repellent) can be worn. Such clothes are available in some sporting good stores and through outdoor equipment catalogs.

- 1. U. S. Environmental Protection Agency. 1999. Office of Pesticide Programs List of Chemicals Evaluated for Carcinogenic Potential-August 25, 1999. Office of Pesticide Programs. Washington, DC.

S3NA-313-WI10 Bird Droppings Safe Work Practices

1.0 Background

- 1.1 According to the National Institute for Occupational Safety and Health (NIOSH), histoplasmosis is an infectious disease caused by inhaling spores of a fungus called *Histoplasma capsulatum* (abbreviated *H. capsulatum*) that may inhabit accumulated masses of pigeon droppings and excrement of other birds and flying animals. Its symptoms vary greatly, but the disease primarily affects the lungs. Occasionally, other organs are affected. This form of the disease is called disseminated histoplasmosis, and it can be fatal if untreated. The acute respiratory disease form of histoplasmosis is characterized by respiratory symptoms, a general ill feeling, fever, chest pains, and a dry or non-productive cough. Distinct patterns may be seen on a chest x-ray. Chronic lung disease resembles tuberculosis and can worsen over months or years. If symptoms occur, they may start within 3 to 17 days of exposure, with an average of 10 days. On a positive note, histoplasmosis is not contagious.
- 1.2 Psittacosis, although primarily a respiratory disease, can cause a wide variety of clinical manifestations. Generally, about 10 days after infection occurs, the clinical illness begins abruptly with fever, chills, weakness, fatigue, muscle pain, anorexia, nausea, vomiting, excessive sweating and difficulty with breathing, headache, backache, and sensitivity to light.
- 1.3 Hypersensitivity pneumonitis is also known as pigeon breeder's disease.

2.0 Symptoms

- 2.1 The acute form of hypersensitivity pneumonitis is clinically characterized by chills, fever, cough, breathlessness without wheezing, and malaise 4-10 hours after exposure. In general, an acute attack subsides after 18 to 24 hours.

3.0 Treatment

- 3.1 If a person should develop any of the symptoms as noted above, or others, it is important to see a physician and inform him of an exposure to pigeon/bird or bat excrement. A failure to diagnose the preceding conditions could occur if a treating physician is unaware of a patient's exposure to pigeon/bird or bat excrement.

4.0 Prevention

- 4.1 Prior to work in any area where pigeons or other flying animals may nest, a written statement from the client shall be obtained in regards to the potential for, and extent of, accumulation of excrement on/in the structure from pigeons and other winged animals.
- 4.2 The client shall be asked to provide appropriate details as to the basis for their statement (e.g., date of last visual survey for pigeon/bird or bat excrement accumulation, date of last excrement removal effort, etc.).
- 4.3 In no case will an AECOM employee or contract employee be permitted to commence structure inspection procedures without project management having received and evaluated the aforementioned written statement from the client.
- 4.4 According to NIOSH, the best way to prevent exposure to *H. capsulatum* spores during survey and inspection work is to avoid situations where excrement and other potentially-contaminated material can become airborne and inhaled. Therefore, it is preferable that the efforts to determine if, and to what extent, there is an accumulation of pigeon/bird or bat excrement on/in structures, or the efforts to clean-up/removal/disposal of such contaminated material, be left to the client or subcontracted out.

5.0 Safe Work Practices

- 5.1 In those cases where AECOM employees or contract employees are contracted by the client to determine the extent of accumulation of animal excrement in/on structures, the following minimum safety and health precautions shall be taken. (NOTE: precautionary measures are based on

- recommendations and best practices prescribed in the NIOSH 2004 public document titled *Histoplasmosis – Protecting Workers at Risk*).
- 5.2 All workers shall wear disposable protective clothing (Tyvek® coveralls). Disposable overalls with hoods shall be donned when working in areas where *H. capsulatum* spore-contaminated material is likely to fall from overhead.
 - 5.3 All workers shall wear disposable shoe coverings fitted with ridged soles made of slip-resistant material to reduce the likelihood of slipping on wet or dusty surfaces. Gloves shall be worn.
 - 5.4 All workers shall wear a full facepiece air purifying respirator fitted with P100 (HEPA) cartridges. If entering an enclosed area in which the extent of excrement contamination is unknown, additional protective measures shall be taken such that workers shall wear a powered air-purifying respirator (APR) with full facepiece fitted with P100 (HEPA) cartridges. Any variance from these requirements must be approved by the Regional SH&E Manager. Workers donning APRs shall be medically screened, cleared, and trained in their proper use in accordance with AECOM safety program standards.
 - 5.5 If contaminated material must be disturbed for purposes of removal/disposal or during the structure inspect process, it shall be wetted down prior to all work and will be rewetted as necessary to minimize airborne dusting.
 - 5.6 After working in *H. capsulatum* spore-contaminated areas and before removing any respiratory protective equipment, workers shall remove all protective clothing and shoe coverings and seal them in a heavy-duty plastic bag for disposal.
 - 5.7 Workers shall observe a high degree of personal hygiene, even if the exposure is casual. Special care shall be taken to wash hands, face, and other areas of exposed skin thoroughly before eating, drinking or smoking.

S3NA-313-WI11 Large Carnivores

1.0 Hazard

- 1.1 Most wild carnivores in the feline family (cougars, lynx, and bobcat) or the canine family (wolves and coyotes) are more predictable than bears and are not predatory towards humans; however, all wild animals can be dangerous if they feel threatened or if they are sick or starving.
- 1.2 Most ungulates (deer, moose, elk, and caribou) will avoid humans and will flee as soon as a human is sighted; however, females with young (during May and June) and males during the mating season (September to November) can be very aggressive, especially if provoked.

2.0 Personal Protective Equipment

- 2.1 Noise makers such as bear bangers, whistles and bells can be used as deterrents for an approaching animal.
- 2.2 Pepper (bear) spray can be used to ward off an imminent attack.

3.0 Safe Work Practice

- 3.1 Most negative encounters with ungulates or carnivores can be avoided with a few key preventative measures:
 - 3.1.1 When working in wilderness isolation, always travel in pairs and make lots of noise.
 - 3.1.2 Always store food in air-tight containers away from sleeping areas (if camping) and never carry strong smelling foods which could attract animals.
 - 3.1.3 Keep your eyes open for fresh animal signs which may indicate a dangerous situation:
 - Extensive fresh rubbing on branches in the fall might indicate the presence of a rutting male ungulate that may become aggressive to defend a potential mate.
 - A fresh kill or carcass which might indicate the presence of a carnivore that may become aggressive to defend its food.
- 3.2 Maintaining a distance of at least 30 metres (100 feet) allows large animals an escape route. If you notice any signs of aggression or behavioral changes, you should move away to a safe location. Wildlife should not be enticed by reaching out or simulating calls.
- 3.3 Pets should be kept secure and away from wildlife as their actions can provoke an attack. Moose, deer and other wildlife may appear quite docile; however, if a dog makes them feel threatened, their behavior can become unpredictable.
- 3.4 **If you are approached by a carnivore (wolf, coyote, or cougar):**
 - 3.4.1 Pick up small children immediately.
 - 3.4.2 Try to appear bigger, hold your arms or an object over your head.
 - 3.4.3 Face the animal and retreat slowly. Do not run or play dead.
 - 3.4.4 Maintain steady eye contact with the animal.
 - 3.4.5 If the animal continues to approach, deter an attack by yelling, waving a stick or throwing rocks.
 - 3.4.6 If you are attacked, fight back. Hit the animal with a heavy stick or rock.
- 3.5 **If you are approached by an ungulate (moose, elk, deer, bison or caribou):**
 - 3.5.1 An angry moose, elk or deer will face you with its head and ears lowered.
 - 3.5.2 Back away slowly.
 - 3.5.3 Look for something to get behind like a tree or a car. You can go faster around an obstacle than the ungulate can.

- 3.5.4 An ungulate is more likely to bluff charge but if it continues the charge and you are attacked in the open, curl up in a ball on the ground. Always protect your head with your arms and lie still.
- 3.5.5 Stay still after the attack until the ungulate moves away.

S3NA-313-WI12 Bear Safety

1.0 Hazard

- 1.1 An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting, to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously.
- 1.2 The hazard or risk associated with a bear encounter varies significantly depending on the location. It is important to research the project area before field work commences to determine the expected probability of encountering a bear. Remoteness from urbanized areas should not be a criterion, as bears have been encountered within city limits, especially near landfills.
- 1.3 The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.
- 1.4 Preparing staff for any type of encounter is key to managing the risk.

2.0 Personal Protective Equipment

- 2.1 The best deterrent of a “bad bear encounter” is knowledge: a good understanding of the ecology and the behavior of the bears that will likely be encountered.
- 2.2 **Bear Spray and Bear Bangers**
 - 2.2.1 Staff must have hands-on training for the safe use of bear spray (a pre-season practice run is a good use of expired bear spray).
 - 2.2.2 Prior to work commencing, staff must ensure that the bear spray they are carrying is still valid and not past its expiration date.
 - 2.2.3 During travel, bear spray must be sealed in an airtight container or bag and must not travel in the cab of a vehicle, aircraft, or helicopter.
- 2.3 **Firearms**
 - 2.3.1 Environments and conditions which pose a high risk of bear encounters, may warrant the use of an armed wildlife monitor. Project managers, in consultation with appropriate project staff and SH&E Management, are responsible for determining the level of risk for their projects and whether or not such measures are required.
 - 2.3.2 A person hired as an armed bear monitor must be properly trained in wildlife monitoring as well as certified in the expert usage of firearms.
 - 2.3.3 The usage of an armed bear monitor is intended only as an additional precautionary measure to be used in specific environments to ensure the protection of field staff; staff should still be equipped and trained appropriately for the risk.

3.0 Restrictions

- 3.1 Staff must not work alone in areas where there is a medium or high risk of a bear encounter.
- 3.2 Generally, AECOM personnel shall not carry a firearm and attempt to function as a wildlife monitor and/or perform their professional duties. This can only be over-ridden with expressed permission of Regional Management.

4.0 Training

- 4.1 In-house Bear Awareness training must be undertaken by all field staff who work in bear country every three years at a minimum, or more often as required.
- 4.2 The Bear Awareness training involves testing and improving the employee’s knowledge about bear encounters, watching videos regarding bear awareness and behavior, and participating in group discussions about how to avoid and how to respond to bear encounters.
- 4.3 Specific considerations are given to black bear, grizzly bear, and polar bear encounters.

5.0 Safe Work Practice

5.1 Staff must be aware of wildlife signs and avoid wildlife encounters.

5.2 Bear Sign

- 5.2.1 **Fresh tracks:** It is often better to see the bear's tracks than to see the actual bear. If you can tell the direction that the bear is travelling in, it is prudent to change your course of direction. Bears will travel down the same pathways as people or other large animals use. If you have a clear track you can determine which type of bear has passed through the area. If you see more than one track, you can tell that it is possibly a female with cubs. Avoid females with cubs!
- 5.2.2 **Scat:** Bear scat will look different depending upon the bear's diet. Close examination of bear scat can sometimes give you an indication of what the bears have been eating at that time of year. If the scat contains remnants of human garbage, there is a human food conditioned bear in the area. These bears associate people with food and can be the most dangerous type of bear to encounter.
- 5.2.3 **Animal carcasses:** IF YOU COME ACROSS A CARCASS, LEAVE THE AREA IMMEDIATELY. Grizzly bears will often cover their kills for a few days and let it rot, then come back and eat it. THE BEAR WILL STAY CLOSE BY. Grizzly bears will defend their kill and this is a situation that could prompt a defensive attack by a bear.
- 5.2.4 **Torn-Up Logs and Stumps:** Bears will forage for insects in dead logs and rotting trees. You will often see torn up logs and stumps, evidence of their foraging.
- 5.2.5 **Evidence of Digging:** Holes dug into the ground are often made by grizzly bears digging for roots or ground squirrels. In particular Grizzlies will dig for food in the early spring soon after they leave their dens.
- 5.2.6 **Claw Marks on Trees:** Claw marks can be left on trees by black bears when they have climbed up a tree. Grizzly bears will also leave claw marks on trees and on the ground. Bears will often chew a small tree or a sign-post, so watch for signs of chew marks along the trail.
- 5.2.7 **Hair on Trees:** Bears will rub against trees, usually trees with rough bark, to scratch themselves. You can find evidence of bears by the hair left in the tree's bark. The higher the hair left on the tree, the bigger the bear. Remember that the bear will often stand on its back legs to scratch its back on the tree.
- 5.2.8 **Daybeds:** Bears will be most active in the early morning and in the evening. It would be prudent for field staff to restrict their field activities during the bear's most active foraging times as much as possible. During the heat of the day, bears will rest in daybeds. These can be shallow depressions of piled up leaves in the forest, trampled vegetation, a shallow scrape or a hole. Daybeds are usually located in cool places. Bears will make daybeds along streams and rivers. Daybeds are often associated with feeding places and therefore should be avoided.

5.3 Prevention

- 5.3.1 Your best defense against bears is to actively practice bear avoidance techniques when working in the field. You can prevent chance encounters by taking the following precautions:
- Know the areas and habitats bears use at different times of the year, and attempt to avoid such areas or be extremely cautious if you have to travel through them.
 - Contact the local Fish & Wildlife Office to get current information on the bears in the area. Ask what other camps are in the area and if they are following good bear avoidance practices. (i.e., do they keep a clean camp?) If there are nearby human food sources available, e.g., an open dumpsite, the local bears may not be afraid to approach your camp.
 - Always be aware of your surroundings. Stay alert. Watch for signs of bears along your route.
 - Use binoculars to look around for bears when you are in open terrain.
 - Never approach a bear if you see one feeding in the distance.
 - Note the behavior of other wildlife in the area. Flocks of ravens can alert you to a possible animal carcass, and perhaps a bear. The area should be avoided. Bird or squirrel alarm calls might be telling you that a bear is near.
 - Whenever possible, travel in daylight and try to avoid areas with restricted visibility. (dense brush)

- Make lots of noise, especially when travelling in dense vegetation. Sing, shout, or talk loudly. You can carry portable air horns or cans of rocks. (Please note that bear bells are not effective – they do not make enough noise to warn a bear that you are approaching. You need to be loud so the bear can hear you coming!) Remember that the noise you make can be masked by loud natural sounds such as the wind or water. Therefore it is possible that the noise you make can go unnoticed by a bear whose attention is focused on feeding. You must make every attempt not to surprise a bear. In areas of loud natural noise, be louder!
- Stay together and travel in groups. Bears are less likely to attack groups of people. When travelling in groups, stay close together. Being in a group doesn't help if the individuals have spread apart along the trail!
- Pets should not accompany you when you are travelling in bear country. If you must take your pet, keep the animal on a short leash at all times. Unleashed dogs will harass bears and once scared, run back to their owner with an angry bear in pursuit.
- Do not wear perfumes or cosmetic products when you are travelling in bear country. Do not mask your human scent.
- Women should use internal sanitary protection, (i.e. tampons) when menstruating and burn all used sanitary products after usage. Keep all used sanitary supplies in sealed bags until you have a chance to burn.
- Children should be kept very close by in bear country.
- Carry bear deterrents and know their limitations. Be familiar with how to use the deterrents, how to transport the deterrent safely and under what conditions it is most effective. Carry the deterrent in a belt, out in front and ready to grab at a moment's notice, never in your backpack.

5.4 **Field Workers: Precautions in Bear Country**

- 5.4.1 Field workers should take extra precautions when working in bear country.
- 5.4.2 Make every effort to go out into the field with another person; you should not be working alone in the field. One person can act as a lookout for the other. Keep watch for bear signs.
- 5.4.3 Never approach a bear.
- 5.4.4 Report where you are going and when you will return every time you leave camp. Have a plan of action if someone does not report back to camp at a specified time.
- 5.4.5 Bears do get used to a camp's schedule and you will have fewer surprise encounters if everyone in the camp comes and goes at the same time every day.
- 5.4.6 Take a two-way radio with you when you go out into the field.
- 5.4.7 Always carry bear deterrents with you in the field and understand each deterrent's limitations. Carry your deterrents on a belt, out in front and ready to use instantly. Do not carry your deterrents in your backpack.
- 5.4.8 Keep any food that you take with you sealed in odor-proof/bear proof containers. Make every attempt to take odorless food with you, not something with a heavy scent.
- 5.4.9 Pack out any garbage in odor-proof containers and burn once you return to camp.
- 5.4.10 The noise of an ATV or skidoo can scare off a bear. Starting the machine and revving it up can scare off a curious bear. DO NOT CHASE A BEAR WITH AN ATV OR SKIDOO. You may need to drive the ATV around in circles to scare off the bear, but do not chase the bear.
- 5.4.11 Take extra precautions when travelling along lakes or stream beds; bears use streams and river beds as travel routes. Be sure to carry noise makers.
- 5.4.12 Limit your workday so you are not out in the early morning or evening when bears are most likely to be foraging.
- 5.4.13 All Field Workers should be proficient in First Aid. Do not go out into the field without first aid training.
- 5.4.14 All Field Camps should have a First Aid Kit.
- 5.4.15 All Field Camps should have means of communication with local ambulance or Air-ambulance personnel.
- 5.4.16 A person's best defense against bears is to avoid them. If this is not possible, then being heard, smelled, or seen may lessen your chances of surprising a bear and/or provoking an attack.

- 5.4.17 All wildlife should be respected, avoided, and not harassed at any time.
- 5.4.18 Cooking in remote areas should be avoided. Any food should be stored in airtight containers and all garbage should be managed appropriately: “pack it in, pack it out”.
- 5.4.19 A bear in camp or within human structures is not a chance encounter. If this bear challenges you, you must fight, scream, and do whatever is necessary to live, no matter what species the bear is!
- 5.4.20 In general, there are two types of bear encounters: Defensive and Non-defensive for grizzly bears and black bears. Your response will vary based on your assessment of the situation (your training will help you in identifying these situations and the appropriate response).

6.0 Encounters

6.1 General Recommendations When Encountering a Bear

- 6.1.1 Consider your surroundings and assess the situation before you act.
- 6.1.2 Remain calm. Do not turn your back to a bear.
- 6.1.3 DO NOT RUN – You will trigger the bear’s natural response to chase you. Bears are extremely fast and you cannot outrun a bear. (They are as fast as an Olympic sprinter, so if you are not faster than an Olympic sprinter, don’t run! They can run 40 km/hr and you can’t!) You cannot outswim a bear either.

6.2 Bear Encounters in the Field

- 6.2.1 Your response will depend upon the type of encounter.
- 6.2.2 There are several different encounters listed.
- 6.2.3 Bears are more predictable than once believed and you can determine your best course of action in a confrontation by understanding the bear’s characteristics and motivation. There are two pieces of information you should be aware of in any bear encounter:
- The type of bear you are dealing with; and
 - The reason for the encounter.
- 6.2.4 Some people believe that when you stand your ground against a predatory black bear attack, the bear will feel threatened and leave. This has been effective in some cases. HOWEVER, it is not effective against a grizzly bear predatory attack and it is very difficult to know when it will be effective against black bears. Polar bears do not follow the same behavioral patterns as grizzly and black bears, they are almost always aggressive and will not back down. Special considerations must be given to projects where polar bear encounters are anticipated.

6.3 If you can leave undetected:

- 6.3.1 Leave the area quietly in the same direction that you came from.
- 6.3.2 Move while the bear’s head is down. Stop moving when the bear lifts its head to check its surroundings.
- 6.3.3 Stay downwind so the bear will not pick up your scent.
- 6.3.4 When you have moved a safe distance away, you can either watch and wait until the bear leaves or make a wide detour around the bear.
- 6.3.5 If the bear is unaware of you and approaching: Allow the bear the right of way.

6.4 If you cannot leave undetected:

- 6.4.1 Let the bear know that you are present by smell first; therefore move upwind so they can pick up your scent.
- 6.4.2 If it is possible, try to keep the bear in your sight. Watch to see if the bear leaves when it smells that a person is nearby.
- 6.4.3 Attempt to move out of the way without being noticed by the bear. If you cannot do this, talk loudly to let the bear know where you are.

6.5 If the bear is aware of you but in the distance:

- 6.5.1 Remain calm.
- 6.5.2 Continue walking slowly in the same general direction, but head away from the bear.
- 6.5.3 DO NOT RUN. The bear can quickly outrun you if it is so inclined.
- 6.5.4 If the bear begins to follow you, drop your pack or some article, (not food) to distract the bear. This may distract the bear long enough for you to escape. If you drop food for the bear – you will help the bear associate food with humans and teach it that aggressive behaviour will be rewarded with food.
- 6.5.5 If it is a grizzly following you, climb a tree if there is a large tree around. Although grizzlies can climb trees, they are often not motivated enough to try. Very large grizzlies are not able to climb trees well. If grizzlies climb, they can go 3 to 4 meters. Grizzlies will try and push trees over so do not climb a small tree.

6.6 If the bear is aware of you and close:

- 6.6.1 A bear will feel threatened in a close confrontation. The bear's natural tendency will be to reduce or to remove the threat. Assist the bear by acting as non-threatening as possible.
- 6.6.2 Do not make direct eye contact with the bear.
- 6.6.3 Do not make any sudden moves.
- 6.6.4 Do not run!
- 6.6.5 The bear needs to identify you as a person, so talk in low tones and slowly wave your arms over your head.
- 6.6.6 Attempt to give the bear an opportunity to leave. Be sure the bear has an open escape route. Do not corner a wild animal.
- 6.6.7 Try to back away slowly and/or climb a tree if appropriate.
- 6.6.8 Attempt to deter the bear if you are in a safe position.

6.7 If the bear is close and threatening:

- 6.7.1 If you have a deterrent such as a bear banger or bear spray, be prepared to use it depending on how close the bear is. Try to scare the bear off.
- 6.7.2 If you do not have a deterrent, or if using the deterrent is not successful, act as non-threatening as possible.
- 6.7.3 Talk to the bear in a calm authoritative tone of voice.
- 6.7.4 Do not startle or provoke the bear by making sudden moves.
- 6.7.5 Never imitate the bear's aggressive sounds, signals or posture. The bear is attempting to establish dominance and imitating its moves is a challenge to its dominance.
- 6.7.6 Back slowly away from the bear and drop a pack or some other article in order to distract the bear momentarily.
- 6.7.7 Remember that the bear may be defending cubs that you have not yet seen or they have a food cache nearby. Attempt to look as non-threatening as possible.

6.8 If the bear is very close and approaching:

- 6.8.1 A distance of less than 50 meters in an open area and closer in a forested area.
- 6.8.2 If the bear continues to approach, use your deterrent.
- 6.8.3 If the bear does not respond to the deterrent you must now STAND YOUR GROUND!
- 6.8.4 If the bear continues to approach and is acting aggressive, YOU MAY HAVE TO SHOOT if you are carrying a firearm.

6.9 If the Bear Charges!

- 6.9.1 A bear will charge you at high speed down on all four legs and often crouched low to the ground.
- 6.9.2 Bears do not charge when standing up on its hind legs.

- 6.9.3 Many charges are bluffs and the bear will often stop or veer off just at the last minute. It is difficult to know if the bear is bluff charging or not until it gets very close.
- 6.9.4 When faced with a charging bear you have two options:
- Use your bear deterrent; or
 - Roll into a ball and cover your neck and head with your arms if you are unarmed and have no other choice.
- 6.10 **Playing Dead:**
- 6.10.1 Note: Playing dead is a very controversial topic among seasoned field personnel. Some will tell you to never play dead in any situation, others will swear that it is the only thing you should do. Playing dead is a personal choice that you will have to make.
- 6.10.2 If you play dead it is possible that you can prevent serious injuries if a chance encounter with a bear results in an attack. Playing dead may reduce the threat that you represent to the bear.
- 6.10.3 If you decide to play dead, it is important to protect your vital areas. The older information that is still found online states that the person should roll into a ball to protect their vital organs. This has been replaced and you are now advised to lie in the prone position. Lie flat on your stomach and lace your fingers behind your neck (to protect it), Spread your legs apart to provide stability if the bear tries to turn you over. Stay in this position. If the bear manages to roll you over, immediately roll back onto your stomach to protect your face, neck and vital areas. Do not try to resist or struggle as this will intensify or prolong the attack. Once the attack is over, DO NOT MOVE until the bear has left the area. Look around and be very sure that the bear is gone before moving. (If the bear is a female with cubs, she will leave and move her cubs to safety.) If the bear covers you with leaves and vegetation, it probably thinks you are dead. Grizzly's will often cover their prey with vegetation and leave the carcass to ripen for a few days.
- 6.10.4 It is important to note that if the bear attack is prolonged or if the bear begins to eat you, the attack has changed from what you may have first believed to be a defensive attack, to a predatory attack. Fight back in a predatory attack. Concentrate your efforts on the face, eyes and nose of the bear.

S3NA-313-WI13 Small Mammals

1.0 Hazard

- 1.1 Working in the field either directly or indirectly with small mammals has inherent risks of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) that all field staff need to protect themselves against.
- 1.2 The risks are usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, there are also risks through air-borne diseases (e.g., Hantavirus).
- 1.3 Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

2.0 Personal Protective Equipment

- 2.1 Full-length clothing (long sleeves and pants).
- 2.2 Insect repellent.
- 2.3 Respiratory equipment (when directly handling wildlife).
- 2.4 Gloves (when directly handling wildlife).

3.0 Restrictions

- 3.1 Wildlife handling must only be completed under direct supervision of an experienced individual.

4.0 Training

- 4.1 Any staff that will be handling wildlife must be adequately trained and/or supervised by a wildlife biologist experienced in the job task.

5.0 Safe Work Practice

- 5.1 Wild animals can carry a variety of diseases that humans can contract: viral, parasitic, bacterial, and protozoal. Basic PPE such as full-length clothing, gloves and a respiratory mask will greatly reduce the risk of exposure.
- 5.2 Whenever a wild animal must be handled, the procedure must be accomplished as safely and quickly as possible.
- 5.3 Proper techniques must be employed to avoid or minimize the risk of personal injury while, at the same time, avoiding or minimizing injury to the animal.
- 5.4 Gloves, catch sticks, caging, and other appropriate equipment may be necessary when handling a wild animal. Most of these animals will be extremely stressed, resisting every restraint attempt.
- 5.5 In the unfortunate circumstance that a person is bitten or scratched, he or she should cleanse the wound thoroughly with soap and flush with water immediately, providing for a mechanical removal of potentially infective organisms. This should be followed by cleansing under medical supervision and consultation with a physician to consider the potential exposure to the rabies virus.

6.0 Rabies

- 6.1 You will not be able to accurately determine if an animal has rabies simply by observation as traditional symptoms of rabies (foaming at the mouth, biting, etc.) do not occur in all animals nor at all stages. There are some mammals that are at a higher risk than others for the rabies virus, such as raccoons, skunks, stray cats and dogs, foxes, coyotes, rodents. and bats; however, any mammal can contract the virus.

- 6.2 Rabies is contracted by contact of an infected animal's saliva with an open wound – a bite or a scratch.
- 6.3 Symptoms of rabies in humans usually do not present themselves for a minimum of 10 days to a year or longer (the average is 30 to 50 days). Symptoms are typical of a flu, including malaise, loss of appetite, fatigue, headache, and fever. Over half of all patients have pain (sometimes itching) or numbness at the site of exposure. They may complain of insomnia or depression. Two to 10 days later, signs of nervous system damage appear; hyperactivity and hypersensitivity, disorientation, hallucinations, seizures, and paralysis.
- 6.4 Because rabies is so difficult to detect and positively identify, it is very important to consult a physician immediately. If rabies is a possibility, begin treatment with the rabies vaccine as soon as possible (unlike other vaccines, rabies vaccination begins after exposure because the virus takes a comparatively long time to induce disease).

7.0 Hantavirus

- 7.1 Rodents can carry a variety of diseases; of notable concern is the North American hantavirus which can cause Hantavirus Pulmonary Syndrome (HPS).
- 7.2 A common host of the hantavirus is deer mouse and related species (*Peromyscus spp.*), which are common throughout much of North America.
- 7.3 Although infection is rare, it can be fatal and; therefore, it is necessary that risk of exposure be minimized. Infection can be spread to humans when they:
 - 7.3.1 Breathe air contaminated by deer mouse saliva, urine or feces containing infectious hantaviruses; or
 - 7.3.2 Accidentally rub eyes, mouth or broken skin with hantavirus-infected deer mouse saliva, urine or feces.
- 7.4 The following precautions will be taken for all field operations:
 - 7.4.1 Limit exposure to soils handling and use gloves where appropriate.
 - 7.4.2 Wash or sanitize hands often throughout the day and before meals.
 - 7.4.3 Equipment bags, storage areas, and vehicles will be inspected daily for signs of deer mouse infestation.
 - 7.4.4 Rodent-proof storage containers will be used when practical.
 - 7.4.5 Do not enter buildings infested with deer mice without adequate respiratory protection.
 - 7.4.6 Droppings should never be removed by vacuuming or sweeping. Wetting down an area with a mixture of 1:9 household bleach and water solution will reduce risk of airborne exposure.
- 7.5 If flu-like symptoms develop three days to six weeks after exposure to rodents, a doctor should be contacted immediately (mechanical ventilation is the primary method of treatment).

8.0 References

- 8.1 Trapping and Tagging Small Mammals. A RIC Standard for British Columbia. 1993. Dr. Todd Zimmerling.

S3NA-313-WI14 Snakes

1.0 Hazard

- 1.1 **Snakes have the ability to inject venom.** A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

2.0 Personal Protective Equipment

- 2.1 Long pants and shirts.
- 2.2 Heavy gloves if staff will be handling debris or be close to the ground.
- 2.3 Rubber boots, or boots that fully cover the foot (not sandals!) and preferably are at least 10" high.
- 2.4 Snake Chaps that cover at least the shin.
- 2.5 Personal first aid kit.

3.0 Restrictions

- 3.1 Staff must not work alone in areas where the risk of a snake encounter is high.

4.0 Training

- 4.1 Staff must be notified of the hazard before work commences.

5.0 Safe Work Practice

- 5.1 Staff working in areas known to be inhabited by venomous snakes should take extra precautions, be able to identify the local snake species, and understand the best practices for administering first aid.
- 5.2 Most snakes in Canada are non-venomous; and most snake bites are not fatal, only painful. Learning to identify snake species will assist you in responding appropriately to an encounter, and will assist medical professionals in determining if antivenin needs to be administered if anyone is bit.
- 5.3 Most snakes are non-aggressive and will only attack if immediately threatened.
- 5.4 **Prevention**
- 5.4.1 Before venturing out into the wilderness, familiarize yourself with the snakes in your area, both venomous and non-venomous species.
- 5.4.2 Learn which habitats the venomous species in your region are likely to be encountered in, and use caution when in those habitats.
- 5.4.3 Try as much as possible not to take a snake by surprise.
- 5.4.4 Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs, or when collecting firewood. Take care when overturning any objects on the ground when in snake country.
- 5.4.5 If you see a snake, give it as much room as possible. Most snakes have a strike distance that is only half the length of their body.
- 5.4.6 If you get very close to a rattlesnake, hold very still until it calms down and starts to move away. Then slowly move backwards until you are at least one snake-body length away.
- 5.5 **Treatment**
- 5.5.1 Venomous snakebites are rare, and they are rarely fatal to humans. Of the 8,000 snakebite victims in the United States each year, only about 10 to 15 die. In Canada the number of snake bites each year is very small. However, for any snakebite the best course of action is to get medical care as soon as possible.

- 5.5.2 Try to keep the snakebite victim still, as movement helps the venom spread through the body.
- 5.5.3 Keep the injured body part motionless and just below heart level.
- 5.5.4 Keep the victim warm, calm, and at rest, and transport him or her immediately to medical care.
- 5.5.5 Do not allow him to eat or drink anything.
- 5.5.6 If medical care is more than half an hour away, wrap a bandage a few inches above the bite, keeping it loose enough to enable blood flow (you should be able to fit a finger beneath it). Do not cut off blood flow with a tight tourniquet. Leave the bandage in place until reaching medical care.
- 5.5.7 If you have a snakebite kit, wash the bite, and place the kit's suction device over the bite. (Do not suck the poison out with your mouth.) Do not remove the suction device until you reach a medical facility.
- 5.5.8 Identify the snake that caused the bite to determine if it is venomous, and if antivenin needs to be administered. Do not waste time or endanger yourself trying to capture or kill it. Note the shape & color of the snake's head.
- 5.5.9 If you are alone and on foot, start walking slowly toward help, exerting the injured area as little as possible.
- Note that there are several species of snakes that superficially resemble rattlesnakes. Several species, including Bull, Milk, Fox, and Rat Snakes will even rattle their tails when startled.
 - Massasauga Rattlesnake is recognized as a Threatened Species in Ontario and it is an offence to harass, , or destroy the habitat of this species.
 - One scorpion species, the Northern Scorpion (*Paruroctonus boreus*) occurs in semi-arid areas of southern British Columbia, Alberta, and Saskatchewan. It carries a stinger on the end of its tail. The sting is painful but not life threatening unless there is an allergic reaction.

6.0 Species

6.1 Venomous Snakes in Canada

Eastern Massasauga Rattlesnake (<i>Sistrurus catenatus</i>) found around Wainfleet, Windsor, Bruce Peninsula and eastern Georgian Bay in Ontario.	 Eastern Massasauga Rattlesnake picture by Michael Redmer/Courtesy Lincoln Park Zoo
Northern Pacific Rattlesnake (<i>Crotalus viridis</i>) found primarily in Okanagan and Thompson River valleys of southern British Columbia.	 LANCE TANNAHILL 2000

Prairie Rattlesnake (*Crotalus viridis*) found in south eastern Alberta, and south western Saskatchewan.



6.2 Venomous snakes in the U.S.

Rattlesnake(*Crotalus cerastes*) found mostly concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake.

The rattlesnake is found in many different biomes ranging from along the coast at sea level, the inland prairies and desert areas to the mountains at elevations of more than 10,000 feet.

Species include: Sidewinder, Santa Catalina, Western, Mojave, Red Diamond, Western Diamond, Ridge Nosed, Eastern Diamondback, and Pigmy.

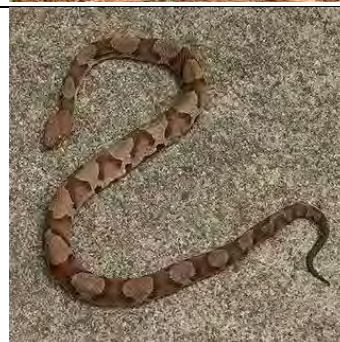


Western Rattlesnake



Eastern Diamondback

Copperhead (*Agkistrodon contortrix*) is the most common venomous snake found in the eastern US. It can be found in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Tennessee, Kentucky, Virginia, Illinois, Indiana, Ohio, Iowa, Pennsylvania, Maryland, New Jersey, Delaware, New York, Connecticut, and Massachusetts.



Cottonmouths (water moccasins) (*Agkistrodon piscivorus*) found in the eastern United States from Virginia, south through the Florida peninsula and west to Arkansas, eastern and southern Oklahoma, and east and central Texas..



Coral Snake (*Micrurus sp.*) found in the southern range of many temperate US states including North Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Kentucky, Arizona, and New Mexico.



Eastern Coral Snake, *Micrurus fulvius*

7.0 References

- 7.1 *The Eastern Massasauga Rattlesnake Stewardship Guide. A resource and field guide for living with rattlesnakes in Ontario.* Sponsored by the Government of Canada, and distributed on behalf of the Toronto Zoo and the Eastern Massasauga Rattlesnake Recover Team.
- 7.2 <http://www.rattlesnakes.us/>
- 7.3 <http://drdavidson.ucsd.edu/Portals/0/snake/Crotalus.htm>

S3NA-313-WI15 Alligators

1.0 Hazard

- 1.1 Your chance of encountering an alligator is greatest during the animal's courtship and mating season, which takes place from March through September. This is when male alligators become most dominant and aggressive as they try to intimidate rival males and attract females by their show of power. Some males end up having to travel to find a mate. July through September is when mother alligators are guarding nests.
- 1.2 Mating season takes up much of the warmer months - a very popular time in the southeastern USA for outdoor activities - and alligators are solar-powered, so-to-speak. The warmth from the sun fires up their metabolism, giving them renewed energy; and renewed energy means great potential for conflict.

2.0 Encounter

- 2.1 The alligator is naturally wary of humans, and will flee quickly if you get too close to it, or it may utter a very audible and compelling warning hiss. In some cases; however, alligators may charge or attack. Here are some examples of such cases:
 - 2.1.1 An alligator that is accustomed to being fed by humans may not be so shy.
 - 2.1.2 An alligator that is surprised and alarmed by your approach may attack, thinking that it is being attacked itself.
 - 2.1.3 A mother alligator caring for her nest or for live babies. If you see alligator babies, or if you encounter a nest (usually a mound of vegetation mixed with mud), remove yourself to a safe distance, the mother alligator is sure to be close by. If you get close, the mother may sound a very audible and intimidating warning hiss. Such a nest may be difficult to identify for a non-expert, but it is likely the mother will issue you a warning.
 - 2.1.4 Alligator mothers are well-known to be practically fearless when defending their offspring, whether the little ones have hatched or not. A mother alligator was observed leaping, jaws agape, to attack a helicopter as it approached the nest area to land! (The helicopter carried biologists studying alligator nests.)
- 2.2 Also be careful near heavy vegetation in or near the water's edge. This is where an alligator likes to enjoy privacy and peace during the daylight hours. If you trudge through there and surprise it, the outcome may not be positive.
- 2.3 Generally, a good minimum distance to keep between you and an alligator or nest is 15 feet/ 4.6 meters.
- 2.4 When trying to get past an alligator, make sure not to walk between the alligator and the water, because if it's spooked, it's going to run to the water.
- 2.5 If an alligator does approach in a threatening manner, make as much noise and movement as possible. This should show the alligator that he has taken on more than he can handle and he'll back away.



3.0 Alligator Charge

- 3.1 The alligator is not a natural runner. Those short legs obviously don't serve it like a horse's legs do, and the alligator can actually tire out in a relatively short time. When it charges after a human or animal, it is either trying to scare it away or seize it. It has a fast and furious burst of energy which serves it well for stealth hunting -- grabbing prey when it doesn't expect it. Furthermore, the reptile is

opportunistic, which means, quite simply, it doesn't like to work very hard to get its food if it doesn't have to.

- 3.2 In the very rare event you are charged or chased by an alligator, move in as straight a line as possible away from it as fast as you reasonably can. In many cases, the vegetation features of the wild will serve to protect you by slowing the alligator down, like trees, bumps, bushes, etc. -- your comparatively long legs usually make it easier for you to maneuver through the trees and brush than an alligator's short legs do.
- 3.3 Most adult humans can outrun even a fast crocodilian, which has been clocked at a maximum of about 10 mph/17 kilometers per hour (kph), compared to a human speed of 15-17 mph/24-27 kph. But this doesn't matter much; an alligator will often give up the chase because it sees that the runner is moving away too quickly, and realizes that too much effort will be required to continue pursuit.
- 3.4 You may have heard somewhere that the zigzag run (running in a "z" pattern, side-to-side) is a good idea, but this is not only an unnecessary maneuver but probably a very unwise one. Here's why:
 - 3.4.1 Unless you're an Olympic athlete, running zigzag over natural topography increases your risk of tripping and falling over rocks, plants, roots, and the like. And it goes without saying that falling while being pursued by an alligator is not good.
 - 3.4.2 Furthermore, an alligator doesn't have the degree of stereoscopic vision we have. It actually has a small 'blind spot' directly in front of it. Hence, the alligator's vision is most effective in the 'sides' of its field of view. So, running zigzag not only slows your rate of distance from your pursuer, it may clearly indicate to the animal exactly where you are; even this point hardly matters since in many cases the alligator may keep its eyes shut while pursuing so as not to get them hit by twigs, grass stalks and branches in its path.
 - 3.4.3 Finally, an alligator bites very effectively in a side-swiping motion, so if you are trying to run zigzag and are slowed down by plants, rocks, or other obstacles, the backwards flying leg of a running human is an optimal target for side-swiping, chomping jaws (the operative word here is "side").
- 3.5 Simply put, when faced with an attack, move directly away from the alligator as quickly as possible, navigating the terrain as carefully as possible. The zigzag idea will likely not serve you well.

4.0 Alligator Attack

- 4.1 If it seizes prey, and the prey fights back hard, the alligator may release it, depending on factors such as its own size relative to that of the victim, its own level of aggression, and its measure of hunger. Merely struggling to break free may not be enough counter-aggression to stop an alligator, and may actually prompt a devastating "death roll" response, in which the reptile furiously spins on its central axis to tear muscle and bone free of the victim's body.
- 4.2 These armored saurian are among the toughest beasts in the animal kingdom, so an attack victim should channel his or her nervous energy and will to survive and take the offensive by fighting hard. Not struggling...fighting very, very, very hard. Others on hand during such an event may be able to help by fighting the reptile, too. This should include punching the snout, poking the eyes, and even jabbing the ears, which are seen as small slits behind the eyes.

5.0 Additional Resources

- 5.1 Additional resources can be found at:
 - 5.1.1 <http://www.tpwd.state.tx.us/huntwild/wild/species/alligator/index.phtml>
 - 5.1.2 <http://corkscrew.audubon.org/Wildlife/Alligators.html>

S3NA-314-PR Working Alone and Remote Travel

1.0 Purpose and Scope

- 1.1 This Procedure establishes the requirements for communication and accountability between personnel at a work site to reduce the potential for incidents occurring to one employee without help readily available and to facilitate the rapid mustering of assistance to employees in the event of an emergency.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Buddy System:** A system of organizing employees at a work site in such a manner that each employee is accompanied by at least one other employee or is escorted by a client or contractor representative during work site activities.
- 2.2 **Controlled Work Areas:** One or more designated work areas on a field project site where hazardous activities and/or strictly defined operations take place. Such controlled work areas include, but are not limited to, remediation or construction sites; a restricted radius where a critical lift operation will take place could be declared a controlled work area. On a HAZWOPER site, the controlled work area is divided into the exclusion zone, the contaminated reduction zone, and the support zone.
- 2.3 **Working Alone:** Performing work with no line of sight or direct voice communication with another person who is aware of your assignment and capable of initiating emergency response.

3.0 Attachments

- 3.1 S3NA-314-ST Working Alone
- 3.2 S3NA-314-WI Wilderness Isolation

4.0 Procedure

- 4.1 Employees are discouraged from working alone on any site. If they will be out of contact with other employees, they will establish a buddy system or check-in procedure with another employee or responsible person.
- 4.2 When traveling alone, staff will take appropriate precautions, including notifying someone of their travel plans as well as carrying a communication device and safety equipment, as appropriate.
- 4.3 Managers will provide the resources (staff, communication devices, etc.) and plans (emergency response plans, check-in procedures, etc.) necessary so that employees are not working alone or have a buddy system in place.
- 4.4 No staff person shall work by themselves or out of contact with other personnel if they are conducting a hazardous job task. On the following tasks, a buddy system will be established:
- Working from heights
 - Working in a confined space
 - Working in a trench
 - Lock out/tag out
 - Working with electricity
 - Working with power tools/equipment
 - Working with hazardous substances or materials
 - Working with material under pressure
 - Working where there is a possible threat of violence
 - Working in isolation from first aid services or immediate/emergency assistance
 - Traveling in severe weather
 - Working in avalanche areas
 - Working on water or ice

- Working in remote or wilderness isolation
- Working in a controlled area
- Extreme heat or cold stress environments
- Working around high traffic or mobile equipment

4.5 **Office Work**

- 4.5.1 Each office will have in place and will communicate as part of its local safety orientation its procedures for the safety and security of an employee working alone in the office.
- 4.5.2 Employees working in the office after regular working hours or in situations where they are working alone will keep the entrance to the office locked.
- 4.5.3 If the building is monitored by a security service, employees working in the office after regular working hours or working alone will notify the security guard of their presence and anticipated hours. If the building does not have a security service, it is advisable that a staff person working alone notify a family member, friend, or manager of his or her location.
- 4.5.4 During all working hours, employees shall stay alert to unauthorized entries into the building and to other suspicious activities and shall report them immediately.
- 4.5.5 Contact numbers to be used in case of emergency are posted at all major exits.

4.6 **Field Work**

- 4.6.1 Prior to work commencing, a hazard assessment shall be prepared for all assignments on which employees are to work alone (in accordance with *S3NA-209-PR Project Hazard Assessment and Planning*). The hazard assessment shall consider travel time, weather, available communications, and the hazards associated with the task and work environment.
- 4.6.2 The assessment should also consider whether the employee assigned to work alone has sufficient training in the tasks to be performed to allow the employee to work safely alone. The employee's personal medical conditions may be considered if the employee has voluntarily made the medical condition known to the Supervisor or Project Manager.
- 4.6.3 The hazard assessment should identify the controls required for the safety of employees as applicable to the job task and location. Some controls associated with working alone or in remote isolation include a buddy system, standardized check-in times, specialized communication devices, and enhanced emergency supply kits.

4.7 **Buddy System**

- 4.7.1 When conducting hazardous work, staff will work with a buddy (another responsible individual) at all times.
- 4.7.2 Client or contractor personnel may be substituted for an AECOM employee's buddy only if they are designated by the client or contractor, are properly trained in this Standard Operating Procedure, and are properly trained in the site's emergency response procedures.
- 4.7.3 Once assigned as buddies, personnel shall remain in each other's line of sight and in direct voice contact at all times.
- 4.7.4 When unusual conditions do not permit line of sight and direct voice contact, the site supervisor will be informed. If permission from the site supervisor is obtained to continue the work, voice contact will be achieved using electronic communication devices such as, but not limited to, hand-held radio or cell phone.
- 4.7.5 When electronic communication devices are used, a protocol will be established and agreed to by each buddy to confirm that periodic effective and faultless communications are maintained:
- The person in communication with the field employee working alone will have direct communication with the employee at a frequency not to exceed each hour.
 - The frequency shall be established considering task hazards, weather conditions, personal medical conditions, and the availability of emergency response.
 - A missed communication event shall trigger emergency response procedures. The results of each communication event shall be documented in the project files.

4.8 Check-In Procedures

- 4.8.1 All field crews will establish check-in procedures prior to leaving the office and confirmed with the assigned Check-In Person.
- 4.8.2 The timing and frequency of those check-in procedures schedule shall be established prior to the initiation of field operations and will vary depending on the task and location of the work.
- At a minimum, all crews will check-in by 5:00 p.m.
 - Crews working in isolation or on hazardous sites will increase their check-in times accordingly (e.g., noon and 5:00 p.m.).
- 4.8.3 If crews will separate once they reach their field site, they will then be considered to be “working alone” and will establish a buddy system with the other members of the crew.
- 4.8.4 Staff working alone or in small crews in remote isolation will have an effective means of communication system including cell/radio/satellite phone as well as established check-in times.
- 4.8.5 The Check-In Procedure will be reviewed daily as part of the Task Hazard Analysis review or more frequently if there is a change in work arrangements that could adversely affect a worker's well-being or a report that the system is not working effectively.

4.9 Emergency Response Procedures (ERP)

- 4.9.1 All field staff AND the Check-In Person will be provided with the Emergency Response Plan (which is documented on the Task Hazard Analysis, if an ERP does not already exist for the site).
- 4.9.2 The Check-In Person will have access to a route map or understands their anticipated route of travel.
- 4.9.3 If communication is lost between buddies or a check-in time is missed, it will be assumed that an emergency situation exists (e.g., severe injury, illness, other accident situation), and the site's emergency response procedures will be implemented. Site work will cease until the emergency is resolved and the site supervisor directs personnel to restart work.
- 4.9.4 The established contact person will follow the procedures below if a field staff member has missed a check-in:
- First, they will attempt to make contact with the field staff directly.
 - If that fails to provide a response, they will contact other persons who may have been on site, including client supervisors, or other locations where the field staff might be (e.g., hotel, home, office).
 - If the field staff still cannot be located, the emergency contact person notifies the project manager or manager responsible for the staff.
 - Depending on the location and situation, they will then dispatch either another AECOM staff member, another on-site supervisor, or an appropriate emergency response agency (e.g., police) to travel to the last known location of the field staff.
 - If the dispatched responder arrives at the site but cannot locate the field staff, the appropriate public emergency contacts (e.g., police, search and rescue) will be made and the staff members' personal contacts shall be notified by Human Resources or the manager (if HR is unavailable).
 - If the dispatched responder finds the crew in an emergency situation (medical, environmental, structural, etc.), the appropriate steps will be taken to isolate the hazard, administer first aid, and notify the appropriate agencies and emergency support services.

4.10 Training

- 4.10.1 All staff will receive an initial orientation that includes the hazards and controls associated with working alone.
- 4.10.2 If working in wilderness, all field staff will be able to orienteer using a map and compass—if not, the basic skills of orienteering will be provided by an experienced staff member before work commences.
- 4.10.3 Staff regularly working in remote, isolated wilderness locations will either participate in a wilderness survival course from a qualified provider (1 or 2 day) or will obtain management approval based on their level of experience/competence in wilderness situations.

5.0 Records

5.1 None

6.0 References

- 6.1 Canadian Centre for Occupational Health and Safety
(<http://www.ccohs.ca/oshanswers/hsprograms/workingalone.html>)
- 6.2 Health Canada (http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/outdoor-plein_air-eng.php)

S3NA-314-ST Working Alone

The following Occupational Health and Safety regulations apply directly to working alone (and not with a specific job task):

Jurisdiction	Regulation
United States	
OSHA	n/a
Canada	
Alberta	OHS Code (2009) Sect 393, 394 Alberta's Occupational Health and Safety Code: An Explanation of the "Working Alone" Requirements (November 2006) Working Alone Safely - A Guide for Employers and Employees (September 2000)
British Columbia	OHS Regulation (1997) Sect 4.20.1 – 4.22
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 9.1 – 9.3
New Brunswick	Code of Practice for Working Alone Regulation - Occupational Health and Safety Act (N.B. Reg. 92-133)
Newfoundland/Labrador	n/a
Nova Scotia	n/a
NWT/NU Territories	General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 14
Ontario	n/a
Prince Edward Island	OHS Regulations (EC180/87) Sect 53.1 – 53.5
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 322 Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 3.22.1
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 35
Yukon Territory	n/a

S3NA-314-WI Wilderness Isolation

1.0 Planning

- 1.1 Working in wilderness isolation presents many more potential hazards and should only be conducted by teams with documented experience, safety plans, and equipment appropriate for the tasks and conditions of the work.
- 1.2 A Safe Work Plan will be approved by the Regional SH&E Manager.

2.0 Safety Equipment

- 2.1 All field staff should regularly carry a compass, fire starter, a small folding saw, and a map on their person.
- 2.2 All field staff should regularly carry a first aid kit and survival equipment applicable to the situation.
- 2.3 All field staff will be equipped with (or have access to) communication devices appropriate to the type of coverage anticipated in the project area.
- 2.4 When hiking long distances, it is recommended that a "mini survival kit" that includes the following items be carried:
- Lighter, matches, or a "flint" of fire steel
 - Fire starter (tinder). Cotton balls with lip balm work well, or paper egg cartons with cotton balls and paraffin wax; if buying commercial fire starter, test it after several months.
 - A whistle
 - Heavy tinfoil (to melt snow, to cook on, or to boil water in)
 - Some high-energy food
 - A Mora knife or folding saw (Japanese tooth rake is best) or "camp chainsaw in a can"
 - Cordage/rope (about 50 feet)
 - Bear spray (and/or bear bangers)
- 2.5 When using an ATV or helicopter for isolated work, it is recommended that a survival bag or backpack that can be left at a known muster point be put together. This bag should include the following items:
- Additional fire starter (tinder)
 - Matches, fire steel
 - A multi-tool (like a Swiss Army knife)
 - A folding saw
 - 3-8'x6" tarps plus one 12 X 16" tarp or larger (or a tent)
 - 100 " of utility cord or parachute cord
 - A small pot
 - Lean spoon
 - A small stove (a small folding military stoves with trioxethelyne tablets will work well)
 - Closed cell foam pads or several square feet of double-wall bubble insulation (the silver sided bubble wrap used in construction) to use as a sleeping pad or for hypothermia treatment
 - Food
 - Water
 - Sleeping bag with a mylar bivy sack to be used as a vapor barrier inside

3.0 Drinking Water

- 3.1 No surface water can be considered safe for human consumption without treatment. Even the cleanest looking spring water could be polluted. Untreated water may be contaminated with bacteria, viruses, or protozoa.
- 3.2 On short trips, carry treated water or obtain water from another safe source.
- 3.3 When field projects take you into remote isolation where there is the potential for not having access to clean drinking water, be sure to take the appropriate tools with you: a water filter, tin foil or a pot for boiling water, or tablets or chemicals for treating the water prior to consumption.
- 3.4 Generally, the chances of finding safe drinking water in the mountains increase as you gain altitude. Intense sunlight at high altitudes kills undesirable bacteria and viruses but harmful cysts are unaffected.
- 3.5 Runoff water from streams below glaciers is often cloudy with silt and should be filtered.
- 3.6 Well water, fast-moving rivers, and the deepest parts of lakes are the best locations to obtain water. Avoid stagnant water, shoreline water, and water close to human habitations and campsites.
- 3.7 During the winter, it is best to use an open water source or to obtain water through a hole in the ice. Check the safety of the ice first. Melting ice and snow consumes fuel and takes extra time. Eating snow or ice directly can lead to chilling and hypothermia and could also cause stomach cramps and headaches. Beware of colored snow, which indicates the presence of algae that could cause diarrhea if ingested. Even in winter, all water should be purified.

3.8 Water Treatment

- 3.8.1 Each method of water treatment has its advantages and disadvantages. Use only treated or boiled water for drinking, brushing teeth, or washing fruits and vegetables that will be eaten raw.
- 3.8.2 Boiling. Heat is the oldest, safest and most effective method of purifying water. Bring the water to a boil for at least one minute (adding one more minute for each 300 m (1000 ft.) above sea level. If the water is cloudy, filter it before boiling. Boiling will give your water a flat taste that can be remedied by pouring the water quickly back and forth from one clean container to another, by letting the water cool, or by adding a pinch of salt per litre of water.
- 3.8.3 Chemical Purification. When boiling is not practical because of time and lack of a heat source, disinfection with chlorine or iodine compounds may be effective. Use two water containers: one for treating water and the other for carrying purified water. After disinfection, shake the container vigorously. Wait five minutes. Shake it again with the lid loose so that some water leaks out to cleanse the mouth of the container. Disinfection alone may not kill some protozoa. Pass the water first through a filter with a pore size of 0.5 micron (absolute) or less to remove protozoa, then disinfect it to kill viruses and bacteria. Disinfection will give the water a peculiar taste. If you find it unpleasant, try using flavoured drink crystals or concentrated citrus juice to mask the taste of the disinfectant. Add drink powders or juice only after the treatment time has elapsed.
- 3.8.4 Filtration. Water filters for use in the wilderness are available, but be wary when making your choice. Avoid filters that allow particles larger than 0.5 microns to pass. Filters with a pore size of 0.1 to 0.3 micron can remove protozoa and bacteria but may not remove viruses. Filtration alone is insufficient to purify water; hence, it should be combined with disinfection to remove viruses. Follow the operating and maintenance instructions carefully.

Table 1: Summary of Water Purification Methods

	Boiling	Chlorine	Iodine	Filters
Bacteria	E	E	E	M
Viruses	E	E	E	N
Protozoa	E	M	M	M
Chemicals	M	N	N	N

E = effective

M = may be effective (see text)

N = not effective

- 3.9 Some water-borne diseases are difficult to diagnose. If you are not feeling well and have recently drunk water from a source in the wild, inform your doctor that you may have consumed untreated water.

S3NA-405-PR Drilling, Boring, and Direct Push Probing

1.0 Purpose and Scope

- 1.1 Provides the minimum requirements to be followed when drilling and boring work are performed.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 None

3.0 Attachments

- 3.1 S3NA-405-FM1 Drill Rig Inspection
- 3.2 S3NA-405-FM2 Subsurface Investigation Checklist
- 3.3 S3NA-405-ST Drilling and Boring
- 3.4 S3NA-405-WI Core Drilling Machine Safety Card

4.0 Procedure

- 4.1 All client on-site safety procedures shall be understood and adhered to.
- 4.2 Be aware of the provincial/territorial regulations that govern drill rig operations and exposed moving parts.
- 4.3 **Roles and Responsibilities**
 - 4.3.1 **Project Manager or Resident Engineer** is responsible for ensuring that sound principles of safety, training, inspection, maintenance, and operation consistent with all resource data available from the manufacturer, OSHA, and ANSI is provided to the operator and users by the Contractor or operating entity.
 - 4.3.2 **Site Safety Coordinator (SSC)** shall assist the **Project Manager** in compliance with the requirements of this procedure.
 - 4.3.3 The **SH&E Department** shall assist site management with guidance about this procedure.
 - 4.3.4 **AECOM employees** engaged in project field activities shall be cognizant of contractor activities that may affect their safety and shall follow these procedures.
 - 4.3.5 **AECOM Equipment Operator**
 - In cases where AECOM owns and operates drilling, boring, or probing equipment, the lead equipment operator is responsible for the maintenance and safe operation of equipment under their control consistent with those responsibilities of a Contractor.
 - Operations will be terminated during an electrical storm, and all crew members will move away from the rig. If lightning is observed, shut down all rig operations immediately.
 - 4.3.6 **Contractors**
 - **Contractors** have direct control over the application and operation of all drilling, boring, and probing equipment owned by their organization.
 - It is the **Equipment Contractor** operator's responsibility to implement safe work practices provided by the **Contractor's** project management or supervisory staff supplemented by good judgment, safe control, and caution whenever operating drilling, boring, and probing equipment.
 - 4.3.7 **Safety Representative:** Unless the **Contractor** has a designated **Safety Representative**, the **Contractor's** responsible person for safety for the drill crew will be the drill rig operator. The safety person's responsibilities are to
 - Consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.

- Be the leader in using proper personal protective equipment (PPE) and set an example in following the rules that are being enforced on others. See section 4.5 for PPE required by this SOP.
- Enforce the use of proper safety equipment and take appropriate corrective action when proper PPE is not being used.
- Understand that the proper maintenance of tools and equipment and general housekeeping on the drill rig will provide an environment that promotes and enforces safety. See Sections 4.7 and 4.9 for housekeeping and maintenance requirements of this SOP.
- Ensure that the operator has had adequate training and is thoroughly familiar with the rig, its controls, and its capabilities prior to commencement of drilling activities.
- Inspect the rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and/or damaged pressure gauges and pressure relief valves. A Rig Inspection Form has been provided in S3NA-405-FM1 Drill Rig Inspection for use in performing inspections when the Contractor does not have their own.
- Check and test all safety devices such as emergency shutdown switches at least daily and preferably at the start of a work shift. Rig operation should not be permitted until all emergency shutdown and warning systems are working correctly. Wiring around, bypassing, or removing an emergency device is not permitted.
- Check that all gauges, warning lights, and control levers are functioning properly, and listen for unusual sounds on each starting of an engine.
- Ensure that all new rig workers are informed of safe operating practices on and around the rig. Provide each new rig worker with a copy of the organization's drilling operations safety procedures and, when appropriate, the rig manufacturer's operations and maintenance manual. The safety person should ensure that each new employee reads and understands the safety procedures.
- Ensure that a first aid kit and fire extinguishers are available and properly maintained on each rig and on each additional vehicle.
- Be well trained and capable of using a first aid kit, a fire extinguisher, and all other safety devices and equipment.
- Maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.), and inform other members of the drill crew of its location.
- See that new workers are instructed in rig safety, and observe the new worker's progress toward understanding safe operating practices.
- Observe the mental, emotional, and physical capability of workers to perform the assigned work in a proper and safe manner. Dismiss from the job site any worker whose mental and physical capabilities might cause injury to the worker or coworkers.
- Rig Crew and Other Field Personnel (Those employees involved in fieldwork): All personnel engaged in site activities are required to become thoroughly familiar with, and to conform to, the provisions of AECOM's safety plan, procedures, and such other safety directives as may be considered appropriate by **Project Managers, Safety Officers, and Supervisors**.
- Rig Workers: Personnel are encouraged to offer ideas, suggestions, or recommendations regarding any operational condition, procedure, or practice that may enhance the safety of site personnel or the public. Their primary responsibilities will be:
 - Perform all required work safely.
 - Familiarize themselves with and understand the plan, including proper use of personal protective equipment.
 - Report any unsafe conditions to supervisory personnel.
 - Be aware of signs and symptoms of thermal stress.

4.4 Training

4.4.1 All staff shall be provided with on-site orientation to the rig and its operator.

4.4.2 All operators and assistants shall have industry-standard safety training and be versed in the equipment to be utilized. This may include, but is not limited to, HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.

4.5 **Personal Protective Equipment**

4.6 For most geotechnical, mineral, and/or groundwater drilling projects, PPE should include

- Hard hat: Hard hats shall be worn by everyone working at a drilling/boring site. Hats should meet the requirements of ANSI Z89 and be kept clean and in good repair with the headband and crown straps properly adjusted for the employee.
- Safety shoes: Safety shoes or boots shall be worn by all drilling personnel and all visitors to the site who observe operations within close proximity of the rig. Safety shoes or boots should meet the requirements of ANSI Z4 1.1.
- Safety glasses: All rig personnel shall wear safety glasses meeting the requirements of ANSI Z87.1.
- High Visibility Class II Safety Vest shall be worn by all **AECOM employees**. All rig personnel should attempt to wear high-visibility clothing that should be close fitting and not have large cuffs or loose material that can catch on rotating or translating components of the rig.
- Close fitting gloves and clothing: All rig personnel should wear gloves for hand protection against cuts and abrasions that could occur while handling wire rope or cable and from contact with sharp edges and burrs on drill rods and other drilling or sampling tools. Gloves should be close fitting and not have large cuffs or loose ties which can catch on rotating or translating components of the rig.
- Other protective equipment: For some operations, the project may dictate use of other protective equipment. The management of the contractor and its safety person shall determine the requirements. Such equipment might include face or ear protection or reflective clothing. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client.
- Each worker should wear noise reducing ear protectors around operating equipment or during elevated noise levels.
- When drilling, boring, or probing is performed in chemically or radiological contaminated ground, special protective equipment and clothing will probably be required.
- The clothing of the individual rig worker is not generally considered protective equipment; however, clothing should be close fitting and comfortable without loose ends, straps, draw strings or belts or otherwise unfastened parts that might catch on some rotating or translating component of the rig. Rings and jewelry should not be worn during a work shift.

4.7 **Housekeeping**

4.7.1 A key requirement for safe field operations is that the Contractor safety person understands and fulfills the responsibility for maintenance and “housekeeping” on and around the drill rig, including the following:

- Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the crew or a visitor.
- Storage or transporting tools, materials, or supplies within or on the mast (derrick) of the rig should be avoided.
- Pipe, drill rods, probe rods, casing augers, and similar tooling should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding and other accesses should be kept free of materials, debris and obstructions and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- All controls, control linkages, warning and operation lights, and lenses should be kept free of oil, grease, and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, red safety container with a flame arrester in the fill spout and having the word “gasoline” easily visible.

4.8 Traffic Control

4.8.1 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passerby pedestrians.

4.8.2 All traffic control devices shall be installed, placed, and maintained in accordance with the Traffic Control Plan, client specifications, and/or the Manual of Uniform Traffic Control Devices (MUTCD). Traffic control devices shall consist of and not be limited to:

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

4.9 Maintenance & Inspection

4.9.1 Good maintenance and thorough inspection will make operations safer. Maintenance tasks should be done safely by a qualified maintenance person. Inspection and maintenance tasks include but are not limited to the following requirements:

- Inspections shall be completed at the beginning of each day by the equipment operator and in the presence of an AECOM employee when the equipment is not owned and operated by AECOM. A Rig Inspection Form is provided in S3NA-405-FM1 Drill Rig Inspection for use in performing inspections.
- Safety glasses should be worn when performing maintenance on a rig or on drilling or probing tools.
- The drill rig engine should be shut down to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running).
- Precautions should be taken to prevent accidental starting of an engine during maintenance by removing or tagging the ignition key.
- Wheels or the lowering of leveling jacks or both should be blocked ("zero energy state") and hand brakes set before working under a drill rig.
- When possible and appropriate, all pressure on the hydraulic systems should be released as well as the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Personnel shall not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have adequate time to cool.
- Welding and cutting shall not occur on or near a fuel tank.
- Wire rope safety factors shall be in accordance with American National Standards Institute B 30.5-1968 or SAE J959-1966.
- Gasoline or other volatile or flammable liquids shall not be used as a cleaning agent on or around an I rig.
- The manufacturer's recommendations should be followed for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.
- All caps, filler plugs, protective guards, panels, high-pressure hose clamps, chains, or cables that have been removed for maintenance should be replaced.

4.10 Hand Tools

4.10.1 A large number of hand tools can be used on or around a drill or probe rig and in repair shops and more than an equal number of instructions for proper use exist. "Use the tool for its intended purpose" is the most important rule. Additionally, equipment operators and assistants should not use their hand in place of the proper tool; work shall be stopped until the correct tool can be found. The following are a few specific and some general suggestions that apply to the safe use of several hand tools that are often used on and around rigs:

- When a tool becomes damaged, either repair it before using it again or get rid of it.
- When using a hammer, any kind of hammer for any purpose, wear safety glasses and require all others around you to wear safety glasses.

- When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts; don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut, first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing – check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease which would otherwise build up and cause wrenches to slip. Replace hook and heel jaws when they become visibly worn.
- Avoid the use pipe wrenches in place of a rod-holding device whenever possible.
- When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

4.11 Clearing Work Areas

4.11.1 Prior to set up, adequate site clearing and leveling should be performed to accommodate the rig and supplies and provide a safe working area. Clearing the site includes clearing the intended drilling area of underground utilities in accordance with *S3NA-417-PR Utilities, Underground*. Drilling or probing should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

4.11.2 Start-Up

- All rig personnel and visitors should be instructed to "stand clear" of the rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the neutral-actuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

4.12 Drilling and Probing Operations

4.12.1 The following safety measures shall be taken during drilling and probing operations on-site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots and hearing protection shall be worn in the presence of a rig.
- Services shall be cleared prior to drilling or probing.
- Hands shall be kept away from moving parts (augers).
- The emergency shut-off switch on the rig should be identified to site personnel and tested on a regular basis by the operator.
- Unauthorized personnel shall be kept clear of the rig.

4.12.2 Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *S3NA-417-PR Utilities, Underground* and *S3NA-406-PR Electrical Lines, Overhead*.
- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pads until the mast (derrick) is lowered completely.

- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a rig should only operate a drill rig from the position of the controls. If the operator of the rig shall leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools will not be permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a rig or while on the job.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All air and water lines and pumps should be drained when not in use if freezing weather is expected.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes should be covered, protected, or backfilled adequately and according to local or state regulations on completion of the drilling project.
- "Horsing around" within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the rig is shut down.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Always use adequate fall protection and a full body harness when climbing above six feet of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.

4.13 **Elevated Derrick Platforms**

4.13.1 The following precautions should be used:

- When a rig worker first arrives at a derrick platform, the platform should immediately be inspected for broken members, loose connections, and loose tools or other loose materials.
- A derrick platform over 4 feet (1.2 m) above ground surface should have toe boards and safety railings that are in good condition.
- When climbing to a derrick platform that is higher than 6 feet (am), a fall arresting device shall be used. The fall arresting device should consist of a full body harness and fall protection. The harness should fit snugly but comfortably. The lifeline when attached to the derrick should be less than 6 feet (2 m) long and attached to a fall arrester. The harness and lifeline should be strong enough to withstand the dynamic force of a 250-pound (115 kg) weight (contained within the belt) falling 6 feet (2 m).
- When a rig worker is on a derrick platform, the lifeline should be fastened to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
- Tools should be securely attached to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.
- When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
- Loose tools and similar items should not be left on the derrick platform or on structural members of the derrick.
- Workers on the ground or the drilling floor should avoid being under rig workers on elevated platforms whenever possible.

4.14 Lifting Heavy Objects

- 4.14.1 Before lifting any object without using a hoist, make sure that the load is within your personal lifting capacity. If it is too heavy, ask for assistance.
- 4.14.2 Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.
- 4.14.3 If a heavy object shall be moved some distance without the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.
- 4.14.4 Move heavy objects with the aid of handcarts or lifting devices whenever possible.

4.15 Use of Wire Line Hoists, Wire Rope, and Hoisting Hardware

- 4.15.1 The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron Steel Institute, Wire Rope Users Manual.
- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper revving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes that have not been used for a period of a month or more should be thoroughly inspected before being returned to service.
 - End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.
 - If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the swivel freely rotates under load.
 - If a rod-slipping device is used to hoist drill or probe rods, do not drill through or rotate drill rods through the slipping device; do not hoist more than 1 foot (.3 m) of the rod column above the top of the mast (derrick); and do not hoist a rod column with loose tool joints while the rod column is being supported by a rod slipping device. If rods should slip back into the hole, do not attempt to break the fall of the rods with your hands or by applying tension to the slipping device.
 - Most sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should never be increased without first consulting with the manufacturer of the drill rig.
 - Wire ropes shall be properly matched with each sheave. If the rope is too large, the sheave will pinch the wire rope; if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger-sized wire ropes and therefore shall be replaced.
- 4.15.2 The following procedures and precautions shall be understood and implemented for safe use of wire ropes and rigging hardware.
- Use tool-handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool-handling hoists to pull on objects always from the rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.
 - When struck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
 - When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
 - Minimize shock loading of a wire rope. Apply loads smoothly and steadily. Avoid sudden loading in cold weather.
 - Never use frozen ropes.
 - Protect wire rope from sharp corners or edges.
 - Replace faulty guides and rollers.

- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Clutches and brakes of hoists should be periodically inspected and tested.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves, and pinch points while slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body, or feet of any personnel. Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement wire ropes should conform to the drill rig manufacturer's specifications.

4.16 **Use of Cathead and Rope Hoists**

4.16.1 The following safety procedures should be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, for rope wear grooves. If a rope groove forms to a depth greater than 1/8 inches (3 mm), the cathead should be replaced.
- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope "grabs" the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.
- The rope should always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg or any other part of your body.
- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.
- Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or laces.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum. Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator shall be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

4.17 Use of Augers

4.17.1 The following general procedures should be used when starting a boring with continuous flight of hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.
- An auger guide can facilitate the starting of a straight hole through hard ground or a pavement.
- The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnection auger sections, and inserting and removing the auger fork. The operator shall ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench, or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

4.18 Rotary and Core Drilling

4.18.1 Rotary drilling tools should be safety checked prior to drilling:

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

4.18.2 Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting, and lowering of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.

- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

4.19 **Site Movement of Equipment**

4.19.1 The individual who transports a rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state, and local regulations.
- Know the traveling height (overhead clearance), width, length and weight of the rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with an adequate margin.
- Never move a rig unless the vehicle brakes are in sound working order.
- Allow for mast overhand when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
- Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.
- Never travel on a street, road, or highway with the mast (derrick) of the rig in the raised or partially raised position.
- Remove all ignition keys if rig is left unattended.

4.19.2 Loading and Unloading

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the rig carrier before approaching loading ramps.
- Distribute the weight of the rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the high of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- The rig and tools should be secured to the hauling vehicle with ties, chains, and/or load binders of adequate capacity.

4.19.3 Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts, and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Attempt to cross obstacles such as small logs and small erosion channels or ditches squarely, not at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.

- After the drill has been moved to a new drilling site, set all brakes and/or locks. Always block/chock the wheels.

4.20 **Tires, Batteries, and Fuel**

4.20.1 Tires on the rig shall be checked daily for safety and during extended travel for loss of air and they shall be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be inflated to normal pressures before movement on firm or hilly ground or on streets, roads and highways. Under-inflated tires are not as stable on firm ground as properly inflated tires. Air pressures should be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between dual or embedded in the tire casing. Damaged or poorly fitting rims or rim flanges.
- Abnormal wear, cuts, breaks, or tears in the casing.
- The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacturer's repair manual.

4.20.2 Batteries contain strong acid. Use extreme caution when servicing batteries.

- Batteries should only be serviced in a ventilated area while wearing safety glasses.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Cell caps should be loosened prior to charging to permit the escape of gas.
- Spilled battery acid can burn your skin and damage your eyes. Spilled battery acid should be immediately flushed off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte; use a flashlight (not an open flame) to check electrolyte levels and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

4.20.3 Special precautions shall be taken for handling fuel and refueling the rig or carrier. Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.
- Do not fill fuel tanks while the engine is running. Turn off all electrical switches. Do not spill fuel on hot surfaces. Clean any spillage before starting an engine. Wipe up spilled fuel with cotton rags or cloths. Do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials, and flames or sparking equipment well away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Fuel containers and hoses should remain in contact with a metal surface during travel to prevent the buildup of static charge.

4.21 **First Aid (see S3NA-207-PR Medical Services and First Aid)**

4.21.1 At least one member of the crew (and if only one, preferably the drilling and safety supervisor) should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red Cross or a similar organization would best satisfy the requirements of first aid training for drill crews.

4.21.2 For drilling and probing operations it is particularly important that the individual responsible for first aid should be able to recognize the symptoms and be able to provide first aid for electrical shock, heart

attack, stroke, broken bones, eye injury, snake bite, and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crewmembers by instructors qualified by an agency such as the American Red Cross.

- 4.21.3 A first aid kit should be available and well maintained on each drill site. The contents of the first aid kit shall be placed in a weatherproof container with individual sealed packages for each type of item.

4.22 **Rig Utilization**

- 4.22.1 Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc.

- 4.22.2 Only use the drill rig and tools for the purposes that they are intended and designed.

4.23 **Rig Alterations**

- 4.23.1 Alterations to a rig or drilling or probing tools should only be made by qualified personnel and only after consultation with the manufacturer.

5.0 Records

- 5.1 None

6.0 References

- 6.1 None

S3NA-405-FM1 Drill Rig Inspection

Project Name:

Project Number:

Date:

Subcontractor Inspected:

Site Manager:

General Safety		
Safety Officer Designated for Job:	☐ Yes	☐ No
Name:		
Safety Meeting Performed (Daily)	☐ Yes	☐ No
Personal Protective Equipment (PPE)		
Hard Hats	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No
Steel-toed Boots	☐ Yes	☐ No
Hearing Protection	☐ Yes	☐ No
Work Gloves	☐ Yes	☐ No
Orange Work Vests	☐ Yes	☐ No
Traffic Cones and Signs	☐ Yes	☐ No
Other	☐ Yes	☐ No
Disposal of PPE in Proper Waste Containers (if applicable)	☐ Yes	☐ No
Comments:		
Daily Inspections of Drill Rig		
Structural Damage, Loose Bolts	☐ Yes	☐ No
Proper Tension in Chain Drives	☐ Yes	☐ No
Loose or Missing Guards, Fluid Leaks	☐ Yes	☐ No
Damaged Hoses and/or Damaged Pressure	☐ Yes	☐ No
Gauges and Pressure Relief Valves	☐ Yes	☐ No
Comments:		

Check and test all safety devices such as:		
Emergency shutdown switches, at least daily	☐ Yes	☐ No
All gauges and warning lights, and ensure control levers are functioning properly	☐ Yes	☐ No
First aid and fire extinguishers on drill rig	☐ Yes	☐ No
Back up alarm functioning properly	☐ Yes	☐ No
Comments:		
Drill Crew Training Requirements		
40-hour OSHA Training	☐ Yes	☐ No
8-hour Annual Refresher Training	☐ Yes	☐ No
Drill Rig Training/Safe Operating Practices	☐ Yes	☐ No
First Aid/CPR	☐ Yes	☐ No
Emergency Procedures	☐ Yes	☐ No
Emergency Phone Numbers Posted	☐ Yes	☐ No
Site Orientation	☐ Yes	☐ No
Health and Safety Plan Review	☐ Yes	☐ No
Comments:		
Housekeeping		
Suitable storage for tools, materials, and supplies	☐ Yes	☐ No
Pipes, drill rods, casing, and augers stacked on racks to prevent rolling and sliding	☐ Yes	☐ No
Platforms and other work areas free of debris materials and obstructions	☐ Yes	☐ No
Comments:		

Hand Tools		
Tools in good condition	☐ Yes	☐ No
Broken tools discarded and replaced	☐ Yes	☐ No
Right tool used for the right job	☐ Yes	☐ No
Comments:		
Drilling Operations		
Mast or derrick down when moving rig	☐ Yes	☐ No
Overhead obstructions identified before mast is raised	☐ Yes	☐ No
Drill rig stabilized using leveling jacks or solid cribbing	☐ Yes	☐ No
Secure and lock derrick	☐ Yes	☐ No
Comments:		
Overhead and Buried Utilities		
Buried utilities identified and marked	☐ Yes	☐ No
Safe distance of drill rig from overhead power lines	☐ Yes	☐ No
Comments:		
Wire Line Hoists, Wire Rope, and Hardware		
Inspection for broken wires where reduction in rope diameter, wire diameter, fatigue, corrosion, damage from gear jamming, crushing, bird caging, kinking	☐ Yes	☐ No
Inspect and lubricate parts daily	☐ Yes	☐ No
Comments:		

Auger Operations—what to look for:

- A system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections and inserting and removing auger fork.
- During connecting and disconnecting auger sections and inserting auger for the tool, handler should position himself away from the auger column while it is rotating.
- When securing the auger to the power coupling, pin should be inserted and tapped into place using a hammer or other similar device.
- Tool hoist should be used to lower second section of auger into place.
- Both operators should be clear of auger as it is being lifted into place.
- Long-handled shovel should be used to move dirt away from auger.

Overall Summary:

S3NA-405-FM2 Subsurface Investigation Checklist

Name of Contractor:

Location:

Project #:

Date:

Time:

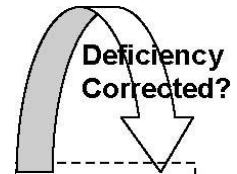
Weather:

Person Conducting Inspection:

Title:

*Note: As you conduct your inspection, you should be able to answer each question with a **YES**.*

*If the answer to any question is **NO**, this deficiency should be corrected as soon as possible.*



	YES	NO	OK	N/A
1. Do on-site personnel have required-level PPE (steel-toe boots, safety vests, hard hats, safety glasses, and gloves)?	☐	☐	☐	☐
2. Is there a copy of HASP and EAP available at each drill rig location?	☐	☐	☐	☐
3. Are there a PID, multi-gas meter, and a colorimetric pump available at each drill rig location?	☐	☐	☐	☐
4. Has the field screening equipment been calibrated in the morning?	☐	☐	☐	☐
5. Are calibration gases available at the site?	☐	☐	☐	☐
6. Are drilling fluids contained in the mud tub?	☐	☐	☐	☐
6a. Does mud tub setup provide adequate splash guards to protect the public?	☐	☐	☐	☐
6b. Does setup present five (5) feet of walk space for the public?	☐	☐	☐	☐
6c. Will the mud tub be emptied at end of day?	☐	☐	☐	☐
6d. Explain how the mud tub will be covered to prevent an accident.	☐	☐	☐	☐
6e. Are adequate containment practices being implemented to prevent mud tub liquids from being released onto pedestrian walkways?	☐	☐	☐	☐
7. Is the drill rig properly grounded?	☐	☐	☐	☐
8. Is there a DOT permit available on site at each drill rig location?	☐	☐	☐	☐
8a. Are operations in compliance with DOT permit?	☐	☐	☐	☐
9. Is there an orange snow fence with appropriate warning signage erected as a site barrier around the drill rig to keep pedestrians out of the work area?	☐	☐	☐	☐
10. Are hydrant water hoses out of the pedestrian sidewalk?	☐	☐	☐	☐
11. Are smoking and eating prohibited in the immediate work area?	☐	☐	☐	☐
12. Does each drill rig have a fire extinguisher, absorbent materials to cleanup a spill, and a first aid kit?	☐	☐	☐	☐
13. Is the waste from the mud tub properly contained in 55-gallon drums?	☐	☐	☐	☐
13a. Are drums properly labeled?	☐	☐	☐	☐
14. Are proper housekeeping procedures followed to avoid slips, trips, and falls?	☐	☐	☐	☐
15. Are decontamination/hand washing facilities available at the site?	☐	☐	☐	☐

COMMENTS:

S3NA-405-ST Drilling and Boring

Jurisdiction	Regulation
United States	
OSHA	29CFR 1910.212
Canada	
Alberta	OHS Code (2009) Sect 310, 362
British Columbia	OHS Regulation (1997) Sect 8.10, 16.27, 16.28
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 16.5, 22.5
New Brunswick	OHS Regulation (91-191) Sect 237, 241, 242
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 52, 61, 68, 71, 73
Nova Scotia	OHS Regulation (N.S. Reg. 44/99) Sect 87, 88
NWT/NU Territories	General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 39, 97, 141, 220
Ontario	O. Reg. 851 Sect 24
Prince Edward Island	OHS Regulations (EC180/87) Sect 30.2, 30.8
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 340 Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 2.10.2, 3.10.13
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 135
Yukon Territory	OHS Regulations (O.I.C. 2006/178) Sect 1.12, 7.19

S3NA-405-WI Core Drilling Machine Safety Card

1.0 Objective / Overview

- 1.1 Core drilling machines are used on all types of jobs. They can be electrical or gas powered and come with a stand or can be hand held. Caution should be used when operating such a machine. It may look harmless and easy to run, but drilling machines have many hazards.

2.0 Safe Operating Guidelines

- 2.1 Clean the flanges before mounting the blade.
- 2.2 Make sure the blade is correct for the material being cut and that the arrow on the blade corresponds with the direction of rotation of the machine spindle.
- 2.3 Avoid tilting the blade when cutting.
- 2.4 Use only the machines that have an approved safety guard.
- 2.5 Remove the diamond blade from the machine during transit to prevent accidental damage.
- 2.6 Inspect the blades frequently to detect cracks or undercutting of the steel center.
- 2.7 Don't let excessive heat be generated at the cutting edge of the blade.
- 2.8 Use adequate water supply to both sides of the blade.
- 2.9 Follow the manufacturers recommended pulley sizes and operating speeds for specific blade diameters.
- 2.10 Make sure to tighten drive belts to ensure full available power.
- 2.11 Don't force the blade on the blade shaft or mount blade on an undersized spindle.



3.0 Potential Hazards

- 3.1 Electrical shock.
- 3.2 Flying debris.
- 3.3 Severe cuts.
- 3.4 Hearing loss.
- 3.5 Breathing fumes or dust.
- 3.6 Binding/biting – torque control.

4.0 Training Requirements

- 4.1 Review of Applicable SOPs (e.g., *S3NA-305-PR Hand and Power Tools*; *S3NA-302-PR Electrical, General*).
- 4.2 Demonstrated knowledge on the use of a coring machine.
- 4.3 Review and follow manufacturers' operating guidelines.

5.0 Personal Protective Equipment (Level D PPE)

- 5.1 Leather gloves.
- 5.2 Face shield.
- 5.3 Steel-toed/composite-toed boots.
- 5.4 Hearing protection.

5.5 Respirator or dust mask.

6.0 Other Safety Tips

6.1 Keep fingers and hands away from the cutting edge.

6.2 Hold handle firmly when operating.

6.3 A subsurface utility clearance should be performed prior to initiating drilling operations.

6.4 Stand firmly and apply body weight at anchored side of guarded platform.

S3NA-406-PR Electrical Lines, Overhead

1.0 Purpose and Scope

- 1.1 Provides the safe work requirements to be observed where overhead power lines are present on a job site.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 Types of overhead lines:
 - 2.1.1 Overhead power lines
 - 2.1.2 Structural cable supports
 - 2.1.3 Guy wires
 - 2.1.4 Cable television / communication lines

3.0 Attachments

- 3.1 S3NA-406-FM Overhead Electrical Lines Acknowledgement Form

4.0 Procedure

- 4.1 An appropriate distance must be kept between equipment and overhead utility lines.
- 4.2 **Employees** must contact the power line operator before work is done or before equipment is operated within 15.25 metres (50 feet) of an energized overhead power line, in order to:
 - 4.2.1 Determine the voltage of the power line, and
 - 4.2.2 Establish the appropriate safe limit of approach distance as identified by provincial/territorial regulations.
- 4.3 The safe limit of approach distances do not apply to a load, equipment, or building that is transported under energized overhead power lines if the total height, including equipment transporting it, is less than 4.15 metres (13.5 feet).
- 4.4 **Employers** or **Project Managers** must formally notify (using the *S3NA-406-FM Overhead Electrical Lines Acknowledgement form*) all subcontractors or equipment operators of an energized overhead power line before work is done or equipment is operated in the vicinity of the power line at distances less than the safe limit of approach distances and obtain the operator's assistance in protecting workers involved.
- 4.5 **Employees** must not place earth or other material under or beside an overhead power line if doing so reduces the safe clearance to less than the safe limit of approach distances.
- 4.6 To maintain minimum safe clearances:
 - 4.6.1 Install warning devices and signs (hang a sign from and mark all guy wires to warn traffic of low clearance; provide warning signage for all overhead services).
 - 4.6.2 Install telescopic, nonconductive posts and flagging across right-of-way at the minimum allowable clearance as allowed by regulations for the line voltage.
 - 4.6.3 Position signs or other devices to determine the "Danger Zone."
 - 4.6.4 Inform all on-site staff with the on-site clearances required.
 - 4.6.5 Beware of atmospheric conditions, such as temperature, humidity, and wind, that may dictate more stringent safety procedures.
- 4.7 Operation of heavy equipment and cranes in areas with overhead power lines represents a significant hazard to all personnel on the job site. Accidental contact with an energized line or arcing between a

high power line and grounded equipment can cause electrocution of equipment operators or nearby ground personnel, and damage to power transmission and operating equipment. Although maintaining a safe distance from all energized lines is the preferred means for control of this hazard, site conditions may not always accommodate this. If work will (or may) occur within 50 feet of any energized line, the procedures outlined below will be observed.

- 4.8 Overhead power lines will be identified on each job site before the work commences. For each identified line, the **Project Manager** must determine whether it is energized (and the operating voltage for energized lines), and whether work operations will require that activities with heavy equipment (excavators, loaders, cranes, etc.) will occur within 50 feet (15.25 metres) of the line. Unless verified, it will be assumed that all lines are energized.
- 4.9 Safe working distance is the minimum distance that must be maintained between any energized electrical line and any part of the operating equipment to maintain adequate safety margins and is based on the line voltage of the power line. Figure 4-1 lists the line voltages in kilovolts and the Minimum Safe Work Distance in the United States and Figure 4-2 indicates the Nominal Phase to Phase voltage rating in kilovolts for Canada. The following safe working distance criteria will be applied for all AECOM operations:

Figure 4-1: United States Overhead Line Criteria

Line Voltage (Kilovolts)	Minimum Safe Working Distance
0 – 50	10 feet
>50 – 200	15 feet
>200 – 350	20 feet
>350 – 500	25 feet
>500 – 750	35 feet
>750 – 1,000	45 feet

Source: American National Standards Institute, Publication B30.5.

Figure 4-2: Canadian Overhead Line Criteria

Column 1	Column 2
Nominal phase-to-phase voltage rating	Minimum Distance
Over 425 to 12,000	3.0 metres
Over 12,000 to 22,000	3.0 metres
Over 22,000 to 50,000	3.0 metres
Over 50,000 to 90,000	4.5 metres
Over 90,000 to 120,000	4.5 metres
Over 120,000 to 150,000	6.0 metres
Over 150,000 to 250,000	6.0 metres
Over 250,000 to 300,000	7.5 metres
Over 300,000 to 350,000	7.5 metres
Over 350,000 to 400,000	9.0 metres

Source: Canada Occupational Health and Safety Regulations Electrical Safety- Subsection 8.5(6).

- 4.10 Under no circumstances will any object pass closer than 3 metres to any energized, uninsulated electrical line.
- 4.11 Formally notify all subcontractors of Overhead Power lines with the attached *S3NA-406-FM Overhead Electrical Lines Acknowledgement* form.
- 4.12 **Acceptable Safety Procedures**
- 4.12.1 Where any work task will not allow the minimum safe working distance to be maintained at all times, an alternate means of protection must be identified and approved by the **SH&E Department**. In order of preference, acceptable procedures are
- De-energize the power line(s)/lockout by local utility authorities
 - Install insulated sleeves on power lines
 - Assign line spotters to assist the equipment operator
- 4.12.2 De-energize Power Lines
- Elimination of electrical power provides the most acceptable means of ensuring safety of personnel. While temporary site power lines are under the control of the site manager (and can be de-energized locally), electrical distribution and transmission lines can be de-energized only by the owner of the line (generally the local electrical utility). Therefore, de-energizing of a line requires advance coordination with the line owner; generally, at least one week advance notice should be provided.
- 4.12.3 Install Insulating Sleeves
- Insulating sleeves can be placed over power lines to provide a contact and arcing barrier if work must occur closer to the power lines than the accepted safe work distance. Although not as desirable as line de-energizing, the use of these sleeves can provide an acceptable alternative where electrical lines are required to remain in service.
 - As with de-energizing of distribution and transmission lines, placement of insulating sleeves can be performed only by the line owner. This requires advance coordination with the line owner; generally, at least one week advance notice should be provided. To install the sleeves, representatives of the line owner will require access to the job site.
- 4.12.4 Assign Line Spotters
- A line spotter is a person located at ground level who is assigned to observe equipment operations, with the specific duty of assisting the equipment operator to ensure that no part of the equipment gets too close to an energized, unprotected electrical line.
 - Persons assigned to act as line spotters must meet the following requirements:
 - While acting as a line spotter, no other duties may be performed (e.g., the line spotter cannot also act as the load spotter during a lifting operations).
 - The spotter will have a radio or other direct means of communicating with the equipment operator at all times.
 - The spotter will be positioned at a right angle to the equipment operator's line of sight to maximize the sight angles between the personnel.
- Under no circumstances will any portion of a piece of equipment pass closer than 10 feet to any energized, uninsulated electrical line.**
- 4.13 **Additional Safety Measures**
- 4.13.1 The following additional safety measures can be implemented as needed when working around energized power lines:
- Provide equipment with proximity warning devices. These provide an audible alarm if any part of the equipment gets too close to a line.
 - Install ground safety stops. These prevent vehicles from accidentally entering hazardous areas.
 - Equip cranes with a boom-cage guard. This prevents the boom from becoming energized if an electrical line is contacted.
 - Utilize insulated links and polypropylene tag lines. These prevent the transmission of electricity to loads or tag line handlers if an electrical line is contacted.

NOTE: These additional safeguards are intended as supplemental protection. Use of these measures is not permissible as a substitute for maintaining the safe working distance or implementation of the procedures in Section 4.1.

4.13.2 If an electrical power line is hit or an electrical arc occurs:

- All ground personnel must evacuate IMMEDIATELY to a distance of at least 50 feet (15.25 metres). DO NOT attempt to rescue any injured person until the line can be de-energized.
- The operator should remain in the cab until the line can be de-energized and should carefully try to extricate the equipment from the power line. This may not be possible where melting of insulator material or metal has occurred.
- Contact the line owner to report the line contact and request that the line be de-energized immediately.
- Once the line has been confirmed to be de-energized, the operator can safely evacuate the cab and rescue can commence for any injured personnel.
- Contact the **SH&E Department** to report the incident and implement any instructions provided.
- If the operator must evacuate while the line is still energized (because of fire or other life-threatening condition) he/she should jump clear of the equipment (making sure to avoid touching the equipment and the ground simultaneously), and land upright and with feet together. Once on the ground, proceed in a direct line away from the equipment using a short, shuffling gait (feet touching, sliding each foot no more than 1 foot forward at a time) to minimize shock hazard from electrical energy being transmitted through the ground.

5.0 Records

5.1 None

6.0 References

6.1 None

S3NA-406-FM Overhead Electrical Lines Acknowledgement

Company information		
Name of Employer or Contracting Operation:		
Address:		
City:	Province:	Postal Code:
Telephone:	Fax:	
Project name:		
AECOM contact name:		
Acknowledgement		
I acknowledge that I have received a copy of the <i>S3NA-406-PR Electrical Lines, Overhead</i> , I understand that this project site may have Overhead Electrical Hazards, and I have discussed this procedure with all of our company staff who will be on this site.		
Name and Title (Print)	Signature	Date

S3NA-417-PR Utilities, Underground

1.0 Purpose and Scope

- 1.1 Establishes requirements to ensure that underground installations are identified properly before excavation work commences.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Underground Utilities:** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.
- 2.2 **Ground Disturbance (GD):** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

3.0 Attachments

- 3.1 S3NA-417-FM Identifying Underground Installations Checklist
- 3.2 S3NA-417-WI One Call System Definition and Directory
- 3.3 S3NA-417-ST Underground Utilities

4.0 Procedure

- 4.1 Ground disturbance may be conducted for a variety of purposes, including, but not limited to, exposing existing buried lines, soil sampling, remedial excavations, or installing monitoring wells or test pits.
- 4.2 Improper ground disturbance may impact a buried pipeline or utility line and cause a major release of a hazardous substance, flood, or electrocution. Serious injuries and significant property damage have resulted from insufficient/inadequate identification of underground installations during the course of ground disturbance work.
- 4.3 To control hazards associated with coming in contact with such installations, the American Public Works Association's (APWA) guidelines for the uniform identification of underground installations has been adopted.
- 4.4 **Project Managers** are responsible for ensuring that all work, including the identification, location, and access to all underground utilities, is planned and performed in accordance with contract specifications and safety requirements.
 - 4.4.1 The planning for associated work and avoidance of contacting underground utilities shall be part of the project safety planning in the HASP.
- 4.5 The **Lead Site Manager or Supervisor** is responsible for the execution of work in accordance with this and other associated AECOM SOPs, including:
 - The review of the HASP.
 - Verification that all steps have been taken to identify existing underground utilities in the area to be disturbed.
- 4.6 **Region SH&E Manager** provides guidance as needed.
- 4.7 **Personal Protective Equipment**
 - Long sleeved shirt and pants (coveralls/Nomex LILA for upstream oil and gas)
 - Safety toe boots
 - Hard hat
 - High-visibility clothing
 - Gloves
 - Respirator with organic vapor/particulate filter cartridge (for use when the exposure exceeds the occupational exposure limit stated on the MSDS), as required

S3NA-418-PR Welding, Cutting, and Other Hot Work

1.0 Purpose and Scope

- 1.1 Establishes the minimum requirements for welding, cutting, and hot work activities.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.
- 1.3 AECOM employees shall not operate a welder's torch; however, AECOM may oversee subcontractors who conduct welding, and therefore the requirements for hot work would still apply on our job sites and still require a permit. Other AECOM activities may also trigger the need for a Hot Work Permit and procedure (for example, engine ignition in flammable atmospheres).

2.0 Terms and Definitions

- 2.1 **Class 1 Area:** Any area in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
 - 2.1.1 Guidance to identify Class 1 can be provided by area classification diagrams (as presented in the IM website) and by standards such as the following:
 - American Petroleum Institute, API Recommended Practice 500, Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2, 2nd ed., November 1997.
 - BP GP 44-60, Guidance on Practice for API RP 500 Area Classification.
 - National Fire Protection Association 70™ National Electric Code®
- 2.2 **Class 1, Division 1:** Refers to the designation and classification of specific hazardous environments in the National Electrical Code (NEC). A Class I Hazardous Location is one in which flammable gases or vapors may be present in the air in sufficient quantities to be explosive or ignitable. Refer to local regulations, Occupational Safety and Health Administration (OSHA) and NEC for information about this type of hazardous area. Dusts or fibers may also produce explosive or ignitable conditions.
- 2.3 **Combustible Material:** Any material that may ignite when introduced to an ignition source (e.g., wood, paper, cardboard and plastic).
- 2.4 **Hot Work:** A work activity that by the nature of the operation (e.g., grinding, burning thermo cutting/welding, brazing, etc.) creates an open source of ignition or that could produce temperatures high enough to cause the ignition of flammable gases and combustible materials
- 2.5 **Hot Work Control Areas:** Fire-hazardous areas such as cable-spreading rooms, cable trays, conveyor galleries, rubber-lined piping equipment and structures, potentially explosive atmospheres, and similar hazardous hot work areas identified by project safety personnel.
- 2.6 **Hot Work Permit:** Document issued prior to the start of hot work, which is used to verify the presence of appropriate fire prevention and protection measures.
- 2.7 **Primary Source Ignition (PSI) Hot Work:** Any work with equipment and tools that are likely to ignite a flammable or combustible atmosphere, solid materials and liquids when used in a normal manner. Primary Source Ignition (PSI) hot work is often referred to as 'naked flame' hot work. High energy is present in the form of a flame, electric arc or incandescent sparks.
 - 2.7.1 Examples of PSI hot work include, but are not limited to, the following:
 - Welding and burning.
 - Grinding.
 - Torch cutting and soldering.
- 2.8 **Secondary Source Ignition (SSI) Hot Work:** Any work with equipment and tools that may create low-energy sparks and ignite a flammable or combustible atmosphere when used in a normal manner or due to errors or malfunction. Secondary source ignition (SSI) hot work is also referred to as 'spark potential' hot work.

- 2.8.1 Examples of SSI hot work include, but are not limited to, the following:
- 2.8.2 Sandblasting.
- 2.8.3 Using electrical and electronic equipment that is not intrinsically safe or explosion-proof (e.g., most electronic communication devices, flashlights).
- 2.8.4 Using spark-ignition engines (including vehicles) in a Class 1 area (e.g., vehicle entry into tank dike).
- 2.8.5 Using a rotating steel brush.
- 2.8.6 Electrical isolation testing.
- 2.8.7 Producing a friction spark, typically from a rusty surface.
- 2.9 **Sources of ignition:** In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, and mechanical), spontaneous ignition, chemical and physical-chemical reactions, and radiant heat.

3.0 Attachments

- 3.1 S3NA-418-FM Hot Work Permit
- 3.2 S3NA-418-GL Hot Work Permit Applicability
- 3.3 S3NA-418-ST Welding, Cutting and Other Hot Work

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Hot Work Operator

- In the scope of this procedure, a **Hot Work Operator** is defined as an individual who operates hot work equipment to perform hot work operations.
- The **Hot Work Operator** shall perform the following duties:
 - Know and apply applicable company and regulatory policies, standards and procedures related to hot work operations.
 - Participate in the inspection of welding and burning equipment and work areas.
 - Participate in the completion of and sign the Hot Work Permit to acknowledge his or her understanding of the conditions documented on the permit.
 - Comply with the conditions of the issued Hot Work Permit.
 - Safely handle hot work equipment and processes.
 - Cease hot work operations if unsafe conditions develop and notify the Field Task Manager immediately for evaluation and appropriate action.

4.1.2 Project Manager, Field Task Manager, Supervisor

- Assures that AECOM employees receive the specified level of protection as to project welding, cutting and burning activities.
- Assures that a Hot Work Permit is issued and all control measures are maintained.

4.1.3 Authorized Air Monitor

In the scope of this procedure, the **Authorized Air Monitor** is an individual responsible for operating air-monitoring equipment to monitor the presence of flammable gas in the area where hot work is planned.

- The **Authorized Air Monitor** may also be the **fire watch** under certain conditions specified in Section B – **Fire Watch** of the Hot Work Permit.
- The **Authorized Air Monitor** shall not be a **hot work operator** during primary source ignition (PSI) hot work but may be a **hot work operator** during secondary source ignition (SSI) Class 1 hot work.
- The **Authorized Air Monitor** will sign as a performing authority on the Permit Cover Sheet indicating their role.

- The **Authorized Air Monitor** shall perform the following duties:
 - Verify that the air monitoring device to be used is calibrated according to the manufacturer's instructions and that calibration information is documented in Section A – Atmospheric Monitoring of the Hot Work Permit.
 - Perform initial air monitoring of the hot work area for the presence of flammable gas.
 - Perform continuous air monitoring for the presence of flammable gas between the hot work and potential vapor sources.
 - Verify that a Lower Explosive Limit (LEL) Mitigation Plan, according to Lower Explosive Limit Mitigation Plan of this procedure, is developed and documented in Section E - LEL Mitigation Plan of the Hot Work Permit if initial or continuous air monitoring detects the presence of flammable gas (LEL is greater than 0 percent).
 - Verify that the LEL Mitigation Plan is implemented and flammability is controlled to less than 10 percent of the LEL before allowing hot work to proceed. (Refer to Lower Explosive Limit Mitigation Plan).
 - Stop all hot work if any air monitoring reading is greater than 10 percent of the LEL.

NOTE Refer to Air Monitoring (Class 1 Areas) of this practice for additional information regarding the **Authorized Air Monitoring** and air monitoring requirements.

4.1.4 Fire Watch

- In the scope of this procedure, the **Fire Watch** is responsible for monitoring hot work and the surrounding area for incipient fires and changing conditions. The **fire watch** may also be the **authorized air monitor** under certain conditions specified in Section B – **Fire Watch** of the Hot Work Permit.
- The **Fire Watch** shall not be a **hot work operator**. If simultaneously performing the **authorized air monitor** role, the **fire watch** shall not have any additional roles. The **Fire Watch** shall not have any other duties besides those specified in this procedure during the hot work activities and for 30 minutes afterwards.
- The **Fire Watch** shall perform the following duties:
 - Understand the location, nature and hazards of the hot work to be performed.
 - Survey the area to verify that the necessary fire protection equipment is in place and ready for use.
 - Confirm that safe conditions are maintained during hot work operations.
 - Make fire-extinguishing equipment readily available and be trained in its use.
 - Remain within communication range of the person(s) performing the hot work and maintain a line of sight with the hot work.
 - Not leave the area for any reason without a replacement or stopping the hot work.
 - Watch for fires in all areas exposed to hot work and communicate to **hot work operators** to cease all hot work if a fire occurs.
 - Try to extinguish a fire only when the fire is obviously within the capacity of the equipment available.
 - Sound the alarm (e.g., air horn) and implement evacuation procedures immediately if he or she determines that a fire is not within the capacity of the available extinguishing equipment.
 - Remain in the hot work area at least 30 minutes after the hot work has ceased to detect and extinguish possible smoldering fires.

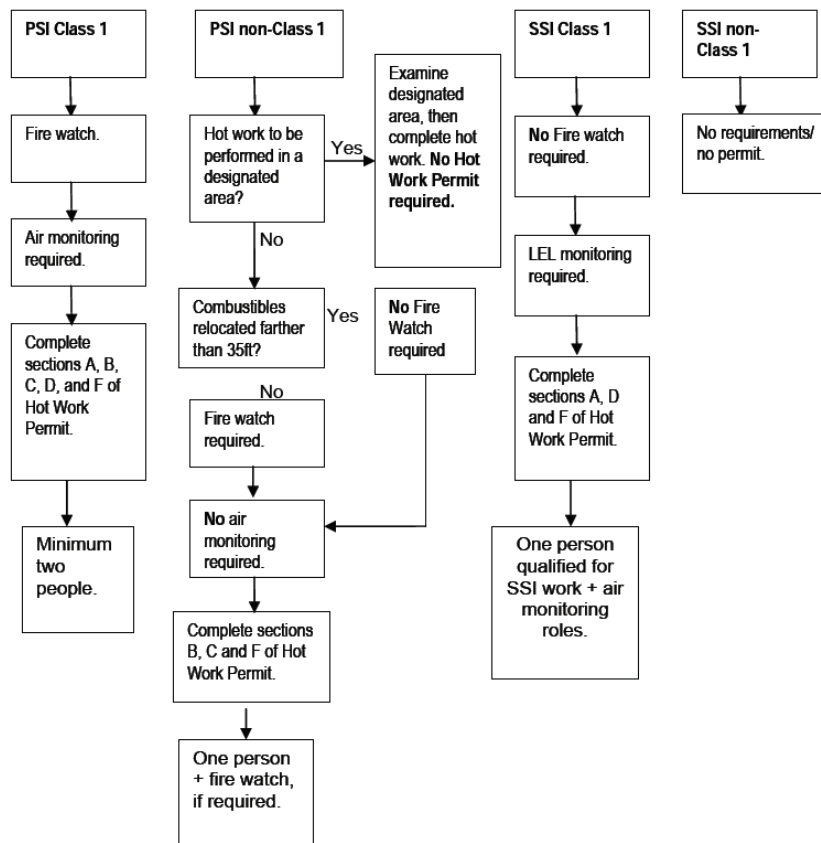
4.2 Performing hot work in classified and non-classified areas may be considered a hazardous activity, and a Hot Work Permit may be required. The Hot Work Permit has five purposes:

- 4.2.1 To serve as written permission to do the work.
- 4.2.2 To provide a minimum safety checklist.
- 4.2.3 To show the steps necessary for making the work site safe for conducting hot work.
- 4.2.4 To alert operating personnel to the work in progress.
- 4.2.5 To provide a record of safety steps taken for contract work.

- 4.3 S3NA-418-GL Hot Work Permit Applicability provides guidelines for determining whether a Hot Work Permit is required.
- 4.4 Occasionally AECOM staff may be working in the vicinity of welding operations. Exposure to welding operations can result in eye damage, burns, or respiratory illness.
- 4.5 Engineering controls will be implemented to control hot work hazards to the extent feasible.
- 4.6 Equipment will be used only for operations for which it is approved and as recommended by the manufacturer. Employees assigned to operate or maintain oxygen/fuel-gas supply equipment and resistance welding equipment will be thoroughly instructed in the safe use of such equipment by a qualified person.
- 4.7 Before any cutting or welding is performed, the area will be evaluated for flammables or combustibles by the Issuing Authority responsible for authorizing hot work. Where hot work permits are used, all welding activities shall be controlled and isolated from flammables and combustibles.
- 4.8 Training shall be provided as to the use of Hot Work Permits to all associated workers.
- 4.9 **Hot Work Permit**
- 4.9.1 A Hot Work Permit shall be prepared before any PSI hot work (other than in a designated area) or any SSI Class 1 hot work is performed. Any volatile contaminants (surface or subsurface) on sites shall be evaluated to determine if the definition of Class 1 is met.
- 4.9.2 A Hot Work Permit is not required for SSI non-Class 1 hot work.
- 4.9.3 A Hot Work Permit is valid for no more than one work shift. If hot work is suspended during a shift, the permit shall be revalidated before further hot work can continue. Revalidation involves inspecting the hot work area for any change in previous conditions and conducting air monitoring if the hot work is performed in a Class 1 area.
- 4.9.4 Individuals who have the technical and procedural competencies as defined by AECOM and their roles within the Hot Work activity will provide input to the permit as necessary to address all hazards and permit conditions related to the hot work.

	Class I	Non Class I
PSI hot work	 • Permit • Air monitor • Fire Watch	 • Permit • <u>No Air monitor</u> • Fire Watch
SSI Hot Work	 • Permit • Air monitor • <u>No Fire Watch</u>	 • <u>No Permit</u> • <u>No Air monitor</u> • <u>No Fire Watch</u>

4.9.5 Hot Work Permit Applicability



4.10 Non-Permissible Areas

4.10.1 All hot work is prohibited in areas not authorized by facility management and the following areas:

- Sprinkler-equipped buildings where sprinklers are impaired, unless the requirements of NFPA 25 are met.
- In the presence of explosive atmospheres (greater than or equal to 10 percent of the LEL).
- In the presence of unclean or improperly prepared tanks, vessels or other containers and equipment that have previously contained flammable or combustible materials when their contents may be exposed to an ignition source.

4.11 Preparation for All Primary Source Ignition (PSI) Hot Work

4.11.1 PSI hot work designates any work with equipment and tools that, when used in a normal manner, are likely to ignite a flammable or combustible atmosphere, solid materials and liquids.

4.11.2 PSI hot work, such as grinding, has been known to generate sparks with enough force to transport them up to 35' (10.67m) from the point of the hot work; therefore, it is possible to perform PSI hot work up to 35' (10.67m) away from a Class 1 location and yet still introduce an ignition source into a Class 1 area.

4.11.3 Prior to performing PSI hot work, the requirements presented in this section shall be met and shall be verified by the permit writer:

- The hot work equipment shall be in satisfactory operating condition and in good repair.
- All combustible and flammable materials shall be relocated at least 35' (10.67m) in all directions from the work site.

4.11.4 If relocating these materials is impractical, the following precautions shall be taken:

- The materials shall be shielded with fire-retardant covers or with metal or fire-retardant guards or curtains.
- The edges of covers at the floor shall be tight to prevent the entrance of sparks, including at the point where several covers overlap when a large pile is being protected.
- A **fire watch** may be required.

- 4.11.5 NOTE: Consideration should be given to spark-containment techniques that lessen the distance sparks are able to travel freely (e.g., fire-retardant screens, guards, spark/slag catcher).
- A fully charged and operable fire extinguisher appropriate for the type of potential fire shall be available for use in the work area (20lbs [9.07kg] minimum).
 - A nonflammable, impervious material shall seal sewer openings, ducts and drains. Where sealing is insecure or impractical, water spray or stream should be directed across openings.
 - The location of the hot work relative to combustible and flammable materials and classified areas shall determine the need for a **fire watch**, as outlined in this practice. Personnel within the vicinity of the hot work shall be suitably protected against such dangers as heat, sparks, flash and slag.
- 4.12 **Preparation for Primary Source Ignition (PSI) Class 1 Hot Work**
- 4.12.1 Prior to performing any PSI Class 1 hot work, the requirements set in Preparation for all Primary Source Ignition Hot Work of this procedure, this section and the relevant requirements of Air Monitoring of this practice shall be met and verified by the permit writer.
- A **fire watch** shall be assigned for the duration of the hot work and for 30 minutes after the hot work is completed to detect and extinguish any smoldering fires.
 - The venting, draining or bleeding of flammable or combustible liquids and gases shall be stopped within 35' (10.67m) of the hot work.
 - Affected excavations, conduits and manholes within 35' (10.67m) of the hot work shall either be monitored for the presence of flammable gas or sealed to confirm that an ignition source is not introduced.
 - Initial and continuous air monitoring shall be performed and documented on the Hot Work Permit. (Refer Air Monitoring [Class 1 Areas] of this practice.)
- 4.12.2 NOTE Non-intrinsically safe tools (including cell phones) are prohibited from use in Class 1 areas, except as defined in Initial and Continuous Hot Work Air Monitoring, regarding SSI Class 1 Hot Work.
- 4.13 **Preparation for Primary Source Ignition (PSI) Hot Work within 35' (10.67m) of Buildings or Other Structures**
- 4.13.1 The conditions in Preparation for all Primary Source Ignition Hot Work and this section shall be met and verified before any PSI hot work is performed inside or within 35' (10.67m) of buildings or structures with building materials or contents that may be combustible or flammable.
- Openings or cracks in walls, floors or ducts within 35' (10.67m) of the hot work shall be tightly covered with fire-retardant or noncombustible materials to prevent the passage of sparks to adjacent areas.
 - Ducts that might carry sparks to distant combustible or flammable materials shall be shielded, shut or both.
 - If hot work is performed near walls, partitions, ceilings or roofs of combustible materials, fire-retardant shields or guards shall be provided to prevent ignition.
 - If hot work is done on one side of a wall, partition, ceiling or roof, combustibles on the other side shall be relocated if possible. If it is impractical to relocate combustibles, a **fire watch** shall be provided on the side of the combustibles.
 - Hot work shall not be attempted on a partition, wall, ceiling or roof with a combustible covering or insulation, or on walls or partitions of combustible sandwich panels or similar construction.
 - If the hot work is close enough to cause ignition by conduction, it shall not be performed on pipes or other metal that is in contact with combustible walls, partitions, ceilings roofs or other combustibles.
 - The following procedures shall apply to hot work performed in close proximity to a sprinkler head:
 - A wet rag shall be laid over the sprinkler head and then removed at the conclusion of the welding or cutting operation.
 - Special precautions (e.g., ventilation, shielding) shall be taken during the hot work to avoid accidental operation of automatic fire suppression systems.

4.14 Preparation for Secondary Source Ignition (SSI) Class 1 Hot Work

- 4.14.1 Secondary Source Ignition (SSI) Hot Work designates any work with equipment and tools that may create low-energy sparks and ignite a flammable or combustible atmosphere when used in a normal manner or due to errors or malfunction. Secondary source ignition (SSI) hot work is also referred to as 'spark potential' hot work.
- 4.14.2 Before any SSI Class 1 hot work is performed, initial air monitoring shall be performed and documented on the Hot Work Permit. (Refer to Initial Hot Work Air Monitoring [PSI Class 1] of this procedure.)
- 4.14.3 Periodic up to continuous air monitoring, as determined by the permit writer and documented on the Hot Work Permit Section D. – Area Monitoring Program, shall be performed and the results documented on the Section A – Atmospheric Monitoring on the Hot Work Permit.
- 4.14.4 Air monitoring equipment is to produce an audible alarm when LEL exceeds 10 percent. The **authorized air monitor** shall remain in hearing range of the audible alarm and locate the air monitoring equipment between the hot work and potential vapor source. More than one instrument may be needed to monitor the air properly.
- 4.14.5 NOTE: Non-intrinsically safe tools (including cell phones) are prohibited from use in Class 1 areas, except as defined in Initial and Continuous Hot Work Air Monitoring, regarding SSI Class 1 hot work.

4.15 Air Monitoring (Class 1 Areas)

- 4.15.1 Flammable and combustible liquids and gases are present in Class 1 areas. In order to perform hot work safely in these areas, initial and continuous air monitoring is required to confirm that any flammable gas in the work area is detected and properly controlled.
- 4.15.2 If the hot work will be performed in a tank or vessel, the air monitoring requirements for confined spaces will apply.
- 4.15.3 When the possibility exists for an oxygen-deficient atmosphere the oxygen level could be below the level required by the air monitor to give the correct flammability (LEL) reading. This could occur where a tank, vessel or piping contains an inert gas such as nitrogen or carbon dioxide. For this reason, it is important to monitor oxygen levels prior to monitoring for LEL.
- 4.15.4 General Requirements
- Hot work is prohibited if air-monitoring readings are greater than or equal to 10 percent of the LEL.
 - All air monitoring associated with hot work will be conducted by an **authorized air monitor** who is trained and competent in the use of the instrument and hazards of the monitored area.
 - The instrument(s) used for air monitoring shall be calibrated prior to use. The **authorized air monitor** shall maintain documentation of the calibrations in Section A – Atmospheric Monitoring of the Hot Work Permit.
- 4.15.5 Initial Hot Work Air Monitoring (Primary Source Ignition Class 1)
- Initial hot work air monitoring should be conducted as close to the start of the hot work as possible.
 - Initial air monitoring shall be conducted prior to the authorization and issuance of all Hot Work Permits for PSI Class 1 hot work.
 - Initial air monitoring shall be performed by an authorized gas tester surveying at least a 35' (10.67m) radius from the point of the hot work with a properly functioning, calibrated air monitor equipped with LEL and O₂ sensors.
 - For all PSI Class 1 hot work, initial air monitoring shall be done according to the Area Monitoring Program on the Hot Work Permit.
 - If initial air monitoring indicates the presence of any flammable gas, the hot work may not proceed until an LEL mitigation plan is developed, documented on Section E – LEL Mitigation Plan of the Hot Work Permit and implemented. (Refer to Lower Explosive Limit Mitigation Plan of this practice.)

4.15.6 Continuous Hot Work Air Monitoring (Primary Source Ignition Class 1)

- All PSI Class 1 hot work requires attended continuous air monitoring while the hot work is being performed. An authorized gas tester shall attend to the monitor and survey the perimeter of the permitted area at least once an hour. The survey shall cover at least a 35' (10.67m) radius from the point of the hot work.
- During drilling operations where the potential of flammable gas is known to exist or the potential of flammable gas exists, the borehole may be classified as a Class 1 area and continuous gas monitor will be used in the immediate proximity of the top of the hole.
- When not conducting a periodic perimeter survey, the authorized gas tester shall be primarily positioned between the hot work and any potential sources of flammable gas.

NOTE: The use of several air monitors around the hot work should be considered, depending on the work location. If more than one continuous monitor is in use, only one instrument needs to be actively attended.

- Readings from continuous air monitoring and hourly surveys need should be recorded on the Hot Work Permit even if the monitors do not alarm and the readings do not differ from the initial air monitoring results.
- If initial air monitoring readings are 0 percent LEL but continuous air monitoring indicates the presence of flammable gas (greater than 0 percent of the LEL), the hot work shall stop and an LEL mitigation plan shall be developed, documented, and implemented. (Refer to Lower Explosive Limit Mitigation Plan of this practice.)
- If the implementation of the LEL Mitigation Plan controls the flammability level to less than 10 percent of the LEL, the authorized gas tester will continue monitoring the area while hot work continues. If at any time the LEL reading reaches 10 percent, the hot work shall stop until the source of the flammable gas is controlled to less than 10 percent of the LEL.

4.15.7 Initial and Continuous Hot Work Air Monitoring (Secondary Source Ignition Class 1)

- Vehicles, mobile plant equipment and other non-intrinsically safe equipment present potential ignition sources. Consequently, SSI hot work in Class 1 areas (e.g., a tank dike) requires the completion of a Hot Work Permit and the performance of air monitoring.
- Air monitoring shall be performed for SSI hot work in Class 1 areas:
 - Before a vehicle or equipment that is not intrinsically safe is allowed to enter the Class 1 area, an authorized gas tester shall survey the area along its planned path to its destination.
 - The vehicle or equipment can proceed into the classified area only when flammability readings are 0 percent LEL, or less than 10 percent of the LEL with an implemented LEL mitigation plan.
- Continuous air monitoring shall be performed as long as the vehicle's engine or non-intrinsically safe equipment is running and initial monitoring is greater than 0 percent.
- If the vehicle or non-intrinsically safe equipment is shut off, it shall not be restarted until the area around the vehicle or non-intrinsically safe equipment is surveyed for flammable gas.
- The planned egress of the vehicle or equipment from the Class 1 area shall be surveyed for flammable gas prior to its departure from the area.
- Periodic up to continuous air monitoring, as determined by the risk assessment, shall be performed and documented on the Hot Work Permit.

4.15.8 Area Monitoring Program

- An Area Monitoring Program shall be developed before any Class 1 hot work is performed.
- The following information, which is documented in Section D of the Hot Work Permit, shall be included in the Area Monitoring Program:
 - The area where the hot work will be performed, including the specific points where the hot work will be performed.
 - All hot work equipment (ignition sources) and all potential sources of flammable gas within 35' (10.67m) of the hot work. Examples of potential sources of flammable gas include sumps, drains, flanges, valves, liquid boots, excavations and all confined areas and equipment located within them, such as floating roof pontoons, piping, excavations, vessels and boreholes or wells with potentially flammable gases.
 - The area that will be monitored by the authorized gas tester. At a minimum, this includes a 35' (10.67m) radius from the point of the hot work. Hot work in a confined space requires air monitoring for flammable gas throughout the entire space. (Refer to the Confined Space

Defined Practice.)

4.16 **Lower Explosive Limit Mitigation Plan**

4.16.1 Section E of the Hot Work Permit documents the location of confirmed sources of flammable gas and the controls needed to reduce the LEL reading to less than 10 percent of the LEL.

4.16.2 An LEL mitigation plan shall be developed and implemented if the presence of flammable gas is detected (LEL greater than 0 percent) at any time during the hot work.

4.16.3 The following information shall be documented in Section E of the Hot Work Permit:

- The percent of the LEL that was measured.
- The identified source(s) of the flammable gas within the hot work area.
- The controls, if any, that will be implemented to effectively reduce the flammability level to less than 10 percent of the LEL within the hot work area.
- The percent LEL measured after controls, if any, have been implemented.

If at any time the LEL reading is greater than or equal to 10 percent of the LEL, the hot work will stop immediately and will not resume until controls are implemented to reduce the LEL level to less than 10 percent of the LEL.

4.17 **Fire Watch**

4.17.1 A **fire watch** is required whenever the hot work meets any of the following criteria:

- The hot work consists of PSI Class 1 hot work.
- The PSI hot work will be performed:
 - Within 35' (10.67m) of shielded combustible material.
 - Within a 35' (10.67m) radius of wall or floor openings that expose combustible materials.
- Adjacent to metal partitions, walls, ceilings or roofs that are in contact with combustible materials on the other side and are likely to be ignited by conduction or radiation.
- Where fire alarms or suppression systems have to be disabled.

4.17.2 The **fire watch** shall be in the ready position at all times while hot work is being performed. The ready position consists of the following:

- Being attentive to the hot work being performed.
- Properly positioning the fire extinguisher prior to the start of work.
- Always maintaining a line of sight to the hot work being performed.

4.17.3 The **fire watch** shall stop the work if he or she deems that:

- Unsafe conditions have developed.
- The work is exceeding the scope described in the Hot Work Permit.

4.17.4 When required, a **fire watch** will be maintained for at least 30 minutes after completion of welding/cutting operations so that possible smoldering fire can be detected and extinguished.

4.17.5 Firewatchers will have fire-extinguishing equipment readily available and be trained in its use.

4.17.6 They will be familiar with facilities and procedures in the event of a fire. They will watch for fires in all exposed areas and attempt to extinguish them only when obviously within the capacity of the equipment available. The Fire Department will be immediately notified of all fires.

4.17.7 A second **fire watch** shall be required if one **fire watch** cannot directly observe combustible materials that could be ignited by the hot work operation.

4.18 **Welding and Cutting General Requirements**

4.18.1 Equipment will be used only for operations for which it is approved and as recommended by the manufacturer.

4.18.2 Employees assigned to operate or maintain oxygen/fuel-gas supply equipment and resistance welding equipment will be thoroughly instructed in the safe use of such equipment by a qualified person.

- 4.18.3 Engineering controls will be implemented to control hot work hazards to the extent feasible.
- 4.18.4 Before any cutting or welding is performed, the area will be evaluated for flammables or combustibles by the Supervisor responsible for authorizing hot work.
- 4.18.5 A written Hot Work Permit (Attachment 1 or the equivalent) may be required by clients particularly in process plant facilities based on conditions or on projects that AECOM controls. In the latter case, the PM or site lead manager should review any Contractor/Subcontractor Hot Work permits issued.
- 4.18.6 Where hot work permits are used, all welding activities shall be controlled and isolated from flammables and combustibles.
- 4.18.7 Avoid looking directly at the welding arc.
- 4.18.8 Avoid prolonged exposure to welding/paint fumes.
- 4.18.9 Avoid touching recently welded joints.
- 4.18.10 Employees should see a Doctor if irritation or “red eye” occurs as a result of welder’s flash. Symptoms include:
- Pain that may be mild to very severe
 - Bloodshot eyes
 - Light sensitivity
 - Watery eyes
 - Blurred vision
 - The feeling of having something in your eye
- 4.18.11 Employees should seek urgent medical help if any of the following symptoms are experienced:
- Blurred vision
 - Vision changes
 - Seeing spots or flashes of light
 - Pain when moving your eyes
 - Worsening pain

4.19 **Gas Welding and Cutting Safety**

- 4.19.1 Fuel-gas hoses and oxygen hoses will be easily distinguishable from each other. The contrast will be made by different colors or by surface characteristics readily distinguishable by touch. Oxygen and fuel-gas hoses will not be interchangeable. A single hose having more than one gas passage will not be used.
- 4.19.2 When parallel sections of oxygen and fuel-gas hose are taped together, not more than 4 inches out of 12 inches will be covered by tape.
- 4.19.3 All hoses in use will be inspected at the beginning of each work shift. Defective hose will be removed from service.
- 4.19.4 Hoses, cables, and other equipment will be kept clear of walkways, ladders, and stairs.
- 4.19.5 Clogged torch tip openings will be cleaned with approved cleaning wires, drills, or other devices designed for this purpose.
- 4.19.6 Torches to be used will be inspected at the beginning of each work shift for leaking shutoff valves, damaged hose couplings, and clogged tip connection. Defective torches will not be used.
- 4.19.7 Torches will be ignited by friction lighters or other approved devices only. Matches, flame lighters, or hot work will not be used to ignite a torch.
- 4.19.8 Oxygen and fuel-gas pressure regulators, including related gauges, will be in proper working order and equipped with “Flashback” arrestors attached to the gauges. NOTE: Flashback arresters are in addition to “Backflow” devices.
- 4.19.9 All oxygen cylinders and fittings will be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus will be kept free from oil or greasy substances and

will not be handled with oily hands or gloves. Oxygen will not be directed at oily surfaces or greasy clothes, or used within a fuel oil or other storage tank or vessel.

- 4.19.10 Torches and hoses will be completely depressurized (bled) of pressurized gas, prior to storage, or at the end of each shift.
- 4.19.11 Torches and hoses will not be stored in enclosed areas (e.g., gang boxes, lockers) while connected to cylinders and gauges will be removed at the end of shift.
- 4.19.12 Oxygen connections will include a means to prevent backflow.
- 4.19.13 Fuel gas cylinders will be provided flashback protection.

4.20 **Arc Welding and Cutting Safety**

- 4.20.1 Electrode holders which are designed for arc welding/cutting and are capable of safely handling the maximum rate current will be used.
- 4.20.2 Any current-carrying parts passing through the holder which the arc welder or cutter grips in his/her hand, or the outer surfaces of the jaws of the holder, will be fully insulated against the maximum voltage encountered and properly grounded.
- 4.20.3 All arc welding/cutting cables will be completely insulated and flexible, capable of handling the maximum current requirements of the work.
- 4.20.4 Only cables free from repair or splices for a minimum distance of 10 feet from the electrode holder will be used. Cables with standard insulated connectors or splices with insulating quality that is equal to that of the cable are permitted.
- 4.20.5 If it is necessary to splice lengths of cable, insulated connectors equivalent to that of the cable will be used. If connections are made by cable lugs, they will be securely fastened together and provide a good electrical contact. Exposed metal parts of the lugs will be completely insulated.
- 4.20.6 If electrode holders are left unattended, the electrodes will be removed and the holder placed so that they cannot make electrical contact with employees or conducting objects.
- 4.20.7 To avoid the possibility of electric shock, electrode holders will not be dipped in water.
- 4.20.8 When the arc welder or cutter leaves work, stops work for any length of time, or when the arc welding cutting machine is to be moved, the power supply to the equipment will be turned off.
- 4.20.9 Any faulty or defective equipment will be reported to the supervisor and tagged out of service until repaired.
- 4.20.10 All arc welding/cutting operations will be shielded by noncombustible or flameproof screens to protect employees and other persons working in the vicinity from the direct ray of the arc.

4.21 **Storage and Handling of Compressed Gas Cylinders**

- 4.21.1 Compressed gas cylinders will be legibly marked with either the chemical or trade name of the gas. Such markings will be stenciled, stamped, or labeled and will not be easily removable.
- 4.21.2 The marking will be located on the shoulder of the cylinder.
- 4.21.3 Compressed gas cylinders will be equipped with approved connections
- 4.21.4 Acetylene cylinders will be stored and used valve end up.
- 4.21.5 Cylinders will not be stored near highly combustible/flammable materials, especially oil or grease.
- 4.21.6 Cylinders will be stored in an upright and secure position with caps installed and separated from fuel-gas cylinders or combustible materials (especially oil or grease), by a minimum distance of 20 feet, or by a noncombustible barrier at least 5 feet high and having a fire resistance rating of at least one half hour.
- 4.21.7 Cylinders will be not dropped, struck by objects, or permitted to strike each other violently.
- 4.21.8 Cylinder valves will be closed and gauges removed before moving cylinders
- 4.21.9 Cylinder valves will be closed and gauges removed at the end of the shift or when work is finished.
- 4.21.10 Valves of empty cylinders will be closed.

- 4.21.11 Cylinders will be kept far enough away from the actual welding/cutting operation so that sparks, hot slag, or flames will not reach them.
- 4.21.12 Cylinder valves will always be opened slowly.
- 4.21.13 An acetylene cylinder valve will not be opened more than one and one-half turns of the valve stem and preferably no more than three-fourths of a turn.
- 4.21.14 Where a special wrench is required to operate a cylinder valve, it will be left in position on the stem of the valve while the cylinder is in use. In the case of manifolded or coupled cylinders, at least one such wrench will be available for immediate use.
- 4.21.15 Regulators will be removed, valve caps in place, and valves closed when cylinders are transported by vehicles. All vehicles used to transport cylinders will have a proper support rack installed.
- 4.21.16 A suitable cylinder truck, chain, or other steadying device will be used to prevent cylinders from being knocked over while in use or storage.
- 4.21.17 Cylinders will not be placed where they may become part of an electric circuit. Tapping of an electrode against a cylinder to strike an arc will be prohibited.

4.22 Personal Protective Equipment

4.22.1 Selection and Use

- Selection and use of personal protective equipment will comply with *S3NA-208-PR Personal Protective Equipment Program*
 - If you are required to observe the welding operation, use welder's helmet fitted with a filter shade that is suitable for the type of welding that is being performed.
 - If you are required to observe the chipping and grinding operation, use coated safety goggles or safety glasses with both UVA and UVB radiation protection.
 - Contact lenses should not be worn if there is a potential exposure to dust particles or chemicals that can irritate the eye.

4.22.2 Eye and Face Protection

- Eye and face protection will comply with the following:
 - Welding helmets and hand shields will be used during all arc welding/cutting operations, excluding submerged arc welding. Cutting/welding goggles will also be worn during arc welding/cutting operations. The goggles or glasses may be either clear or colored glass, depending on the type of exposure in welding operations. Helpers or attendants will wear proper eye protection.
 - Safety goggles or other approved eye/face protection are for use during gas welding operations on light work, torch brazing, or inspection.
 - All operators and attendants on resistance welding or brazing equipment will use face shields or goggles, depending on the particular job.

4.22.3 Protective Clothing

- Hot work will require the following protective clothing:
 - Except when engaged in light work, all welders will wear flameproof gauntlet gloves.
 - Flameproof aprons made of leather, or other suitable material, may also be desirable for protection against radiated heat and sparks.
 - Woolen clothing will be worn in preference to cotton because it is not so readily ignited. Nylon clothing is not permitted for welding/cutting operations. All outer clothing, such as jumpers or overalls, will be reasonably free from oil or grease.

4.22.4 Respiratory Protective Equipment

- Respiratory protective devices will be required when one or more of the following conditions exist:
 - Feasible engineering controls are insufficient to mitigate the hazards.
 - Room size (with special regard to ceiling height) is limited, or welding/cutting work is extensive and ventilation is limited.
 - Several welders are working in the area at the same time.
 - Potentially unsafe atmospheric conditions exist.

- Too much heat is generated.
- Hazardous fumes, gases, or dusts of toxic metals, particularly lead, cadmium, chrome, beryllium, and zinc are present in the base metal or in coatings.
- Respiratory protective equipment will be selected, used, and maintained in accordance with SH&E 115 – Respiratory Protection.

4.22.5 Mechanical Ventilation

- Mechanical ventilation will consist of either general dilution systems or local exhaust systems. Local exhaust systems are preferred.
- General mechanical ventilation will be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fume and smoke within safe limits.
- General ventilation may not be used as the only means of control when toxic metals are involved in the operation.
- Local exhaust ventilation will consist of freely movable hoods intended to be placed by the welder or burner as close as practicable to the work. This system will be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits
- Contaminated air exhausted from a working space will be discharged into the open air or otherwise clear of the source of intake air. Environmental regulations may require filtering or other cleaning of exhausted air.
- All makeup air will be clean and suitable for breathing.
- Oxygen will not be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.
- The project Site Safety Representative will provide appropriate methods and controls in the case of specific requirements (including welding rods and fluxes, paints and coatings) for materials containing zinc, lead, mercury, beryllium, cadmium, and stainless steel to be cut, heated, and/or welded.

4.22.6 Fire Protection

- When possible, objects to be welded, cut, or heated will be moved to a designated safe location. If this is not possible, all movable fire hazards in the workspace will be taken away to a safe place.
- If the object to be welded, cut, or heated cannot be moved and all fire hazards cannot be removed (e.g., equipment, walls, floors, etc.), positive means will be taken to confine the heat, sparks, and slag to protect the immovable fire hazards as well as opposite sides.
- No welding, cutting, or heating will be done where the application of flammable paint, the presence of other flammable compounds, or heavy dust concentrations create a possible hazard
- Wherever there are openings or cracks in the flooring that cannot be closed, precautions will be taken so that no sparks will drop through the floor. The same precautions will be taken in the presence of cracks or holes in walls, open doorways, and open or broken windows.
- Approved fire extinguishing equipment will be present in the immediate work area. A minimum of a 10- pound ABC fire extinguisher is required.

4.22.7 Welding/Cutting on Containers

- No welding, cutting, or other hot work will be performed on empty drums, barrels, tanks, or other containers until they have been thoroughly cleaned. (*This is to ensure that there are no flammable materials present or any substances such as greases, tars, acids, or other materials which, when subjected to heat, might produce a hazard.*) Any connection to the drum or vessel will be disconnected or blanked off.
- All hollow spaces, vacancies, or containers will be ventilated to remove gases before preheating, cutting, or welding. Purging with inert gas is recommended.
- In addition to the requirements presented in SH&E SOP 713 – Confined Space Entry, welding/cutting in confined spaces such as a tank, boiler, pressure vessel, or small compartment will require the following precautionary measures:
 - Local exhaust ventilation will be provided, unless workers wear supplied-air respirators.
 - Gas cylinders and/or welding machines will be placed outside the confined space.

4.22.8 Manifolding of Cylinders

- Cylinder manifolds will be installed under the supervision of an experienced person(s) and must

comply with proper practices in construction and use.

- All manifolds and parts will be appropriate for the gases for which they are approved.
- When acetylene cylinders are manifolded, approved flashback arresters will be installed between each cylinder and the coupler block. One flash arrestor installed between the coupler block and regulator is acceptable only for outdoor use or if the number of cylinders coupled does not exceed three.
- Each cylinder lead will be provided with a backflow check valve.

5.0 Records

5.1 None

6.0 References

- 6.1 American Petroleum Institute, API Recommended Practice 500, Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2, 2nd ed., November 1997.
- 6.2 CSA Standard W117.2 regarding Safety in Welding, Cutting and Allied Processes
- 6.3 National Fire Protection Association 70™ National Electric Code®
- 6.4 "Practical Solution Guide to Arc Flash Hazards", developed by the Electrical Safety Authority

S3NA-418-FM Hot Work Permit

Name of Contractor: _____

Location: _____

Project #: _____

Date: _____

Time: _____

Weather: _____

Person Preparing Permit: _____

Title: _____

Person Conducting Hot Work: _____

Title: _____

THIS PERMIT BECOMES VOID:

1. At the end of the shift, or
2. Whenever conditions change significantly, or
3. On any emergency signal

TYPE OF HOT WORK

☐

PSI CLASS I (Complete full permit)

☐

PSI NON-CLASS I (Complete section B, C, and F)

☐

SSI CLASS I (Complete section A, D, and F)

A. ATMOSPHERIC MONITORING

(Initial and continuous monitoring are required for all Class I Hot Work [PSI and SSI])

AUTHORIZED AIR
MONITOR 1 NAME: _____AUTHORIZED AIR
MONITOR 1 SIGNATURE: _____

YES/NO/NOT APPLICABLE

INSTRUMENT 1
SERIAL NUMBERS: _____DATE AND
RESULTS OF
LAST
CALIBRATION: _____PRE-USE
CALIBRATION CHECK
PERFORMED: _____INSTRUMENT 2
SERIAL NUMBERS: _____DATE AND
RESULTS OF
LAST
CALIBRATION: _____PRE-USE
CALIBRATION CHECK
PERFORMED: _____

Initial Reading %LEL (if >0% fill out section E)

Time	%LEL	Time	%LEL	Time	%LEL	Time	%LEL	Time	%LEL

Continuous Reading %LEL

Time	%LEL	Time	%LEL	Time	%LEL	Time	%LEL	Time	%LEL

B. FIRE WATCH

YES NO

1. Will PSI Class I work be performed?
2. Will PSI Non-Class I work be performed within 35' (10.67 m) of combustible materials?
3. Will PSI hot work be performed where wall or floor openings within 35' (10.67m) would compose combustibles in adjacent areas?
4. Is PSI hot work to be performed where combustibles are adjacent to the opposite side of partitions, ceilings, or roofs being worked on?
5. Will fire alarms or suppression systems be disabled for hot work?

Note: If the answer to any of the fire watch conditions to the left is YES, a dedicated fire watch must be assigned.

Note: The fire watch is authorized to perform air monitoring.

Fire Watch 1:

Fire Watch 2:

C. WORK AREA PREPARATION FOR HOT WORK

	YES	NO	NOT APPLICABLE
1. Is the hot work equipment in proper working order?			
2. Are the proper material safety data sheets available for review?			
3. Have combustible materials been relocated more than 35' (10.67m) from hot work or been properly shielded?			
4. Is firefighting equipment in proper working order?			
5. Have ducts, drains, and sewers been adequately covered to prevent sparks from entering?			
6. If hot work is to be performed indoors, have combustible floors been wet down or properly shielded?			

7. If arc welding equipment will be used, have measures been taken to protect personnel from shock?			
8. If required, is a 20 lb. (9.07kg) fire extinguisher available and appropriate for the type of fire expected?			
9. If hot work is to be performed in or on containers, vessels, tanks, or similar equipment, have they been cleaned, purged, or ventilated, or have other precautions been taken to verify that they are safe for hot work?			
LIST ANY PERSONAL PROTECTIVE EQUIPMENT THAT IS REQUIRED (OTHER THAN THE MINIMUM REQUIRED):			
D. AREA MONITORING PROGRAM			
DOCUMENT WHERE AIR MONITORING WILL OCCUR, WHAT POTENTIAL GAS OR VAPOR SOURCES EXIST WITHIN THE HOT WORK AREA, AND THE WIND DIRECTION:			
E. LOWER EXPLOSIVE LIMIT (LEL) MITIGATION PLAN (Required if initial or continuous monitoring LEL is greater than 0%)			
% LEL DETECTED:		% LEL AFTER CONTROLS IMPLEMENTED	NOT APPLICABLE (If not applicable, continue monitoring source)
DOCUMENT THE LOCATION OF CONFIRMED SOURCE(S) OF GAS/VAPOR AND WHAT CONTROLS (IF ANY) HAVE BEEN IMPLEMENTED (Note: Hot work is prohibited if the LEL reading is greater than or equal to 10% in the hot work area.)			
F. AUTHORIZING SIGNATURES			

AUTHORIZED AIR MONITOR: I have performed initial air monitoring with a survey of the hot work area. I agree to perform continuous air monitoring while hot work is being performed in a Class I area and to stop hot work if the LEL reading is greater than or equal to 10%.

Name: Signature:

FIRE WATCH: I agree to maintain a line of sight with the hot work operation at all times, to have immediate access to a fire extinguisher and to remain at the hot work area for 30 minutes after the hot work is completed to verify the area is fire-safe.

Name: Signature:

HOT WORK OPERATORS: *I have reviewed and understand the permit the permit conditions specific to the scope of work. I agree to perform hot work operations within these conditions, to stop any work that I deem to be unsafe, and to notify the performing authority upon completion or interruption of this permitted work.*

Name: **Signature:**

The location where this work is to be done has been examined, necessary precautions have been taken, and permission is granted for this work.

Permit expires:

Signed:

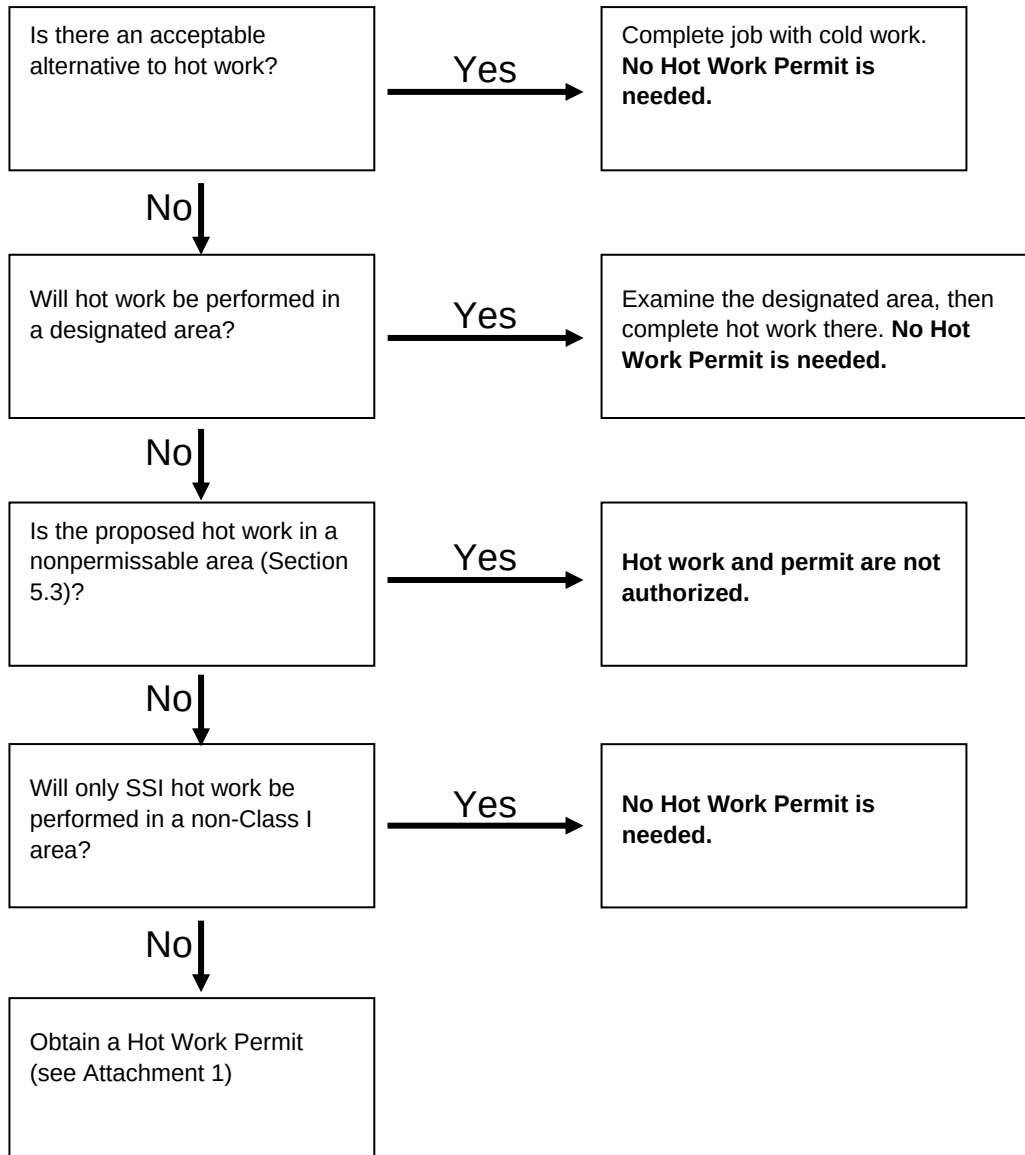
Site Safety Coordinator

Time Hot Work Started:

Time Hot Work Completed:

S3NA-418-GL Hot Work Applicability

Guidelines for determining whether a Hot Work Permit is required are provided below.



S3NA-418-ST Welding, Cutting and Other Hot Work

The following Occupational Health and Safety regulations apply directly to hot work and welding activities:

Jurisdiction	Regulation
United States	
OSHA	OSHA General Industry 29CFR1910.106, Hazardous Materials – Flammable and combustible liquids 29CFR1910.251-255, Welding, Cutting, and Brazing 29CFR1910.307, Electrical – Hazardous (classified) locations OSHA Construction 29CFR1926.350-354, Welding and Cutting 29CFR1926.407, Electrical – Hazardous (classified) locations.
Canada	
Alberta	OHS Code (2009) Sect 169, 171 – 174
British Columbia	OHS Regulation (1997) Sect 12.112 – 12.126
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 17.1 – 17.9
New Brunswick	OHS Regulation (91-191) Sect 273 – 285
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 75 – 78
Nova Scotia	OHS Regulation (N.S. Reg. 44/99) Sect 109 – 119
NWT/NU Territories	General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 154 – 167
Ontario	O. Reg. 213/91 Sect 122 – 124
Prince Edward Island	OHS Regulations (EC180/87) Sect 37.1 – 37.24
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 313 – 321 Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 2.10.7.6, 3.14.1 – 3.14.8
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 370, 373
Yukon Territory	OHS Regulations (O.I.C. 2006/178) Sect 13.08 – 13.12

- Hydrogen Sulfide (H₂S) Monitor (for areas with known or suspected H₂S)

4.8 **Training**

- 4.8.1 Staff shall successfully complete a Ground Disturbance training course.
- 4.8.2 Some clients may also have required client-based Ground Disturbance training.

4.9 **Underground Utility Lines**

- 4.9.1 To avoid injury from electrical and other utilities on site, utility lines shall be located and marked prior to conducting any drilling or digging on site. If available, refer to site drawings or client interviews for information pertaining to utilities on site.
- 4.9.2 Types of underground lines:
 - Gas line
 - Potable water line
 - Raw water line
 - Sewer line
 - Power line
 - Cable television/communication line
 - Cathodic protection lines
 - Grounding cable
 - Process piping/flow line
- 4.9.3 Prior to conducting the ground disturbance, you shall locate all pipelines and utilities that pass within (30 m) of the work area. This is your search and control area. To do so, you need to do the following:
 - Notify all pipeline and utility companies, and confirm that their notification requirements are fulfilled prior to conducting a ground disturbance.
 - Identify pipelines, power lines, utilities, and irrigation canals in a 30-foot (9.1 m) zone of the work area with the owner of the utility.
 - On private property, a properly trained and competent third party utility locator shall be used.
 - Get approval for work within a right-of-way (ROW) or within 15 feet (4.6 m) of a line if there is no ROW.
 - Prepare a site map identifying the search area, the ground disturbance area, and known underground utilities.
 - Confirm that all pipelines, power lines, and utilities are marked.
- 4.9.4 Look for pipeline indicators:
 - Look for warning signs where pipelines cross roads or water courses.
 - Look for cut lines, wells, tanks, or valves that may indicate the presence of pipelines.
 - Look for ground settling from previous work.
 - Talk to nearby landowners and residents.
 - Look for vegetation appearing “different” from the surrounding vegetation (e.g., greener, taller, shorter, or more brown than surrounding vegetation).
- 4.9.5 When you are working within a pipeline right-of-way, you shall get written approval from the pipeline owner prior to doing your work.
- 4.9.6 Call the pipeline owner at least two full working days before you dig so the pipeline can be located and marked.
- 4.9.7 Expose the pipeline by hand/hydrovac before digging within 15 feet (4.6 m) of the pipeline with machinery (no machinery comes may come within 2 feet [60 cm] of the pipeline) with the supervision of the owner or their representative, and call the owner at least one full day before you cover the exposed line.

4.9.8 During ground disturbance:

- All underground utilities shall be hand exposed or hydrovac'd within 3.3 feet (1 m) of a mark out or within the distance required by the owner of the utility before operating any mechanized equipment.
- Make arrangements for supervision ("a Signal Person") during hand exposure.
- If for any reason these hand excavations are temporarily filled in, mark them.
- Make arrangements for supervision ("a Signal Person") during any mechanical excavation within 5 m of the underground utility.
- Make arrangements for supervision ("a Signal Person") during backfilling of utilities.
- Cutting back and shoring of excavations shall be completed to ensure that there are no cave-ins (follow *SOP S3NA-303-PR Excavation and Trenching*).
- Do not damage utilities by shovels when hand exposing and picks should not be used.
- Remember that all workers have the right and responsibility to refuse to carry out any work or procedures that they feel are unsafe.
- If the ground disturbance is deeper than 3.3 feet (1 m), all crew members shall have appropriate training for excavations and trenches and shall be protected from cave-ins or sliding/rolling materials (follow *SOP S3NA-303-PR Excavation and Trenching*).
- Remember that incidents, injuries, and near misses shall be reported immediately.
- Review the site-specific emergency response plan.

4.9.9 If you hit an underground facility, stop the work immediately and notify the owner of the facility.

- The owner shall be informed of the location of the contact and the type of damage that resulted.
- If the facility is a pipeline, the company (client) shall immediately notify the required agencies and regulatory bodies of the location of the contact and the type of damage that resulted.
- The government agencies will require a written record and the company (client) should conduct an incident investigation into the causes and make recommendations for the future prevention of this incident.

4.10 Identification of Installations

4.10.1 Various forms of underground utility lines or pipes may be encountered during AECOM deployments to field sites. Damaged utilities, in particular, can present other hazards including asbestos, explosion, electric shock, scalding, etc., and they shall be avoided. The presence of damaged utilities at any work location shall be immediately brought to the attention of the field Lead Manager or other member of the AECOM site management team.

4.10.2 Guidance will be provided on the appropriate action to be taken, which could include suspension of work until the responsible utility agency is contacted and the hazard is either isolated or eliminated.

4.10.3 Extreme caution shall always be exercised when attempting to locate underground utilities. The location of utilities can be in some cases not consistent as shown on drawings, as indicated by the placement of surface signage, or as described by personnel. Coordination and planning of the job shall be required with the client or owner.

- Prior to digging and drilling operations, the client shall always be informed of the potential location(s) of underground utility systems.
- If a utility permit is required from the client or owner, it shall be secured.
- The client shall explain how the utility line may be identified—e.g., red concrete encasement.
- All underground installations shall be considered "live" and "operational" until the owner, client, or utility authority isolates any hazardous energy or deactivates the system and can demonstrate that condition.
- Where a line placement and depth is known or suspected and where there is potential for contact, hand digging, or hand auguring, instrumentation and other investigative techniques shall be used.

4.10.4 The One Call System Definition and Directory or its equivalent shall be used to prepare for excavation work in the event the identity of an underground installation(s) is unknown.

4.10.5 Line location documentation (or appropriate regional agency or company) provides a listing of companies that have registered buried facilities in the proposed work area. Some public utilities and private companies are not members of the One Call System. In order to give line operators sufficient

time to respond to a request to locate, a minimum waiting period of 72 business hours is required prior to beginning work.

- 4.10.6 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines contained in this SOP or as contract-specified.

4.11 **Surface Markings**

- 4.11.1 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.
- 4.11.2 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than two inches.
- 4.11.3 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

4.12 **Uniform Color-Coding**

- 4.12.1 The colors and corresponding installation type are as follows unless otherwise contract-specified.
- 4.12.2 Red: Electric Power Lines, Cables, Conduit, and Lighting Cables
- 4.12.3 Yellow : Gas, Oil, Stream, Petroleum, or Gaseous Materials
- 4.12.4 Orange : Communication, Alarm or Signal Lines, Cables, or Conduit
- 4.12.5 Green: Sewers and Drain Lines
- 4.12.6 White : Proposed Ground Disturbance area
- 4.12.7 Pink: Temporary Survey Markings
- 4.12.8 Purple: Nonpotable Water

5.0 **Records**

- 5.1 The following records on the identification of and response to underground utilities will be maintained in the project files:
- 5.1.1 All information regarding the identification of underground installations (this information can also be transferred to the appropriate drawings and/or prints and shall be available on site).
- 5.1.2 Drawings and/or prints shall be maintained for the life of this project.
- 5.1.3 Identifying Underground Installations Checklist.

6.0 **References**

- 6.1 American Public Works Association, Excavator's Damage Prevention Guide and One-Call System Directory International 1990-1991, Utility Location and Coordination Committee.

S3NA-417-FM Identifying Underground Installations Checklist

Name of Contractor:

Location:

Project #:

Type of Ground Disturbance Planned:

Date:

Time:

Weather:

Person Conducting Inspection:

Title:

Responsibilities of the Ground Disturbance Contractor

Supply as much pertinent information as possible when calling in location (house #, pole #, facility #, landmark to measure distance, nearest intersection, etc.)

	Completed	N/A
Notify the One-Call Center 3 business days in advance but no more than 10 days prior to activities.	☐	☐
Hand expose or hydrovac within 2 feet (60cm) of a mark out or within the distance required by the owner of the utility before operating any mechanized equipment.	☐	☐
Mark and identify perimeter of proposed site of excavation or boring locations in white.	☐	☐
Protect and preserve markings, staking, or other designations until no longer necessary for safe excavation, demolition, or blasting.	☐	☐
Obtain new ticket every 30 business days.	☐	☐
Check surrounding area before initiating ground disturbance.	☐	☐
Recordkeeping		
Confirmation number received.	☐	☐
Copy of mark-out ticket readily available.	☐	☐
Site Map documenting ground disturbance area and identified utilities completed.	☐	☐
Records have been maintained to document any damage.	☐	☐

Comments:

S3NA-417-WI One Call System Definition and Directory

1.0 What Is It?

- 1.1 It is a communication system established by two or more utilities, governmental agencies, or other operators of underground facilities to provide one telephone number for excavating contractors and the general public to call for notification of their intent to use equipment for excavating, tunneling, demolition, or any other similar work. This one-call system provides the participating members an opportunity to identify and locate their underground facilities.

2.0 Why Is It Needed?

- 2.1 Damage to underground facilities increased considerably following the building boom of the 1950s, 1960s, and early 1970s when the trend was to go underground with utilities. Thousands of miles of underground facilities were vulnerable to excavating machines such as backhoes, and the resulting damage interrupted utility service and threatened life, health, and property.

3.0 How to Get It

- 3.1 Write or call the number of the Utility Location and Coordination Council (ULCC) One-Call Systems International Committee representing the area within your American Public Works Association (APWA) region shown on the map. They will be pleased to assist you. For further information on ULCC programs, write APWA headquarters.

4.0 Disclaimer

- 4.1 The purpose of this directory is to illustrate the extent of one-call service available. The accuracy of information is not guaranteed by APWA or the one-call systems. Users must verify information including the extent and limit of service from local sources.

Province/State	One-Call Agency	Number
Canada		
British Columbia	http://www.bconecall.bc.ca/	1.800.474.6886
Alberta	http://www.alberta1call.com/	1.800.242.3447
Saskatchewan	http://www.sask1stcall.com/	1.866.828.4888
Manitoba	www.callb4udig.mb.ca/	1.800.827.5094
Ontario	http://www.on1call.com/	1.800.400.2255
Québec	http://www.info-ex.com/	1.800.663.9228
British Columbia	http://www.bconecall.bc.ca/	1.800.474.6886
United States		
	http://www.mail-house.com/utility.htm	811
Alabama	Alabama Line Location Center, Inc.	1.800.292.8525
Alaska	Locate Call Center of Alaska, Inc.	1.800.478.3121
Arizona	Arizona Blue Stake, Inc.	1.800.STAKE.IT (1.800.782.5348)
Arkansas	Arkansas One Call System, Inc.	1.800.482.8998
California	Underground Service Alert North	1.800.227.2600
Colorado	Utility Notification Center of Colorado	1.800.922.1987

Province/State	One-Call Agency	Number
Connecticut	Call Before You Dig	1.800.922.4455
Delaware	Miss Utility of Delmarva	1.800.282.8555
Florida	Call Sunshine	1.800.432.4770
Georgia	Utilities Protection Center, Inc.	1.800.282.7411
Idaho	Dig Line	1.800.342.1585
	Kootenai County Utility Coordinating Council	1.800.428.4950
	One Call Concepts – Idaho	1.800.626.4950
	Palouse Empire Underground Coordinating Council	1.800.822.1974
	Shoshone County One Call	1.800.398.3285
	Utilities Underground Location Center	1.800.424.5555
Illinois	Digger (Chicago Utility Alert Network)	312.744.7000
	Julie, Inc.	1.800.892.0123
Indiana	Indiana Underground Plant Protection Services, Inc.	1.800.382.5544
Iowa	Underground Plant Location Service, Inc.	1.800.292.8989
Kansas	Kansas One-Call Center	1.800.DIG.SAFE
Kentucky	Kentucky Underground Protection Inc.	1.800.752.6007
Louisiana	Louisiana One Call System, Inc.	1.800.272.3020
Maine	Dig Safe – Maine	1.800.225.4977
Maryland	Miss Utility	1.800.257.7777
	Miss Utility of Delmarva	1.800.282.8555
Massachusetts	Dig Safe – Massachusetts	1.800.322.4844
Michigan	Miss Dig System, Inc.	1.800.482.7171
Minnesota	Gopher State One Call	1.800.252.1166
Mississippi	Mississippi One-Call System, Inc.	1.800.227.6477
Missouri	Missouri One Call System, Inc.	1.800.344.7483
Montana	Utilities Underground Location Center	1.800.424.5555
Nebraska	Diggers Hotline	1.800.331.5666
Nevada	Underground Service Alert North	1.800.227.2600
New Hampshire	Dig Safe – New Hampshire	1.800.225.4977
New Jersey	Garden State Underground Plant Location Service	1.800.272.1000
New Mexico	New Mexico One Call System, Inc.	1.800.321.ALERT
New York	New York City – Long Island One Call Center	1.800.272.4480
	Underground Facilities Protective Organization "UFPO"	1.800.962.7962
North Carolina	The North Carolina One Call Center, Inc.	1.800.632.4949

Province/State	One-Call Agency	Number
North Dakota	Utilities Underground Location Center	1.800.454.5555
Ohio	Ohio Utilities Protection Service	1.800.362.2764
Oklahoma	Call Okie	1.800.522.6543
Oregon	Douglas Utilities Coordinating Council	1.503.673.6676
	Josephine Utilities Coordinating Council	1.503.476.6676
	Rogue Basin Utility Coordinating Council	1.503.779.6676
	Utilities Notification Center	1.800.332.2344
	Utilities Underground Location Center	1.800.424.5555
Pennsylvania	Pennsylvania One Call System, Inc.	1.800.242.1776
Rhode Island	Dig Safe – Rhode Island	1.800.225.4977
South Carolina	Palmetto Utility Protection Service Inc. "PUPS"	1.800.922.0983
South Dakota	South Dakota One Call	1.800.781.7474
Tennessee	Tennessee One-Call System, Inc.	1.800.351.1111
	Rogue Basin Utility Coordinating Council	1.503.779.6676
	Utilities Notification Center	1.800.332.2344
Utah	Blue Stakes Location Center	1.800.662.4111
Vermont	Dig Safe – Vermont	1.800.225.4977
Virginia	Miss Utility	1.800.257.7777
	Miss Utility of Delmarva	1.800.441.8355
	Miss Utility of Virginia	1.800.552.7001
Washington	Chelan-Douglas Utilities Coordinating Council	1.509.663.6111
	Grays Harbor & Pacific County Utility Coordinating Council	1.206.532.3550
	Inland Empire Utility Coordinating Council	1.509.456.8000
Utah	Blue Stakes Location Center	1.800.662.4111
Vermont	Dig Safe – Vermont	1.800.225.4977
Virginia	Miss Utility	1.800.257.7777
	Miss Utility of Delmarva	1.800.441.8355
	Miss Utility of Virginia	1.800.552.7001
Washington	Chelan-Douglas Utilities Coordinating Council	1.509.663.6111
	Grays Harbor & Pacific County Utility Coordinating Council	1.206.532.3550
	Palouse Empire Utilities Coordinating Council	1.800.822.1974
	Upper Yakima County Underground Utilities Council	1.800.553.4344
	Utilities Council of Cowlitz County	1.360.425.2506
	Utilities Notification Center	1.800.332.2344
	Utilities Underground Location Center	1.800.424.5555
West Virginia	Miss Utility of West Virginia, Inc.	1.800.245.4848
Wisconsin	Diggers Hotline, Inc.	1.800.982.0299
Wyoming	Albany County Utility Coordinating Council	1.307.742.3615
	Call-in Dig-in Safety Council	1.307.382.9811
	Carbon County Underground Utility Coordinating Council	1.307.324.6666
	Central Wyoming Utilities Coordinating Council	1.800.759.8035

Province/State	One-Call Agency	Number
	Converse County Utility Coordination Council	1.800.562.5561
	Fremont County Utility Coordinating Council	1.800.489.8023
	Southeast Wyoming Utilities Coordinating Council	1.307.638.6666
	Southwest Wyoming One Call	1.307.362.8888
	Utilities Underground Location Center	1.800.454.5555
	Wyoming One-Call	1.800.348.1030
	Palouse Empire Utilities Coordinating Council	1.800.822.1974
	Upper Yakima County Underground Utilities Council	1.800.553.4344
	Utilities Council of Cowlitz County	1.360.425.2506
	Utilities Notification Center	1.800.332.2344
	Utilities Underground Location Center	1.800.424.5555
West Virginia	Miss Utility of West Virginia, Inc.	1.800.245.4848

S3NA-417-ST Underground Utilities

1.0 Regulations

1.1 Every province and territory has strict regulations governing the procedures and practices that MUST be followed. As these regulations vary slightly, before work can commence, the Project Manager MUST review these documents and identify how all of the hazards will be addressed and how the regulations will be adhered to:

1.1.1 Occupational Health and Safety Code

1.1.2 Regional or industry-specific regulations (e.g., Alberta EUB (Pipeline Act)).

2.0 Occupational Health and Safety Regulations

2.1 The following Occupational Health and Safety regulations apply directly to ground disturbance:

Jurisdiction	Regulation
United States	
OSHA	CFR 1926.651
Canada	
Alberta	OHS Code (2009) Sect 441 – 464, Schedule 9
British Columbia	OHS Regulation (1997) Sect 20.78 – 20.101
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 26.0 – 26.47
New Brunswick	OHS Regulation (91-191) Sect 93 – 94.1, 180 – 188
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 139 – 148
Nova Scotia	OHS Regulation (N.S. Reg. 44/99) Sect 153, 166 – 173
NWT/NU Territories	General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 396 – 432
Ontario	O. Reg. 213/91 Sect 6, 7, 222 – 242
Prince Edward Island	OHS Regulations (EC180/87) Sect 12.1 – 12.15
Quebec	Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 3.15.1 – 3.15.10
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 257 – 265, Schedule Table 17
Yukon Territory	OHS Regulations (O.I.C. 2006/178) Sect 10.62 – 10.72

S3NA-502-PR Benzene

1.0 Purpose and Scope

- 1.1 Control occupational exposures to benzene to the lowest level practicable.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.
- 1.3 Note: Operations where the only exposure to benzene is from liquid mixtures containing 0.1 percent or less of benzene by volume or the vapors released from such liquids are exempt from the requirements of this procedure.

2.0 Terms and Definitions

- 2.1 **Action Level (AL):** An airborne benzene concentration of 0.5 parts per million by volume (ppm) (or more stringent as required by the provincial/territorial legislation), calculated as an 8- hour time weighted average (TWA).
- 2.2 **Benzene:** Benzene is a naturally occurring organic compound that has become a major industrial chemical. As a pure chemical, it is a clear, colorless liquid with an aromatic odor. Other characteristics of benzene are low vapor pressure, high flammability, and vapors heavier than air. Benzene has a solubility in water in the range of 700 mg/Liter, and liquid benzene is lighter than water. Benzene evaporates very quickly and inhalation is the most likely route of exposure. Brief exposure to high concentrations of benzene can cause drowsiness, dizziness, and headaches. Long-term exposures to benzene can affect normal blood production, resulting in leukemia, and can impair the body's immune system. Benzene is considered by the US EPA to be a human carcinogen.
- 2.3 **HAZWOPER:** Any onsite contamination investigation or clean-up activities subject to the operational requirements of *S3NA-509-PR Hazardous Waste Operations and Emergency Response*.
- 2.4 **Health and Safety Plan (HASP):** A document prepared for a specific project that details the hazards, precautions, emergency planning, medical, and training requirements for that project.
- 2.5 **Permissible Exposure Limit (PEL):** The maximum exposure concentration to which an individual may be exposed to for an 8- hour time weighted average (TWA) without experiencing adverse health effects. For normal work shifts (8 hours or less), the PEL for benzene is 1 ppm (or more stringent as required by the provincial/territorial/state legislation).
- 2.6 **Short-term Exposure Limit (STEL):** The greatest concentration to which nearly all workers may be exposed during any one 15-minute period without experiencing adverse health effects. The STEL for benzene is 5 parts per million (ppm) (or more stringent as required by the provincial/territorial/state legislation).

3.0 Attachments

- 3.1 None

4.0 Procedure

- 4.1 **SH&E Department Responsibilities:**
 - 4.1.1 Provide technical assistance in the evaluation of benzene exposure hazards as requested by management personnel.
 - 4.1.2 Review and approve all benzene exposure hazard assessments prior to the start of work activities.
 - 4.1.3 Review and approve all benzene exposure mitigation plans and exposure monitoring activities to confirm compliance with federal, provincial, territorial, state, and local regulations.
 - 4.1.4 Monitor compliance with the various aspects of this procedure and provide technical assistance regarding implementation of the requirements set forth in this procedure.

4.2 Project Managers' (field task managers, supervisors) Responsibilities

- 4.2.1 Confirm that the presence of benzene-contaminated materials at AECOM work sites is identified (where reasonably possible) prior to commencing field activities, that prior to initiating any task involving disturbance of or contact with benzene-contaminated materials (or immediately upon identification of previously unknown benzene-containing materials) a benzene exposure task hazard assessment is developed and approved by the **SH&E Department**, and that the applicable requirements are observed for each task where the benzene exposure assessment indicates that the airborne benzene concentrations can exceed the Action Level.
- 4.2.2 Confirm that employees assigned to perform any work activities involving benzene-containing materials have been trained in the job-specific hazards of benzene exposure, have received proper medical surveillance, and are trained and properly fit tested in the use of any designated respiratory protection devices.

4.3 Employee Responsibilities

- 4.3.1 Do not disturb or handle any benzene-contaminated materials without appropriate personal protective equipment (PPE), training in the job-specific hazards of benzene exposure, medical monitoring, and respirator fit test.
- 4.3.2 Immediately notify the Project Manager of the presence or suspected presence of previously unidentified benzene-contaminated materials in the workplace, and cease all work activities involving disturbance or contact with the materials until further direction is received.

4.4 Activity-Specific Requirements

Benzene is typically encountered by AECOM as an environmental contaminant, where it is usually a constituent of petroleum fuels or other refined petroleum products that have been released. Benzene can be found in retail gas stations, refineries natural gas processing systems, oil & gas production fields, chemical manufacturing plants, and in products used by employees such as gasoline and solvent systems.

4.4.1 HAZWOPER Activities

Benzene may be present at HAZWOPER sites as a soil or groundwater contaminant or in wastes stored or processed at the site. If such contamination is noted, the following requirements will be observed:

- The site-specific health and safety plan (HASP) will provide a specific analysis of the benzene exposure hazard for each task involving the disturbance or handling of benzene-contaminated materials.
- If any potential is identified for worker benzene exposures to exceed the AL, then specific benzene exposure control and monitoring procedures will be developed for the work activity and included in the HASP.
- If workers are potentially exposed in excess of the AL, they will complete baseline medical monitoring and benzene training.

4.4.2 Other Activities

If the presence of benzene-contaminated material is identified or suspected at any non-HAZWOPER work location, and there is the potential for this material to become disturbed during planned work activities, then the following requirements will be observed:

- A benzene exposure hazard assessment will be completed for each task in which benzene-containing material might be disturbed.
- If any exposure assessment indicates the potential for worker exposures to exceed the AL, then appropriate exposure mitigation procedures will be identified to keep exposures to less than the PEL (required) and the AL (where feasible). Mitigation procedures will be reviewed and approved by the SH&E Manager prior to implementation.
- If workers are potentially exposed in excess of the AL, they will complete baseline medical monitoring and benzene awareness training.
- The SH&E Department will determine if any exposure monitoring procedures will be implemented during work activities.

4.5 Worker Exposure Control Program

The following requirements pertain to all workers performing tasks where the associated benzene exposure assessment indicates the potential for benzene exposures to exceed the AL.

4.5.1 Medical Monitoring Requirements

Prior to commencing work where benzene exposure might exceed the AL, each employee will have completed a medical evaluation as specified by the AECOM corporate medical provider. Typically this will either be a HAZWOPER-protocol exam or a special-needs exam as determined by the physician.

4.5.2 Training

Each worker will have completed training consisting of the following elements:

- The HAZWOPER 40-hour/8-hour Refresher training series, and
- A special benzene-specific training session that addresses:
 - Benzene exposure limits and other regulatory requirements.
 - Job-specific benzene hazards and exposure prevention measures.
 - The health hazards associated with benzene exposure.
 - The quantity, location, manner of use, release, and storage of benzene in the workplace and the specific nature of operations that could result in exposure to benzene, especially exposures above the PEL.
 - The project-specific engineering controls and work practices associated with the employee's job assignment.
 - The measures employees can take to protect themselves from exposure to benzene, including modification of such habits as smoking and personal hygiene, and specific procedures that AECOM has implemented to protect employees from exposure to benzene such as appropriate work practices, emergency procedures, and the provision of personal protective equipment.
 - The purpose, proper selection, fitting, proper use, and limitations of respirators and protective clothing.

4.5.3 Respiratory Protection

Where respiratory protection is specified for use in controlling worker exposures to benzene, each employee will

- Be medically qualified for use of the specified respiratory protection.
- Complete respirator training and fit testing.
- Be assigned an appropriate respirator for use during field operations.

4.5.4 Personal Protective Equipment

In any operation where workers may experience airborne benzene concentrations above the AL, or where the possibility of skin or eye irritation exists, employees shall be provided with the following:

- Disposable coveralls or similar full-body work clothing.
- Gloves, hoods, and boots or disposable shoe coverlets.
- Face shields, goggles, or other appropriate protective equipment necessary for safe job performance.
- Clean change rooms equipped with separate storage facilities to prevent cross contamination from protective work clothing and equipment to street clothes.
- All protective clothing shall be cleaned, laundered, properly disposed of, and repaired or replaced as necessary. AECOM will provide all necessary PPE that is incidental to the work at no cost to the employee.

4.5.5 Air Monitoring

Operations involving the potential airborne exposure to benzene shall be required to conduct initial and ongoing personal air sampling to represent employee exposure.

4.6 Safe Work Practices

Specific safe work practices tailored to the job site exposure hazards, work activities, and environmental conditions will be developed in every HASP that addresses work at sites where benzene exposures may exceed the AL. At a minimum these work practices shall include prohibitions against smoking and consuming food. Workers shall be provided with potable water for washing exposed skin prior to leaving the project area, eating, drinking, and/or smoking.

4.7 Emergency Preparedness

Fire extinguishers shall be available at project sites where liquid benzene or benzene vapors might be present. Employees shall be trained in the use of the fire extinguishers, the emergency notification provisions of the HASP, and evacuation routes and willer points.

5.0 Records

- 5.1 Medical surveillance, employee monitoring, and training records shall be maintained as specified by *S3NA-003-PR SH&E Training*, *S3NA-602-PR Exposure Monitoring*, *S3NA-604-PR Medical Records*, and *S3NA-605-PR Medical Surveillance Program*.

6.0 References

- 6.1 Title 29, Code of Federal Regulations, Section 1910.1028
- 6.2 S3NA-003-PR SH&E Training
- 6.3 S3NA-209-PR Hazard Assessment and Project Planning
- 6.4 S3NA-602-PR Exposure Monitoring
- 6.5 S3NA-604-PR Medical Records
- 6.6 S3NA-605-PR Medical Surveillance Program

S3NA-505-PR Cold Stress Prevention

1.0 Purpose and Scope

- 1.1 To protect workers from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all workers can be repeatedly exposed without adverse health effects.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Cold Stress:** The production of physiological effects due to cold temperatures and/or wind chill.
- 2.2 **Equivalent Chill Temperature (ECT):** Also known as Wind Chill (see below)
- 2.3 **Frostnip:** Superficial cooling of tissues without cellular destruction.
- 2.4 **Frostbite:** Freezing of tissue, resulting in tissue destruction.
- 2.5 **Hypothermia:** Condition of reduced core body temperature to 95°F (35°C) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.
- 2.6 **Wind Chill:** The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

3.0 Attachments

- 3.1 S3NA-505-WI1 Temperature Thresholds
- 3.2 S3NA-505-WI2 Symptoms and Treatment
- 3.3 S3NA-505-ST Cold Exposure

4.0 Procedure

4.1 Restrictions

- 4.1.1 Staff working in extreme cold (wind chill or ECT below 10°F or -12°C) shall not work alone.
- 4.1.2 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frost bite.
- If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist.
 - Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure.
 - Schedule work for the warmest part of the day or when the wind is most calm.
 - Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
 - Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.

4.2 Roles and Responsibilities

4.2.1 Project Managers/field task managers

- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign personnel physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating worker capability.
- Confirm personnel are properly trained to recognize the symptoms of cold stress.

4.2.2 Region SH&E Managers

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.2.3 Supervisors

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.2.4 Employees

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly vested condition.
- Report all suspected cold stress-related illnesses.

4.3 Training

4.3.1 Before they begin work in a cold environment, project staff who might be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress. Workers that have not had the training within the twelve prior months shall repeat the training before exposure to cold stress.

4.3.2 Personnel potentially exposed to cold stress will receive training including, but not limited to:

- Sources of cold stress, the influence of protective clothing, and the importance of acclimatization
- How the body loses heat.
- Recognition of cold-related illness symptoms
- Cold stress preventative/corrective measures
- The harmful effects of excessive alcohol consumption in a cold stress environment
- The hazards associated with unstable snow or ice build ups
- First aid procedures for symptoms related to cold stress

4.4 Personal Protective Equipment

4.4.1 Wear multiple layers of loose fitting clothing to maintain immobile layers of warm air next to the body.

4.4.2 Avoid cotton, especially blue jeans.

4.4.3 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Confirm extra blankets or sleeping bags are on-site.

4.4.6 Sunglasses and sunscreen should be used when there is a persistent combination of snow and direct sun.

4.4.7 If shelter is not readily available, consider supplying temporary shelters

4.4.8 Confirm that staff carry fire starter materials if working in remote areas..

4.4.9 Pack warm, sweet drinks, and high calorie food for snacks.

4.5 General Cold Stress Prevention Measures**4.5.1** In order to prevent hypothermia:

- Wear multiple layers of clothing to maintain immobile layers of warm air next to the body. Avoid cotton, especially blue jeans.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
 - Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
 - Next remove head gear and neck wrappings.
 - Then coats/parkas should be opened at the waist and sleeves.
 - Finally, layers of clothing should be taken off.
 - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.
- Garments worn to keep out rain and spray should also allow water vapor to escape.
- Take advantage of heat from the sun and stay out of the wind as much as possible.
- Have available emergency shelter providing protection from wind and rain and insulation from the ground.
- Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
- Get adequate rest; conserve energy.
- Get adequate nutrition to replenish energy stores; rest after meals.
- Drink adequate fluids to avoid dehydration.
- If any project staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frost bite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine, particularly cigarettes, and alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8°F (37°C) shall be provided to workers if work is performed in air temperatures below 40°F (5°C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *S3NA-505-W11 Temperature Thresholds*. Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32°F (0°C) regardless of wind speed. However, older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25°F (-32°C) or below.

4.5.6 At air temperatures of 40°F (5°C) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.

- 4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.
- 4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.
- 4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.
- 4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.
- 4.5.11 Walking and working surfaces shall be cleared of ice and snow to prevent slips and falls.
- 4.5.12 Supplies such as PPE, fuels, enclosures, de-icing, traction aids, warm drinks, and batteries will be specified by the SH&E Manager and/or the Project Manager. These supplies will be inspected at least weekly during cold weather projects and replaced when necessary.
- 4.6 **Cold Stress Prevention Measures for the Hands**
- 4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:
- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60°F (15° C), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30°F (-1° C).
 - If the air temperature falls below 60°F (15° C) for sedentary work, 40°F (5° C) for light work, or 20°F (-6° C) for moderate work, and fine manual dexterity is not required, workers should use gloves.
- 4.6.2 To prevent contact frostbite, workers should wear anti-contact gloves:
- When cold surfaces below 20°F (-6° C) are within reach, each worker should be warned to prevent inadvertent contact by bare skin.
 - If the air temperature is 0°F (-18° C) or less, workers should protect their hands with mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.
- 4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40°F (5° C). The workers should wear cold protective clothing appropriate for the level of cold and physical activity.
- 4.6.4 Additional Cold Stress Prevention Measures For work practices at or below 10°F (-12° C) ECT, the following will apply:
- The worker should be under constant protective observation (buddy system or supervision).
 - The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
 - New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing.
 - The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
 - The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
 - Workers should be instructed in safety and health procedures, which should address:
 - Proper rewarming procedures and appropriate first aid treatment.
 - Proper clothing practices.
 - Proper eating and drinking habits.
 - Recognition of impending frostbite.

- Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
- Safe work practices.

4.6.5 Eye protection for workers employed outdoors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

4.6.6 Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of “cryogenic fluids” or those liquids with a boiling point that is just above ambient temperature.

4.6.7 Trauma sustained in freezing or subzero conditions requires special attention, because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 **Work-Warming Regimen**

4.7.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below -15°F (-26°C), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure.

4.7.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.7.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.7.4 A change of dry work clothing should be provided as necessary to prevent workers from returning to the cold environment with wet clothing.

5.0 **Records**

5.1 Training records will be maintained by the SH&E Department

5.2 Exposure assessments will be documented in the project files.

6.0 **References**

6.1 See attachment S3NA-505-WI1 Temperature Thresholds.

S3NA-505-WI1 Temperature Thresholds

1.0 Purpose and Scope

1.1 The following table gives apparent temperatures (wind chill) for various combinations of wind and air temperature, as well as guidelines to the danger of skin exposure.

Table 1. Wind Chill Chart (C)

Actual Temp (°C)	Wind Speed in km/hour									
	8	16	24	32	40	48	56	64	72	80
	Ambient Temperature (°C)									
0	-2	-8	-11	-14	-16	-17	-18	-19	-19	-20
-5	-7	-14	-18	-21	-23	-25	-26	-27	-28	-28
-10	-12	-20	-25	-28	-31	-33	-34	-35	-36	-36
-15	-18	-26	-32	-35	-38	-40	-42	-43	-43	-44
-20	-23	-32	-38	-43	-46	-48	-50	-51	-52	-52
-25	-28	-38	-45	-50	-53	-56	-57	-59	-59	-60
-30	-33	-45	-52	-57	-61	-63	-65	-67	-67	-68
-35	-39	-51	-59	-64	-68	-71	-73	-75	-75	-76
-40	-44	-57	-65	-71	-75	-79	-81	-83	-83	-84
-45	-49	-63	-72	-78	-83	-86	-89	-90	-91	-92
-50	-54	-69	-79	-85	-90	-94	-96	-98	-99	-100

Note: A. Little Danger: if less than one hour of exposure to dry skin.

B. Danger: Exposed flesh freezes within one minute.

C. Great Danger: Flesh may freeze with in 30 seconds.

Source: *Threshold Limit Values (TLV™) and Biological Exposure Indices (BEI™) booklet; published by ACGIH, Cincinnati, Ohio.

Table 2. Equivalent Chill Temperature Chart (F)

Estimated Wind Speed (mph)	Actual Temperature Reading (°F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	Equivalent Chill Temperature (°F)									
Calm	50	40	30	20	10	0	-10	-20	-30	-20
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-24	-33	-46	-58	-70
15	36	22	9	-5	18	-32	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-75	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	35	-51	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Wind speeds >40 mph have little additional effect	LITTLE DANGER				INCREASING DANGER			GREAT DANGER		
	Trenchfoot and immersion foot may occur at any point on this chart.									

Table 3. Work-Warming Schedule Guidelines

Air Temp. (Sunny Sky) °F	No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind		25 mph Wind		Air Temp. (Sunny Sky) °C																				
	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks	Max. Work Period	Breaks																					
above 5°	Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		Normal Work Schedule		above -15°																				
100 min											2	-15° to -17°																					
0° to -4°									75 min	2	-18° to -20°																						
-5° to -9°					100 min	2	75 min	2	55 min	3	-21° to -22°																						
-10° to -14°					100 min	2	75 min	2	55 min	3	40 min	4	-23° to -25°																				
-15° to -19°	100 min 2		100 min	2	75 min	2	55 min	3	40 min	4	30 min	5	-26° to -28°																				
-20° to -24°			75 min	2	55 min	3	40 min	4	30 min	5	Cease Work		-29° to -31°																				
-25° to -29°			55 min	3	40 min	4	30 min	5	Cease Work				-32° to -34°																				
-30° to -34°			40 min	4	30 min	5	Cease Work						-35° to -37°																				
-35° to -39°			30 min	5	Cease Work								-38° to -39°																				
-40° to -44°	30 min 5		Cease Work										-40° to -42°																				
-44° & below													-43° & below																				

Modified from ACGIH 2002 Threshold Limit Values for Chemical Substances and Physical Agents.

Note 1: Schedule describes the maximum continuous duration of work and number of 10-15 minute breaks to be observed during any 4-hour work period and assumes that period will be followed by an extended warm-up period (e.g., lunch). Allowed breaks should be taken in a warm environment.

Note 2: Schedule applies to moderate to heavy work performed by acclimated workers wearing appropriate layered clothing. For light to moderate work apply the schedule for conditions one step lower. For unacclimated workers apply the schedule for conditions two steps lower. These modifications are additive.

Note 3: For work under 25%–50% overcast/clouds, apply the schedule for conditions one step lower. For work at night or under greater than 50% overcast/clouds, apply the schedule for conditions two steps lower. These modifications are additive with any applicable modifications from Note 2.

Note 4: For wind speeds in excess of 25 mph, cease all nonemergency work when temperatures fall below 5°F.

S3NA-505-WI2 Symptoms and Treatment

1.0 Cold Stress-related Illnesses

1.1 Frostbite

1.1.1 Frostbite is a localized cold injury characterized by freezing of the tissues with ice crystal formation.

1.1.2 This injury is almost always limited to the upper and lower extremities or to such appendages as the ears or nose.

1.1.3 Conditions conducive to frostbite include sub-zero temperatures, hypothermia (most important predisposing factor), dehydration, obstruction of the blood supply to the extremities (by constricting clothing, especially on the feet or at the wrists or ankles), contact with cold metal, contact with organic liquids (such as gasoline or solvents that have been left outdoors in sub-zero temperatures), use of substances that cause vasoconstriction (such as smoking tobacco), or other injury or shock.

1.1.4 Symptoms of frostbite include:

- Pain in the involved tissue is the earliest symptom.
- Sudden and complete cessation of cold or discomfort in affected fingers or toes, often followed by a pleasant feeling of warmth.
- Subsequently the only symptom may be the absence of any sensation in the frozen part.
- Paleness in the affected tissues.
- Firm or hard tissues.
- Purple tissue, if a large area, such as an entire hand or foot, is frostbitten.

1.1.5 If exposure occurs in temperatures that are below freezing (32°F or below), frostbite or trench foot (immersion foot) may accompany or complicate the symptoms of hypothermia. Frostbite is the freezing of living tissues with a resultant breakdown of cell structure. Symptoms due to frostbite may include, but is not limited to:

- Superficial redness of the skin
- Slight numbness
- Blisters
- Obstruction of blood flow (ischemia)
- Blood clots (thrombosis)
- Skin discoloration due to insufficient oxygen in the blood (cyanosis)

1.1.6 Frostbite may occur if the skin comes into contact with objects with a surface temperature below freezing, such as metal tool handles. Trench foot is caused by continuous exposure to cold combined with persistent dampness or immersion in water. Injuries in this case include permanent tissue damage due to oxygen deficiency, damage to capillary walls, severe pain, blistering, tissue death, and ulceration.

1.1.7 Additionally, cold exposures may either induce or intensify vascular abnormalities. These include chilblain (a swelling or sore), Raynaud's disease, acrocyanosis (blueness of hands and feet) and thromboangiitis (inflammation of the innermost walls of blood vessels with accompanying clot formation). Workers suffering from these ailments should take particular precautions to avoid chilling.

1.2 Hypothermia

1.2.1 Hypothermia is a lower than normal body temperature that occurs when outer cold cools the body faster than the body can produce heat to stay warm.

1.2.2 Hypothermia can be caused by exposure to wind, cold, and/or moisture. The combination of wind, cold, and moisture can be deadly.

1.2.3 Early warning signs of hypothermia:

- Feeling of being cold and tired.
- Heavier breathing and increased pulse rate.
- Tendency to keep moving (e.g., stamping feet, rubbing hands, continued walking/pacing).
- Goose bumps, holding arms tightly wrapped around the body, hunching of shoulders.

- Shivering.
- 1.2.4 Hypothermia damages both the body's internal temperature mechanisms (hypothalamus) and the peripheral mechanisms to prevent heat loss (vasoconstriction and perspiration.) These effects may last up to three years after the initial hypothermia episode. Symptoms of hypothermia may include, but are not limited to:
- Pain in the extremities.
 - Severe shivering and numbness.
 - Low core body temperature.
 - Drowsiness and muscular weakness.
 - Apathy.
 - Mental confusion.
 - Loss of consciousness.
 - Shock.
 - Decreasing pulse and breathing rate.

2.0 Recommended Treatment for Cold Stress-related Illnesses

2.1 Frostbite

- 2.1.1 Wrap the victim in woolen blanket and keep dry until he or she can be brought inside.
- 2.1.2 Remove the victim from the cold environment.
- 2.1.3 Do not rub, chafe, or manipulate frozen parts.
- 2.1.4 Place the victim in warm water (102°F to 105°F) and make sure the water remains warm. Test the water by pouring it on the inner surface of your forearm. Never thaw affected body parts if the victim has to go back out into the cold; refreezing can cause significant tissue damage.
- 2.1.5 Do not use hot water bottles or a heat lamp, and do not place the victim near a hot stove.
- 2.1.6 Do not allow the victim to walk if his or her feet are affected.
- 2.1.7 Have the victim gently exercise the affected parts once they are thawed.
- 2.1.8 Seek immediate medical attention for thawing of serious frostbite.

2.2 Hypothermia

- 2.2.1 Bring the victim into a warm room or shelter as quickly as possible.
- 2.2.2 Give artificial respiration and stop any bleeding, if necessary.
- 2.2.3 If the victim cannot be moved (spinal injury, etc.), carefully place newspapers, blankets, or some other insulation between the victim and the ground.
- 2.2.4 Remove all wet clothing.
- 2.2.5 Provide an external heat source, because the body cannot generate its own heat. Wrap the victim in prewarmed blankets, place him or her in the liner of a portable hypothermia treatment unit, put the torso (not the extremities) into a tub of warm water, or use body-to-body contact to rewarm the body core. These measures will slowly reopen the peripheral circulation, minimizing the possibility of after-shock or after-drop (the flowing of cooled, stagnated blood from the limbs to the heart), which may cause ventricular fibrillation, cardiac arrest, or death.
- 2.2.6 Do not allow the victim to sleep.
- 2.2.7 Give warm, sweet drinks. Do not give alcohol or pain relievers.
- 2.2.8 Keep the victim still. Do not try to walk.
- 2.2.9 Do not rub numb skin.
- 2.2.10 Get medical attention as soon as possible.

S3NA-505-ST Cold Exposure

The following Occupational Health and Safety regulations apply directly to cold and snow hazards:

Jurisdiction	Regulation
United States	
OSHA	Title 29, Code of Federal Regulations, Sections 1910.1027 and 1926.1127
Canada	
Alberta	n/a
British Columbia	OHS Regulation (1997) Sect 7.33 – 7.38
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 4.12, 4.14
New Brunswick	OHS Regulation (91-191) Sect 44
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 10
Nova Scotia	n/a
NWT/NU Territories	n/a
Ontario	O. Reg. 851 Sect 39, 129
Prince Edward Island	OHS Regulations (EC180/87) Sect 42.1
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Schedule 4
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 70 Cold Conditions Guidelines for Outside Workers
Yukon Territory	Occupational Health Regulations (O.I.C. 1986/164) Sect 9

S3NA-508-PR Hazardous Materials Handling and Shipping

1.0 Purpose and Scope

- 1.1 Prescribes the minimum requirements for shipping samples, hazardous materials (HSM) and dangerous goods. It is designed to provide a framework for compliance with the requirements of the U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR) published under 49 CFR or Transport Canada Transportation of Dangerous Goods Regulations (TDG Regulations) published under Amendment 6 (SOR/2008-34) for shipment of hazardous materials/dangerous goods by land, and the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR) for shipping dangerous goods by air.
- 1.2 Applies to all AECOM North America based staff and operations.

2.0 Terms and Definitions

A complete list of definitions can be found in their entirety in the HMR, the TDG Regulations, and the IATA DGR.

- 2.1 **Carrier:** A person engaged in the transportation of passengers or property by land, water, or air either as a common, contract, private carrier, or civil aircraft.
- 2.2 **Dangerous goods:** Articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the TDG Regulations and/or IATA regulations or which are classified according to the TDG Regulations and/or IATA regulations. Generally synonymous with hazardous materials.
- 2.3 **Hazardous materials (HSM):** A substance or material which has been determined by the U.S. Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials.
- 2.3.1 Hazardous materials may include, but are not limited to: batteries, adhesives, paints, compressed gases, nuclear density meters, laboratory reagents, field samples, soil and sand siftings, hazardous wastes, and materials used for bench scale and pilot plant operations. While most environmental samples (both water and soil) do not meet the definition of hazardous material, extreme care must be taken to properly classify materials. HSM Classifications are as follows:
- Class 1 Explosives
 - Class 2 Compressed Gases
 - Class 3 Flammable Liquids
 - Class 4 Flammable Solids, Spontaneously Combustible and Water Reactive Solids
 - Class 5 Oxidizers and Organic Peroxides
 - Class 6 Poisonous and Infectious Substances
 - Class 7 Radioactive Materials
 - Class 8 Corrosive Substances
 - Class 9 Miscellaneous
- 2.4 **HSM employee:** A person who is employed by AECOM who in the course of employment directly affects dangerous goods/hazardous materials transportation safety. This term includes employees who prepare hazardous materials for transportation, or are responsible for safety of transporting hazardous materials.

- 2.5 **HzM employer:** A person who uses one or more of its employees in connection with transporting dangerous goods/hazardous materials in commerce, causing hazardous materials to be transported or shipping in commerce.
- 2.6 **HMR:** Hazardous Material Regulation
- 2.7 **IATA:** International Air Transport Association.
- 2.8 **ICAO:** International Civil Aviation Organization
- 2.9 **Materials of Trade:** A hazardous material, other than a hazardous waste, that is carried on a motor vehicle
- 2.9.1 For the purpose of protecting the health and safety of the motor vehicle operator or passengers;
- 2.9.2 For the purpose of supporting the operation or maintenance of a motor vehicle (including its auxiliary equipment); or
- 2.9.3 By a private motor carrier in direct support of a principal business that is other than transportation by motor vehicle.
- 2.10 **NAPL:** Non-aqueous phase liquid
- 2.11 **Offeror:** Any person who performs functions including selecting packaging, physical transfer of hazardous materials, classifying hazardous materials, preparing shipping papers, signing hazardous material certifications on shipping papers (as agent for), marking or placarding vehicles or packagings, or providing placards to carriers.
- 2.12 **Reportable Quantity (RQ):** The spill- or incident-related quantity of a material listed in the applicable regulations requiring a formal report.
- 2.13 **Serious Hazardous Materials Incident:** Anytime a material is found outside of its containment and has the potential to harm people or the environment.
- 2.14 **Shipper:** see Carrier

3.0 Attachments

- 3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Americas SH&E Director** is responsible for the following:
- Define the training to be required of employees involved in HZM shipping and facilitate the delivery of that training.
 - Coordinate information/resources for AECOM employees involved in shipping materials.
 - Collect and file copies of all HZM shipping papers in a central location for review by the DOT and other agencies.
 - Provide resources to employees involved in shipping hazardous materials.
 - Contract a 24-hour emergency response service with a telephone number that will be answered by a person either with information on the hazards of the shipment or with immediate access to such a person.
 - Serve as the central point of contact for information regarding this policy and procedure.
- 4.1.2 **Region SH&E Managers** are responsible for the following:
- Ensure that **District, Office, and Project Managers** who have personnel involved in the process of preparing hazardous materials for shipment have appropriately trained individuals, including both office and field personnel.

- The **Region SH&E Manager** will assign a HZM shipping specialist or specialists to manage the Region's hazardous materials program.
- 4.1.3 **Project Managers (including Field task managers, supervisors)** are responsible for the following:
- Be familiar with the training requirements for shipment, labeling, and packaging of HzM.
 - Confirm compliance and implementation of this procedure for all operations under their control. Also confirm that affected personnel have the required formal training in accordance with this procedure for both field/project sites and office locations.
 - File copies of all completed HzM shipping papers in the project file and provide a copy to their HzM Shipping Specialist.
- 4.1.4 **Office Manager** is responsible for the following:
- Develop a process by which hazardous materials will be properly shipped and received.
 - Identify properly trained personnel to manage the hazardous material shipping/receipt process within the office.
- 4.1.5 **HZM Employees** are responsible for the following:
- Shipper/Receiver - Awareness Level
 - Level 1 Shipper
 - Level 2 Shipping Specialist
- 4.1.6 **Shipper - Awareness Level** is responsible for the following:
- Any AECOM **employee** who receives, ships, or packages anything for transport (Fed Ex, UPS, US Postal, etc.) is required to be trained at the awareness level. The training is an education and guidance tool for any personnel that send or receive packages.
- 4.1.7 **Level 1 Shipper** is responsible for the following:
- **Employees** who ship sample coolers and transport field equipment are required to be trained in accordance with DOT HMR/TDG Regulations/IATA DGR requirements. This training provides an elevated level of education for employees in more dynamic roles. This level of training is required for all personnel involved in transport or preparation of paperwork, packaging, and labeling of any hazardous and/or potentially HzM. **Level 1** personnel must have direct support from a **Level 2 AECOM Shipping Specialist** when receiving or shipping regulated materials or when questioning the regulated status of materials.
- 4.1.8 **Level 2 Shipping Specialist** is responsible for the following:
- The **AECOM Level 2 Shipping Specialist** is responsible for oversight of the HzM Program within their respective District or Section. **Level 2** personnel must complete a comprehensive 2-day HzM shipping training course to comply with applicable regulations on transporting HzM. Consult with your representative **District or Region SH&E Manager** for additional information.
- 4.1.9 **Employees** are responsible for the following:
- Do not handle, receive or ship samples, HzM or dangerous goods without having appropriate and documented training as specified in this procedure. Note that if the employee does not think he/she would be allowed to carry the material onto a passenger aircraft, it is probably HzM.
 - The **employee** shall immediately notify the **Field Task Manager** or **Office Manager** of concerns or questions about the condition/contents of samples, HzM, or dangerous goods to be shipped and/or received.

4.2 Shipping

4.2.1 Select the best way to ship the hazardous material based on the quantity, hazard(s), and mode of transportation (e.g., air, land, water). Since more restrictive requirements apply to air shipments, ground shipment (e.g., use of a lab courier service) is encouraged for shipping HzM.

4.2.2 Most (if not all) package shipments (Common Carriers such as Federal Express, UPS, etc.) are transported by air. Air transportation of hazardous materials is regulated by IATA. AECOM will occasionally ship HzM internationally (e.g., Puerto Rico is considered an international destination by Federal Express). AECOM **employees** must follow the IATA DGR for any air transportation of hazardous materials.

4.3 Ground transportation of HzM may use either HMR or TDG Regulations protocols.

4.3.1 Specific packaging and shipping instructions apply to all dangerous goods shipments. These instructions vary by chemical/product and are different for passenger aircraft and cargo aircraft.

4.3.2 Carrier-specific requirements can be obtained from the Internet or by calling the carrier's customer service line.

4.3.3 The process for offering HzM for shipment includes:

- Determine the proper shipping name, hazard class, labeling requirements, and packing group.
- Determine and comply with the proper packaging instructions.
- Choose the proper package based on the packaging instruction and the type and quantity of material being shipped.
- Ensure package contents are compatible.
- Package, mark and label according to applicable regulations and instructions.
- Prepare shipping papers and complete the bill of lading or shipper's declaration for dangerous goods, according to applicable regulations and according to the carrier's specific requirements.
- Include on the shipping documents the shipper's certification, emergency response information and telephone number.
- Include with the shipment a copy of the applicable emergency response information with shipping papers for responders to use in emergency situations. This information includes, but is not limited to, appropriate pages from the DOT Emergency Response Guidebook (ERG) and/or Material Safety Data Sheets (MSDS).

4.3.4 AECOM personnel participating in shipping HzM are required to provide a 24-hour emergency response telephone number that must be answered by a person either with information on the hazards of the shipment or with immediate access to such a person. AECOM has selected INFOTRAC® (<http://www.infotrac.net/>) to provide 24-hour emergency response support service. Effective October 2010, all HzM shipping papers which list INFOTRAC® for 24-hour emergency response must list AECOM's account number 74984.

4.3.5 Determine the placard or placards required for the materials being offered for transportation, provide placards and affix as required.

4.3.6 Notify the carrier of the proper shipping name, hazard class and total quantity of each hazardous material being offered for transportation, and make a final check for compliance with regulations and instructions before tendering the shipment to the carrier. All HzM shipping papers and dangerous goods airbills must be typed.

4.4 Training

4.4.1 **Employees** involved in shipping hazardous materials/dangerous goods (e.g., packaging, preparing paperwork, loading and/or unloading, and transporting hazardous materials) are required to have documented training prior to shipping activities. Training requirements are based on the type of materials shipped (e.g., calibration/compressed gases, laboratory reagents, field samples, hazardous wastes, etc.)

and **employee** responsibility. Training curriculum will include function-specific, general awareness, safety and security awareness based on the two levels of expertise defined below.

4.5 **Training Documentation**

4.5.1 **Employees** are required to have documented training prior to performing activities that involve the shipment of hazardous materials/dangerous goods.

4.5.2 Documentation of training will be maintained by employees (certificates) and in employees' office locations. Documentation must include the following: course outline, sign-up/log-in sheet with employee name, date(s) of training, and certificate of completion from the training institute. The SH&E Department will log the training information to track compliance and refresher dates.

4.6 **Incident Reporting**

4.6.1 AECOM **employees** who ship HzM must be aware of the reporting requirements for any incident that occurs with material we have offered for shipment or that we are transporting as carriers (*S3NA-004-PR Incident Reporting*).

4.6.2 Except for transportation by aircraft, a carrier must notify DOT by telephone when any serious hazardous material incident (defined in 49 CFR 171.15) occurs during the course of loading, unloading, transportation, or temporary storage. Reports are to be made by telephone at the earliest practical moment. The nearest FAA Civil Aviation Security Office may be notified in place of the DOT if the incident involves shipment transported by aircraft.

4.6.3 A carrier must file a written report of the hazardous material incident in addition to telephone notification. The report must be completed using DOT's Hazardous Materials Incident Report (DOT Form F 5800.1) and submitted within 30 days of the incident's discovery to the Research and Special Programs Administration (RSPA) or the nearest FAA Civil Aviation Security Office if the incident involved transportation by aircraft.

4.6.4 As required by the AECOM incident reporting requirements, an initial telephone report is required whenever any of the following occurs during the course of transportation in commerce (including loading, unloading, and temporary storage) from the shipping of hazardous materials by AECOM personnel: As a direct result of a hazardous material:

- A person is killed;
- A person receives an injury requiring admittance to a hospital;
- The general public is evacuated for one hour or more;
- A major transportation artery or facility is closed or shut down for one hour or more; or
- The operational flight pattern or routine of an aircraft is altered;
- Fire, breakage, spillage or suspected radioactive contamination occurs involving a radioactive material (see also the DOT regulations at 49 CFR § 176.48);
- Fire, breakage, spillage or suspected contamination occurs involving an infectious substance other than a regulated medical waste;
- A release of a marine pollutant occurs in a quantity exceeding 450 L (119 gallons) for a liquid or 400 kg (882 pounds) for a solid; or
- A situation exists of such a nature (e.g., a continuing danger to life exists at the scene of the incident) that, in the judgment of the person in possession of the hazardous material, it should be reported to the NRC even though it does not meet the criteria of paragraph (b) (1), (2), (3) or (4) of this section.

5.0 Records

5.1 None

6.0 References

6.1 None

S3NA-509-PR Hazardous Waste Operations and Emergency Response Activities

1.0 Purpose and Scope

- 1.1 Provides requirements for AECOM operations pertaining to hazardous waste and emergency response (HAZWOPER) services.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.
- 1.3 In Canada there is no direct federal or provincial counterpart to HAZWOPER; however, as due diligence and in compliance with applicable provincial duty of care/general duty clauses, staff working in Canada will comply with this procedure.

2.0 Terms and Definitions

- 2.1 **Emergency Response:** A response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrollable release of a hazardous substance. Responses to incidental release of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of the HAZWOPER standard. Responses to releases of hazardous substances where there is no potential safety or health hazard are not considered to be emergency responses.
- 2.2 **Health and Safety Plan:** A document prepared for each project that contains site-specific information including the Emergency Response Plan for the project.
- 2.3 **Incident Command System (ICS):** ICS is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries. In the ICS the first person responding to an incident becomes the Incident Commander and turns that title and duties over to more qualified responders as they arrive on scene.
- 2.4 **First Responder:** First responders are individuals who are likely to witness or discover a hazardous substance release, injury, fire, or other incident and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond first aid, initial control of the incident, and notifying the authorities and others of the incident.
- 2.5 **Hazardous Materials Specialist:** Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities in regards to site activities.
- 2.6 **Hazardous Materials Technician:** Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.
- 2.7 **Incident Commander:** The Incident Commander (IC) is responsible for all aspects of the response, including developing incident objectives and managing all incident operations. The title and responsibilities are typically assumed by a qualified IC from the client or public sector.
- 2.8 **Hazardous Waste:** Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges. They can be

discarded commercial products, like cleaning fluids or pesticides, or the byproducts of manufacturing processes. Hazardous waste are divided into

- 2.8.1 Listed wastes (<http://www.epa.gov/osw/hazard/wastetypes/listed.htm>),
- 2.8.2 Characteristic wastes (<http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm>),
- 2.8.3 Universal wastes (<http://www.epa.gov/osw/hazard/wastetypes/universal/index.htm#wastes>), and
- 2.8.4 Mixed wastes
- 2.8.5 Specific procedures determine how waste is identified (<http://www.epa.gov/osw/hazard/wastetypes/wasteid/index.htm>), classified, listed, and delisted.
- 2.9 **Hazardous Materials:** A hazardous material is any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. Additionally a hazardous material may be defined as any substance or chemical which is a "health hazard" or "physical hazard," including chemicals that are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents that act on the hematopoietic system; agents that damage the lungs, skin, eyes, or mucous membranes; chemicals that are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive, or water-reactive; and chemicals that in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists, or smoke that may have any of the previously mentioned characteristics. This may be caused when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, disposing into the environment, by being transported or moved, and items or chemicals that are "special nuclear source" or byproduct materials or radioactive substances.

3.0 Attachments

- 3.1 S3NA-509-FM1 Direct Reading Instrument Monitoring Log
- 3.2 S3NA-509-FM2 Instrument Calibration Log
- 3.3 S3NA-509-FM3 Personal Sampling Data Sheet
- 3.4 S3NA-509-FM4 Emergency Information and Hazard Assessment

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Region Operations Managers and District Managers** shall be responsible for the following:
 - Provide support to the implementation of Health and Safety Plans and Emergency Action Plans.
- 4.1.2 **Project managers** shall be responsible for the following:
 - Prepare or request a HASP for every AECOM project.
 - Verify that all personnel working on the project are qualified.
 - Request client's emergency response procedures.
 - Appoint a **Site Safety Officer (SSO)** for each project.
 - Communicate the site-specific emergency response details to all employees assigned to a field project.
 - Confirm that the necessary communications equipment for the project is available.
 - Confirm that an accident/incident investigation is performed and a report is filed.
- 4.1.3 **Region SH&E Managers** shall be responsible for the following:
 - Provide technical guidance for the development and implementation of Health and Safety Plans and Emergency Action Plans.
 - Prepare emergency action plans as part of project HASPs and emergency reference sheets.
 - Interface with the local emergency responders when necessary.
 - Interface with clients regarding facility emergency response procedures.

4.1.4 Site Safety Officer is responsible for the following:

- Verify that a HASP is available for the project.
- Communicate the site-specific emergency response details to all **employees** assigned to a field project.
- Stop work and initiate emergency response procedures as required.
- Account for all AECOM and subcontractor employees after site evacuation.
- Conduct pre-entry briefing and daily tailgate meetings and review facility and site-specific emergency procedures.
- Brief on-site and off-site responders in the event of an emergency.

4.1.5 Employees

- Maintain HAZWOPER training.
- Follow the HASP and emergency procedures prepared for the project.
- Initiate emergency response via verbal communications or the alarm system if first to encounter the emergency.

4.1.6 All personnel (e.g., AECOM **employees**, general laborers, equipment operators, chemists, supervisors, etc.) performing activities at hazardous waste sites that expose or potentially expose them to hazardous wastes and health hazards are considered HAZWOPER site workers and must meet the training and medical surveillance requirements specified in 29 CFR 1910.120(e) and (f), respectively. Additional training may be required based on site activities including related exposures and risks (e.g., confined space entry, excavations, fall protection, other materials [lead], etc.). These additional training requirements are to be outlined in the project- or site-specific health and safety plan (HASP).**4.2 Personnel Qualifications—Medical Surveillance and Training****4.2.1** HAZWOPER-qualified employees will participate in the following medical surveillance and training requirements.**4.2.2** Medical Surveillance

- Specific HAZWOPER medical examination protocols have been developed by **AECOM's Corporate Medical Provider (CMP)** to meet the requirements of 29 CFR 1910.120(f). To be medically qualified to perform HAZWOPER work, **employees** receive the following medical examinations:
 - Initial (Baseline) Examination—The initial examination is part of pre-employment requirements and must be completed (with results received) prior to the employee's start of work date.
 - Annual Examination—HAZWOPER-qualified **employees** will complete a medical examination once each year. Medical qualification expires on the anniversary date of the last examination completed. There will be no "grace period" exemptions beyond this date without the express approval of the **Region SH&E Manager**. At the recommendation of the **SH&E Department**, the **CMP** may approve an alternate examination frequency at periods of up to two years (biennial) in cases in which the worker's exposures to environmental contaminants are infrequent and typically well below any occupational exposure limits (e.g., senior management personnel).
 - Termination Examination—When reassigned to non-HAZWOPER duties, or at the conclusion of employment at AECOM, HAZWOPER-qualified personnel will be provided with the opportunity to receive a termination medical examination.
 - Special Examinations—The SH&E Department and the CMP will jointly determine the need for special examinations because of
 - Unusual exposure conditions.
 - In response to possible overexposures.
- The **CMP** will determine the medical protocol elements for each of these examinations based on exposure information provided by the **SH&E Department**. The **CMP** will evaluate the results of each employee's examination and will provide a written statement of medical clearance

clearly stating medical compliance with the HAZWOPER regulatory standard (29 CFR 1910.120(f)) and approval of the employee to perform unrestricted HAZWOPER activities. for initial and annual examinations, the **CMP** will also evaluate the **employee** for the use of air purifying and supplied air respiratory protection. The written evaluation from these examinations will indicate the **CMP's** approval/limitations on the employee's use of respiratory protection.

4.2.3 AECOM Training

- All personnel assigned to work at a hazardous waste site must participate in training meeting the requirements of 29 CFR 1910.120(e).
- Initial 40-Hour Training—Before being assigned to a HAZWOPER site, AECOM employees must complete 40 hours of off-site training meeting the requirements of 29 CFR 1910.120(e)(3)(i). At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (40-hour HAZWOPER) and training dates. A copy of this certification must be provided to the employee's SH&E Coordinator. **Employees** are responsible for maintaining their own copy of this certificate and for presenting it to the site supervisor when working on any HAZWOPER site.
- In addition to the initial 40-hour training, the **employee** must receive three days of actual supervision by a trained experienced supervisor.
 - Available Training Sources:
 - On-site training provided by the SH&E Department.
 - Outsourced training providers approved by the SH&E Department.
- Refresher 8-Hour Training—To remain qualified to perform on-site HAZWOPER work activities, each AECOM **employee** will complete 8 hours of HAZWOPER refresher training meeting the requirements of 29 CFR 1910.120(e)(8) at yearly intervals following completion of Initial 40-hour training. At the conclusion of training, personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction (8-hour HAZWOPER Refresher) and the training date. A copy of this certification must be provided to the employee's SH&E Coordinator. **Employees** are responsible for maintaining their own copy of this certificate and for presenting it to the site supervisor when working on any HAZWOPER site.
 - Available Training Sources:
 - Internet-based training approved by **SH&E Department**
 - On-site training provided by the **SH&E Department**
 - Outsourced training providers approved by the **SH&E Department**
- Supervisor 8-Hour Training—Any AECOM employee acting in a management capacity for HAZWOPER activities (e.g., project management personnel, field managers/foremen, site safety officers, etc.) must complete an additional 8 hours of HAZWOPER Supervisor training meeting the requirements of 29 CFR 1910.120(e)(4). Although this training is required only once, supervisors must maintain their overall HAZWOPER qualification through annual completion of refresher training. At the conclusion of Supervisor 8-Hour Training personnel will receive a written certification of course completion, signed by the instructor, that indicates the course of instruction and the training date. A copy of this certification must be provided to the employee's SH&E coordinator. **Employees** are responsible for maintaining their own copy of this certificate and for presenting it to the senior site supervisor when working on any HAZWOPER site.
 - Available Training Sources:
 - On-site training provided by the **SH&E Department**
 - Outsourced training providers approved by the **SH&E Department**
- 24-Hour HAZWOPER Training—Site support contractors and site visitors may qualify to substitute 24-hour HAZWOPER training in place of 40-hour training, as specified in 29 CFR 1910.120(e)(3)(ii). Personnel potentially qualifying for this alternative training include:
 - Site support personnel who will not work in any Exclusion Zone areas.
- Subcontractors and site visitors whose duties will not entail significant exposure to site contaminants defined as not working in any areas where airborne contaminant concentrations

exceed one-half of any applicable occupational exposure limit, and no contact or exposure to materials with site contaminant concentrations exceeding natural background levels. The **Region SH&E Manager** or **SH&E department** designee must approve the substitution of 24-hour training for initial 40-hour training. Persons qualifying for 24-hour training must provide written certification of course completion prior to beginning work on site. Persons completing 24-hour training must complete 8 hours of annual refresher training at the required interval to maintain eligibility for on-site work and must provide proof of this training (as necessary to demonstrate retraining) prior to beginning work on site.

4.2.4 Subcontractor Personnel

Any subcontractor organization whose employees will support AECOM operations at a HAZWOPER site will:

- Provide the **AECOM Project Manager** with a copy of their written HAZWOPER medical surveillance and training program requirements. The elements of the program(s) must be similar to those for AECOM's own program, as detailed above.
- Provide the **Project Manager** with written certification of a physician's approved medical clearance for each employee who will work on the site. Certification can be demonstrated by:
 - A copy of the physician's signed medical clearance for each **employee** (preferred), or
 - A letter identifying the medical status and clearance expiration date of every **employee**, signed by the company's safety director or an officer of the company.
 - A copy of the each employee's training certifications, which will include:
 - The initial 40-hour training certificate (24-hour training may be substituted with SH&E department approval).
 - The most current Refresher training certificate (must be current within the previous one-year period).
 - A copy of the Supervisor training certificate for each person serving in a site supervisory capacity (e.g., **field managers/foremen, site safety officers**, etc.).

4.3 Project SH&E Documentation—Health and Safety Plans

4.3.1 The project SH&E documentation prepared for HAZWOPER activities is referred to as a site-specific Health and Safety Plan (HASP), and must meet the requirements presented in 29 CFR 1910.120(b)(4).

4.3.2 The required plan elements include:

- A description of the work location, the site history, and a summary of any information available concerning site hazards (including both physical hazards and contamination conditions).
- A summary of the work activities to be performed under AECOM's scope of activities.
- A safety and health risk or hazard analysis for each on-site task that will be performed. Identified risks must include both chemical and physical hazards to which personnel may be exposed during the conduct of the work task.
- Protective measures for each work task to prevent or mitigate the potential hazards identified in the hazard analyses.
- Personal protective equipment (PPE) requirements for each work task.
- Frequency and types of air monitoring, personal monitoring, and environmental sampling techniques and instrumentation to be used.
- Site control measures.
- Decontamination procedures.
- An emergency response plan, *S3NA-509-FM4 Emergency Information and Hazard Assessment*, addressing actions to be taken in the event of each type of credible incident that might result during the performance of planned work activities, including minor and major injuries, and chemical release and fire. Response plans must address the means for coordinating the evacuation of all on-site personnel in the event of a catastrophic incident.

- 4.3.3 Responsibility for development of each AECOM HASP will be coordinated between the **Project Manager** and the **Region SH&E Manager** or **SH&E Department** designee as part of project initiation. Regardless of where the HASP is developed, it will be reviewed and approved by the **SH&E Department** prior to submission to any agency outside of AECOM.

4.4 **Contractors and Subcontractors**

- 4.4.1 The health and safety of any contractor's or subcontractor's employees is solely the responsibility of that contractor or subcontractor, who shall evaluate the hazards and potential hazards to their own employees and shall adhere to their own Health and Safety Plan.
- 4.4.2 In addition, all AECOM subcontractors' Health and Safety Plans will, at a minimum conform to the requirements of the AECOM Health and Safety Plan. The AECOM Health and Safety Plan does not, nor is it intended to, address procedures of contractors or subcontractors during their site activities.

4.5 **Field Emergency Response Plans**

- 4.5.1 AECOM employees are not expected to take action or to participate in rescues or responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911.) If AECOM employees are to participate in the response to a chemical release beyond the initial reaction, there must be a contractual provision for this response and the employees must be specifically trained for this response. This document is designed to provide guidelines on how to prepare a written plan that will ensure prompt and proper response to an emergency situation that arises during field investigations and to outline the duties of AECOM employees during a field emergency and the associated training requirements.
- 4.5.2 Site specific health and safety plans that are prepared to comply with the HAZWOPER standard (29 CFR 1910.120) must address emergency response. This standard specifically outlines the elements that must be contained in an emergency response plan. However, the definition of emergency response, as written in 29 CFR 1910.120, focuses on emergencies involving the uncontrolled release of hazardous substances. Under 29 CFR 1910.120, an employer can opt to evacuate employees from the danger area when such an emergency occurs. AECOM does not expect its employees to actively assist in the handling of uncontrollable chemical releases that may occur during the implementation of field programs. As such, and as provided by the HAZWOPER standard, AECOM is exempt from the emergency response plan requirements of the standard as long as it provides an emergency action plan within the HASP that complies with 29 CFR 1910.38 (a). Therefore, all emergency response plans required under 29 CFR 1910.120 will be written to comply with 29 CFR 1910.38 (a).
- 4.5.3 The HAZWOPER standard does not prohibit AECOM employees from performing limited response activities. AECOM employees can provide response assistance by placing absorbent pillows or vermiculite around a small, contained spill that occurs during sampling efforts. AECOM's SH&E SOP 203—*Spill Containment Program*, describes the specific procedures that AECOM will follow when responding to an incidental chemical spill.
- 4.5.4 Field Project Preparation
- Every HASP that is prepared by AECOM will contain an emergency response section in which the required elements of an emergency action plan will be contained. For all projects that do not require a HASP, an emergency reference sheet will be prepared; minimally, the sheet will list the telephone numbers of the local emergency responders and the local hospital and provides directions to the local hospital. When AECOM is working at an operating facility, the emergency response procedures of the facility will be appended to the HASP or the emergency reference sheet.
 - There are two types of emergency situations that AECOM personnel must be prepared for and that must be addressed in the emergency action plan. These include:
 - Emergencies related to the operations of our clients at the facility where AECOM is working.
 - Emergencies related to our own on-site activities/investigations.
 - AECOM employees are typically not expected to take action or participate in responses to chemical releases beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911.)

- AECOM **employees** are not to accept the role of Incident Commander without specific authority from the **Region SH&E Manager** and the General Operations Manager responsible for the project. Assuming the role of the Incident Commander requires training beyond the scope of this Procedure.

4.5.5 Client Facility Emergency Response Procedures

- AECOM implements field programs on active properties, including manufacturing facilities. These facilities have typically developed an emergency response plan that is specific to facility-related emergencies. If AECOM is working at an operating facility, emergency procedures established by the facility must be followed in the event of a facility catastrophe. AECOM personnel must be aware of and familiar with the alarm signals used at the facility to alert personnel to an emergency. AECOM personnel must also know where to assemble in the event of a facility evacuation as the facility must be able to account for all personnel, including subcontractors such as AECOM in the event of an evacuation.
- The first priority in AECOM's preparation of a project emergency action plan is to ensure that the responsibilities under the client's emergency response plan are fully understood. Because of the nature of their business, many of our clients have in-house fire brigades, medical staff, and hazardous materials teams that can assist AECOM in the event of an emergency related to our field activities. In many instances, our clients prefer or require that subcontractors seek emergency assistance through their facility first before calling outside responders to the site.
- A copy of the facility's procedures must be made available to AECOM so that the information can be incorporated into the HASP or attached to the emergency reference sheet. If this information is not available to AECOM prior to arriving on site, the SSO must meet with client representatives upon arrival to the facility to review procedures in the event of an emergency related to plant operations.

4.5.6 Emergency Action Plan

- As a minimum, each emergency action plan must contain the following topics as required by 29 CFR 1910.38 (a):
 - Procedures and contact information for reporting emergencies to public service responders and on-site (client or host employer) emergency control centers.
 - Emergency escape procedures and emergency escape route assignments.
 - Procedures to be followed by employees who remain to operate critical site operations before they evacuate.
 - Procedures to account for all employees after emergency evacuation is complete.
 - Rescue and medical duties for those employees who are to perform them.
 - Preferred means of reporting fires and other emergencies.
 - PPE to protect employees from expected exposures and potential exposures during an emergency.
 - Names of persons or departments who can be contacted for further information (i.e. emergency reference sheet).
 - Availability of medical surveillance for workers who might have been exposed to chemicals, bloodborne pathogens, or other biological agents as a result of project work or emergency response.
- In addition, each plan must establish the specific alarm system that will be used on site to warn employees of an AECOM emergency. The chosen alarm signals should not conflict with alarm signals already in place at the facility.

4.5.7 Escape Routes and Procedures

- Prior to the commencement of on-site activities, the **SSO** must determine how AECOM employees will evacuate each AECOM work area of the site. Two or more routes that are separate or remote from each other for each work area must be identified. Multiple routes are necessary in case one is blocked by fire or chemical spill. These routes must not overlap because, if a common point were obstructed, all intersecting routes would be blocked.

- Prominent wind direction should also be considered when designating escape routes and assembly areas. Escape routes and assembly areas should be upwind of the site whenever possible.
- Upon arrival to the site, the **SSO** must verify that the selected routes are appropriate for evacuation. During an emergency, the quickest and most direct route should be selected. However, when working at an operating facility, the established escape routes of the facility should be used whenever possible. In the event of a facility-related emergency, all AECOM employees must meet at the facility's assembly area so that the client can verify that AECOM has evacuated the property.

4.5.8 Accounting Method for All Employees after Evacuation

- The **SSO** is responsible for determining that all AECOM employees have been successfully evacuated from the work area(s). It is the responsibility of each AECOM subcontractor to verify that all of its employees evacuated the site and to report this information to the AECOM **SSO**. All employees must meet at the designated assembly area. A headcount is an acceptable way to determine complete evacuation when the field team is of a small size. The site log-in book should be referenced when attempting to account for more than 10 people. In the event of a facility-related emergency, the **SSO** must notify facility representatives that all AECOM employees and AECOM subcontract employees have successfully evacuated the work area(s). The **SSO** must notify emergency responders if any employee is unaccounted for and where on the site they were last seen.
- In the event of a project-related emergency, the SSO will provide off-site emergency responders or on-site HAZMAT teams or fire brigades (Incident Commander) with all available knowledge about the emergency situation upon their arrival to the scene.

4.5.9 Employees Who Remain to Operate Critical Site Operations Before They Evacuate

- All equipment and operations are required to cease in accordance with the established alarm signal procedures. The only exception will be related to health and safety. The **SSO** must determine at the time of the emergency if health and safety will be jeopardized by immediate stoppage of any particular piece of equipment. If such a determination is made, personnel involved in critical operations must be minimized. Once it is determined that the operation is no longer needed or the threat to the operators is imminent, operations will cease and the operators will immediately evacuate.

4.5.10 Rescue and Medical Duties

- Only currently trained individuals will administer first aid or CPR. If the injury is life threatening, the Emergency Medical System (EMS) should be called (911). Depending on the procedures established for the project, the SSO would contact an emergency responder directly or notify the facility representatives for medical assistance. If the employee needs medical attention that can not be provided on-site, the SSO shall escort the individual to the local hospital identified on the emergency reference sheet and shall remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the Project Manager and Regional SH&E Manager.

4.5.11 Preferred Means of Reporting

- Unless facility representatives specifically indicate that they prefer AECOM personnel to notify them first of an emergency, the **SSO** will directly contact the appropriate emergency responders listed on the emergency reference sheet.

4.5.12 Alarm Signals

- An emergency communication system must be in effect at all sites. The most simple and effective emergency communication system in many situations will be direct verbal communications. However, verbal communications must be supplemented any time voices cannot be clearly perceived above ambient noise levels and any time a clear line of sight can not be easily maintained among all AECOM personnel because of distance, terrain, or other obstructions.
- Portable two-way radio communications may be used when employees must work out of the line of sight of other workers.
- When verbal communications must be supplemented, the following emergency signals shall be implemented using handheld portable air horns, whistles, or similar devices. Signals must be

capable of being perceived above ambient noise by all employees in the affected portions of the workplace.

- One Blast: General Warning—A relatively minor and localized, yet important, on-site event. An example of this type of an event would be a minor chemical spill where there is no immediate danger to life or health yet personnel working on the site should be aware of the situation so that unnecessary problems can be avoided. If one horn blast is sounded, personnel must stop all activity and equipment on-site and await further instructions from the SSO.
- Three Blasts: Medical Emergency—A medical emergency for which immediate first aid or emergency medical care is required. If three horn blasts are sounded, all first aid and/or CPR trained personnel should respond as appropriate. All other activity and equipment should stop and personnel should await further instructions from the SSO.
- Three Blasts Followed by One Continuous Blast: Immediate Threat to Life and Health—A situation that could present an immediate danger to life and health of personnel onsite. Examples include fires, explosions, large hazardous chemical release, severe weather-related emergencies, or security threats. If three horn blasts followed by a continuous blast are sounded, all activity and equipment must stop. All personnel must evacuate the site and meet in the designated assembly area where the SSO will account for all employees. The SSO will arrange for other emergency response actions if necessary. Information concerning the need to follow decontamination procedures during an emergency evacuation will be addressed in the emergency action plan.
- The SSO or his designate will acknowledge the distress signal with two short blasts on the air-horn or whistle.
- One Continuous Blast Following Any of the Above: All Clear/Return to Work—Personnel who sound the initial alarm are required to send an all clear signal when the emergency is over.

4.5.13 Emergency Reference Sheet

- An emergency reference sheet (see *S3NA-509-FM4 Emergency Information and Hazard Assessment*) must be prepared for projects not requiring a HASP. Each emergency reference sheet must list the following:
 - Emergency phone numbers for local police, fire, and ambulance service.
 - In-house facility extensions for reporting an emergency (applies to operating facilities only).
 - Phone number and address of closest hospital with an emergency room to the site.
 - Directions to the hospital from the site.
 - Map highlighting the site-to-hospital route.
 - Phone number for the Poison Control Center.
 - Names and phone numbers of AECOM representatives and facility representatives.

4.5.14 On-site and Off-site Communications

- Regardless of the size or location of AECOM's field projects, it is extremely important that both on-site and off-site communications be maintained so that in the event of an emergency employees can contact each other or place a phone call immediately with the appropriate responder(s).
- Walkie-talkies are required when members of the field team are working in separate areas of the site and verbal communications are no longer effective because of distance. A walkie-talkie must be available for each team that is working in a separate area of the site.
- When AECOM is working at an occupied facility, access to a telephone may not be a problem. When AECOM is working on abandoned properties or when there is no access to a phone, a cellular telephone must be brought to the work location.

4.5.15 Evacuation

- Although emergency evacuation procedures are included in AECOM's initial 40-hour HAZWOPER training, emergency procedures at each site will be different. Therefore, employees must be instructed about the specifics of the emergency procedures developed for

the site during the site-specific pre-entry briefing that must be held daily prior to the commencement of field activities. Update training is required anytime escape routes or procedures change. An evacuation drill will be conducted for projects that are scheduled for one month or longer. Visitors and untrained employees shall not be allowed into the project area until they receive a safety briefing including evacuation alarms and procedures.

4.5.16 First Responder

- First responders shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:
 - An understanding of what hazardous substances are, and the risks associated with them in an incident.
 - An understanding of the potential outcomes associated with an emergency.
 - The ability to recognize the presence of hazardous substances and physical hazards in an emergency.
 - An understanding of the role of the first responder.
 - The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.5.17 First Responder HAZWOPER Operations Level

First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

- Knowledge of the basic hazard and risk assessment techniques.
- Know how to select and use proper personal protective equipment provided to the first responder operational level.
- An understanding of basic hazardous materials terms.
- Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.
- Know how to implement basic decontamination procedures.
- An understanding of the relevant standard operating procedures and termination procedures.

4.5.18 Hazardous Materials Technician

Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the employer's emergency response plan.
- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment.
- Be able to function within an assigned role in the Incident Command System.
- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician.
- Understand hazard and risk assessment techniques.
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.
- Understand and implement decontamination procedures.
- Understand termination procedures.
- Understand basic chemical and toxicological terminology and behavior.

4.5.19 Hazardous Materials Specialist

Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the local emergency response plan.
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment.
- Know the state emergency response plan.
- Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist.
- Understand in-depth hazard and risk techniques.
- Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.
- Be able to determine and implement decontamination procedures.
- Have the ability to develop a site safety and control plan.
- Understand chemical, radiological, and toxicological terminology and behavior.

4.6 Personal Protective Equipment (PPE) Ensembles

4.6.1 Defined HAZWOPER PPE ensembles are specified for general use on all AECOM HAZWOPER operations. The project HASP may specify modifications to these requirements to meet site-specific conditions.

4.6.2 Level D Ensemble

- The Level D ensemble provides a minimal level of skin protection (primarily against physical rather than chemical hazards) and no respiratory protection. Level D PPE is the minimum work uniform which will be used on HAZWOPER sites. Its use is appropriate when there is no significant potential for encountering hazardous substances or health hazards while working in controlled work areas.
- Level D Equipment List
 - Hard hat
 - Eye protection
 - Safety-toe work boots
 - Shirts with sleeves and long pants (shorts are unacceptable for use)
 - Hearing protection (as required)

4.6.3 Modified Level D Ensemble

- The Modified Level D ensemble provides moderate skin protection against contact with hazardous substances, but no respiratory protection. Its use is appropriate where there is a moderate-to-low potential for skin contact with known hazardous substances and health hazards, but no significant inhalation hazard is anticipated. The Modified Level D ensemble will consist of the Level D ensemble, supplemented by the addition of one or more of the following items:
- Modified Level D Equipment List
 - Chemical-resistant disposable outer coveralls
 - Chemical-resistant outer gloves taped to outer coveralls¹
 - Chemical-resistant inner gloves¹
 - Chemical-resistant safety-toe boots (taped to outer coveralls)

4.6.4 Level C Ensemble

¹ Selection of specific glove types/materials will be provided in the project HASP based on consideration of the contaminants and the physical conditions of the work.

- The Level C ensemble provides moderate skin protection against contact with hazardous substances and moderate respiratory protection. Its use is appropriate where there is the potential for skin contact with known hazardous substances and health hazards, together with a limited and well-defined potential for exposure via inhalation.
- Level C Equipment List
 - Full-face air-purifying respirator (APR) equipped with cartridge types as designated in the project HASP2
 - Chemical-resistant disposable outer coveralls
 - Chemical-resistant outer gloves taped to outer coveralls³
 - Chemical-resistant inner gloves³
 - Hard hat
 - Safety-toe boots taped to coveralls; the use of boot covers (e.g., booties) or chemical-resistant boots may be specified
 - Hearing protection (as required)

4.6.5 Level B Ensemble

- The Level B ensemble provides both the highest level of inhalation exposure protection and considerable skin contact protection. Its use is appropriate where there are significant known or suspected hazardous substances and health hazards, involving both skin and inhalation exposure (up to and including Immediately Dangerous to Life or Health [IDLH] conditions) or where adverse atmospheric conditions cannot be mitigated by use of air purifying respirators (e.g., oxygen deficient atmospheres or chemicals with poor warning properties). The use of Level B PPE requires prior approval by the Regional SH&E Manager.
- Level B Equipment List
 - Supplied air respirator (SCBA or air line system with Grade D or better breathing air)
 - Chemical-resistant disposable outer coveralls
 - Chemical-resistant outer glove taped to outer coveralls³
 - Chemical-resistant inner gloves³
 - Hard hat
 - Chemical resistant safety-toe boots taped to coveralls
 - Hearing protection (as required)

4.6.6 Level A Ensemble

- The Level A ensemble provides the highest level of both respiratory and skin protection, up to and including protection against skin contact with vapor-phase contaminants. The use of Level A PPE requires prior approval by the Americas SH&E Director.
- Specific Level A ensemble components will be determined on a case-by-case basis by the SH&E Department.

4.7 Employee Exposure Monitoring

4.7.1 Exposure monitoring at HAZWOPER sites will be conducted to determine explosive and oxygen levels, monitor and control employee exposures to airborne contaminants, and to determine and regulate controlled work area boundaries (e.g., support zone, contamination reduction zone, and exclusion zone) for the protection of non-HAZWOPER workers and the general public.

4.7.2 Direct Reading Exposure Monitoring Requirements

- Explosive levels, oxygen levels, and airborne contaminants present potential hazards to HAZWOPER personnel working within controlled work areas and to non-HAZWOPER workers and the general public present outside the controlled work areas. On-site exposure monitoring

² Selection of specific cartridges will be made by the SH&E Department (or Competent Person – Respiratory Protection as designated by the DSM) based on contaminants present. A cartridge change-out frequency will also be specified in the HASP based on the manufacturer's cartridge performance data.

³ Selection of specific glove types/materials will be provided in the project HASP based on consideration of the contaminants and the physical conditions of the work.

will be utilized to assess the magnitude of these hazards and to provide indications of any necessary control procedures to mitigate unacceptable hazards. *S3NA-509-FM1 Direct Reading Instrument Monitoring Log* will be used to record all monitoring efforts using direct reading instruments and will remain part of the project file.

- Specific exposure monitoring requirements will be established in individual HASPs and will be implemented by the project team(s) subject to the following requirements:
 - Direct reading instrumentation will be used in accordance with the following table:

Direct Reading Instrument	Example Trade Names	Use
Flame Ionization Detector (FID)	OVA	Detection of select organic vapors
Photo ionization detector (PID)	miniRAE, Micro-TIP	Detection of select organic vapors
Portable gas chromatograph	OVA	Detection of select organic vapors
Explosive meter	MSA ALTAIR, QRAE II, BW GasAlert	Determine explosiveness (as a percent of the Lower Explosive Limit [LEL])
Oxygen monitor	MSA ALTAIR, QRAE II, BW GasAlert	Determine oxygen concentration (in percent)
Single gas meters (mono-tox) • Hydrogen sulfide • Carbon monoxide • Oxides of nitrogen • Cyanide		Determine airborne concentrations of selected contaminants (in parts per million)
Colorimetric Detector Tubes	Drager	Determine airborne concentrations of selected contaminants (in parts per million)
Aerosol monitor	Mini-RAM	Determine airborne particulate concentration (in milligrams per cubic meter)

- Selected instruments will be capable of discriminating contaminant concentrations to concentrations of at least one-half of the HASP-specified exposure limit. All direct-reading instrumentation will be calibrated daily as directed by the manufacturer. *S3NA-509-FM2 Instrument Calibration Log* will be used to record instrument calibrations.

4.7.3 Work Area Exposure Monitoring

- Work area exposure monitoring will include breathing zone readings for the maximum exposed worker(s).
- Results will be used to determine adequacy of PPE (especially respiratory protection). Specific criteria for upgrade/downgrade will be established in the HASP.

4.7.4 Perimeter Exposure Monitoring

- Perimeter air samples will be collected when the potential exists for airborne contaminants to migrate off-site.
- Perimeter exposure monitoring will be conducted at locations downwind from the project activities at a minimum (also upwind if the potential exists for offsite contamination to migrate onto the site).
- Sample results will be recorded in a log book or on the sample log form provided in *S3NA-509-FM3 Personal Sampling Data Sheet*

- Records will indicate individual name, SSN (last 4 digits is acceptable), and job/operation at the time of sample collection.
- Samples sent out for independent laboratory analysis will follow chain of custody requirements.
- Exposure results will be posted on site and explained in a safety briefing.
- **Employees** will receive a written statement of results within 15 days of receipt from the laboratory.
- Results of all personal exposure monitoring will be provided to the **SH&E department** for inclusion in the employee medical records.

5.0 Records

- 5.1 All forms and documents generated during a HAZWOPER project will be maintained in the project file.

6.0 References

- 6.1 Federal Emergency Management Agency—FEMA: Incident Command System www.fema.gov
- 6.2 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response
- 6.3 29 CFR 1910.38, Emergency Action Plans

S3NA-509-FM1 Direct Reading Instrument Monitoring Log

Project:

Job No.:

Date:

Operator:

Instrument:

Calibration:
(Amt, Component, Date)

Sampling Technique:

Sample Interval:

Background Reading:

Action Level/Response:

Time	Location	Reading (units)	Detection Limits (Scale)

S3NA-509-FM2 Instrument Calibration Log

Instrument Information	
Instrument Name:	Manufacturer:
Serial Number:	Last Service Date:
Parameter(s):	Calibration Gas:
Calibration Procedure:	
Daily Calibration Results	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	
Date:	Calibration Result:
Name:	Signature:
Notes:	

Project:

Job No.:

Date:

Operator:

Instrument:

Calibration:

Client:

Method:

Site Location:

Job No.:

Sampling Media:

[illegible]

S3NA-509-FM4 Emergency Information and Hazard Assessment

EMERGENCY INFORMATION AND HAZARD ASSESSMENT

EMERGENCY REFERENCES

Ambulance: 911

Fire: 911

Police: 911

Medical Services/Regional Hospital (including a map is advisable):

Poison Control Center: <http://www.aapcc.org/poison4.htm>

Emergency Muster Point:

In case of a site/facility emergency, please meet at:

The escape route from the site and an emergency muster point will be determined and provided to all workers during the project mobilization.

Client Contacts:

Office: Cell:

AECOM Project Representatives:

Office: Mobile:

AECOM Medical Records and Medical Consultant

WorkCare

Anaheim, CA 94502

Telephone: 800-455-6155

S3NA-510-PR Hearing Conservation Program

1.0 Purpose and Scope

- 1.1 Establishes procedures to confirm that personal noise exposure remains within acceptable limits and establishes the requirements of an acceptable hearing conservation program.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Decibel (dB):** Logarithmic unit of measurement of sound level.
- 2.2 **Action Level:** An eight-hour, time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently; a noise dose of 50 percent.
- 2.3 **Standard Threshold Shift (STS):** When one's hearing threshold has changed (relative to the baseline audiogram) an average of 10 dB or more at 2000, 3000, or 4000 Hz in either ear).
- 2.4 **Noise Reduction Rating (NRR):** The measure, in decibels, of how well a hearing protector reduces noise, as specified by the Environmental Protection Agency.

3.0 Attachments

- 3.1 S3NA-510-FM Site-Specific Hearing Conservation Program
- 3.2 S3NA-510-WI Hearing Protection Guidelines

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Region SH&E Managers or their designate

- Provide access to initial and refresher hearing conservation training.
- Inform employees of noise monitoring results when full-shift noise exposure is at or above the action level.
- Designate areas and tasks where employees' exposure is at or above the action level.
- Conduct noise monitoring, as applicable, and support hazardous noise assessment/evaluation efforts.

4.1.2 Project or Office Managers

- Implement the hearing conservation program.
- Confirm that a hazardous noise assessment/evaluation has been conducted.
- Confirm that a hazardous noise assessment/evaluation is conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Implement engineering controls to reduce noise levels when such measures are considered feasible and when required by regulation.
- Purchase, monitor, and replenish for employees' use a supply of hearing protection devices with a minimum Noise Reduction Rating (NRR) of 26 dBA.
- Confirm that individuals included in the program receive training and that the training meets the criteria outlined in this program.
- Investigate and implement corrective action to all reports of nonconformance with this procedure, including reports of standard threshold shifts or employees' failure to wear hearing protectors in designated areas.

4.1.3 Supervisors

- Maintain an awareness of the noise levels in work areas for which he/she is responsible.
- Place warning signs in areas where sound levels would require the use of hearing protectors.
- Request that a hazardous noise assessment/evaluation be conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Confirm that all employees are aware of the requirements for hearing protection for any designated area or task.
- Enforce the use of hearing protection by employees in designated areas and for designated tasks.

4.1.4 Employees

- Comply with the requirements of the Hearing Conservation program.
- Wear hearing protection devices in designated areas or for designated tasks.
- Inspect and maintain hearing protection devices.
- Report any suspected change in noise levels of work area to supervisor.
- Report any signs or symptoms experienced that could be the result of overexposure to noise to supervisor.
- Participate in audiometric testing and hearing protection training when required.

4.2 Requirements

- 4.2.1 The requirements of this procedure apply to all locations/facilities/projects where employee noise exposure may equal or exceed 50 percent of the allowable noise dose or Permissible Exposure Limit (PEL). Table 1 provides information relative to the current PEL for noise exposure expressed as a time-weighted average.

Table 1. Permissible Exposure Limit

SOUND LEVEL (dBA)	TIME (hours)
85	8
90	4
95	2
100	1
105	0.5
110	0.25
115	0.125

- 4.2.2 Table 2 provides information relative to the Action Level (or 50 percent allowable noise dose) expressed as a time-weighted average. The action levels outlined in the table below and PELs described in Table 1 are calculated without regard to the protection afforded by the use of hearing protectors.

Table 2. Action Levels for Hearing Conservation Program

SOUND LEVEL (dBA)	TIME (hours)
85	4
90	2
95	1
100	0.5
105	0.25
110	0.125
115	0.0625

4.3 Training Program

4.3.1 All employees with potential exposure above the action levels established in Table 2 of this procedure or who otherwise utilize any type of hearing protector will participate in a hearing conservation training program.

4.3.2 Training Objectives

4.3.3 The initial and subsequent annual hearing conservation training will address, at a minimum, the following topics:

- The effects of noise on hearing, recognizing hazardous noise, and symptoms of overexposure to hazardous noise.
- When and/or where hearing protectors are required to be worn.
- The purpose of hearing protectors.
- The advantages, disadvantages, and effectiveness of various types of protectors.
- Instructions on how to select, use, fit, and care for hearing protectors.
- The purpose of audiometric testing, including an explanation of the test procedures.
- Hearing Conservation Program requirements and responsibilities.

4.3.4 Hearing protection training is conducted biannually for all affected employees or more frequently for employees who do not properly use hearing protectors or otherwise fail to comply with this policy.

4.4 Audiometric Testing

4.4.1 All AECOM personnel with exposure greater than the action level may be enrolled in the medical surveillance program and undergo a baseline audiogram. Thereafter, annual audiograms will be compared with the baseline exam.

4.4.2 Enrolled employees will receive audiograms during their exit physicals.

4.4.3 When a Standard Threshold Shift (STS), as identified by the AECOM Medical Consultant, is noted between the last valid baseline and the annual audiogram, the following steps will be taken:

- A retest will be conducted within 30 days to confirm the STS. The employee will not be exposed to workplace/hobby noise for 14 hours or will be provided with adequate hearing protection prior to testing.
- If the STS persists, ear protection will be upgraded to one with a greater NRR. The minimum NRR will be 26 dBA.
- The employee will be counseled and AECOM will obtain information regarding the employee's possible noise exposure away from the workplace or existing ear pathology.
- Qualified medical personnel will review the audiograms. This group will determine the need for a medical referral.
- The employee will be notified in writing by either the SH&E Department or the AECOM Medical Provider of the STS, within 21 days of determination, as required by regulation.
- The employee's supervisor will be notified of the shift in hearing threshold.

4.4.4 If the employee who has experienced an STS is exposed to 85 dBA for eight hours or 80 dBA for 12 hours, mandatory use of ear protection is required.

4.5 Monitoring of Noise Levels

4.5.1 As deemed necessary by an SH&E Professional, or a Project Safety Plan AECOM will periodically monitor personal and area noise levels using noise dosimetry and/or sound level meters.

4.6 Hearing Protectors

4.6.1 Selection of appropriate hearing protectors must be based on actual or anticipated exposure levels. At a minimum, hearing protectors must provide a level of protection that brings actual or anticipated exposure below the PEL established for the time period shown in the table above. Additional information relative to hearing protector use is as follows:

- Hearing protection will be mandatory for all employees exposed to 85 dBA for eight hours.

- Hearing protection will be mandatory for all employees working in any area that has not been evaluated for noise exposure and the ambient noise level in the area is such that you must raise your voice to have a normal conversation with someone less than four feet from you and/or when within 25 feet of an operating piece of heavy equipment.
- Hearing protection will be mandatory for all employees who work on or near heavy equipment unless personal dosimetry or other techniques have been used to document actual exposure.
- Hearing protectors will be made available to all employees who may be exposed to 85 dBA for eight hours.
- Hearing protection will be mandatory for all employees exposed to 85 dBA for any period of time and who have experienced an STS.

5.0 Records

- 5.1.1 Noise exposure measurement records will be retained for three years at the project/facility.
- 5.1.2 Audiogram records will be retained in the employee's medical records as per AECOM's Medical Surveillance Procedure for a period as directed by regulation or AECOM's Medical Provider.
- 5.1.3 Employee training session documentation will be retained for the duration of employment.

6.0 References

- 6.1 None

S3NA-510-FM Site-Specific Hearing Conservation Program

Site (Project)

1.0 Monitoring

As per regulation, noise monitoring will be conducted by the following procedure:

Such monitoring will consist of *(check those that apply)*:

☐ Noise Dosimetry

☐ Sound Level Meter Survey

Specific instrumentation to be used is (make/model):

Make	Model

and will be calibrated at a frequency of _____ and documented in the _____.

Monitoring strategy is as follows *(list all equipment and activities on site that may involve sound pressure levels above 80 dBA and an explanation of the strategy to document actual exposures)*:

Area/Equipment	Monitoring Strategy

Where areas or equipment are not clearly identified, all monitoring will be documented utilizing an illustrated layout *(attach form developed for the specific site)*. Monitoring frequency will be in accordance with the strategy outlined above and when the following changes in site conditions/activities occur:

1.
2.
3.
4.
5.

2.0 Employee Notification

All site employees exposed above the regulated action level (85 dBA – 8 hour TWA) will be notified of the monitoring results by *(insert name/title)* at an interval not to exceed after completion of monitoring.

Notification shall be written, with a copy to the SH&E Department. Documentation of employee notifications and corresponding signatures of notified employees will be kept in the site health and safety logbook/files.

3.0 Observation of Monitoring

All employees affected by the monitoring, or a designated employee representative, shall be given the opportunity to observe noise monitoring procedures. This will be achieved by:

4.0 Audiometric Testing Program and Requirements

AECOM personnel who perform field activities where noise exposure above action levels is expected are required to participate in an audiometric testing program. Additionally, any subcontractors performing work on AECOM projects where noise levels exceeding action level will be required to provide documentation that they participate in an audiometric testing program that meets the applicable regulations. Documentation of participation in the testing program will be maintained by and will be located at .

5.0 Hearing Protectors and Estimating Attenuation

A selection of suitable hearing protectors will be made available to all employees who are expected to have 8-hour TWA noise exposures above 85 dBA. The types anticipated to be available include:

Protection Type	Attenuation

Hearing protector attenuation will be evaluated by for specific noise environments according to the following method prior to determining their suitability for use:

1.
2.
3.

The following site personnel will be required to wear hearing protectors during specific activities and the results of site-specific monitoring conducted in accordance with this procedure. *(This section can be completed after monitoring, if necessary).*

Employee Name	Activity Type	Type of Protection

Hearing protectors will be properly fitted by upon initial distribution to site workers.

Training in the use and care of hearing protectors shall be conducted by during the initial site-specific health and safety training. Training contents shall meet the requirements set forth in this procedure and the applicable regulations.

Hearing protectors will be distributed by from the storage location at the .

6.0 Access to Information and Training Materials

All information required by regulation to be made available to the employees will be posted by *(insert name/title)* at the .

Local Occupational Health and Safety Regulations will also be kept on site.

7.0 Recordkeeping

Records required by AECOM's Hearing Conservation Program and Regulations shall be completed by and shall be maintained at the and placed on permanent file at the for the minimum duration required by the standard. Employees can access their individual records by contacting .

All records required by this section will be transferred to any employee's successive employer if AECOM ceases to do business.

8.0 Approvals

Project Manager: Date:

SH&E Representative: Date:

S3NA-510-WI Hearing Protection Guidelines

1.0 Comparison

Comparison of Hearing Protection	
Ear Plugs	Ear Muffs
Advantages: • small and easily carried • convenient to use with other personal protection equipment (can be worn with ear muffs) • more comfortable for long-term wear in hot, humid work areas • convenient for use in confined work areas	Advantages: • less attenuation variability among users • designed so that one size fits most head sizes • easily seen at a distance to assist in the monitoring of their use • not easily misplaced or lost • may be worn with minor ear infections
Disadvantages: • requires more time to fit • more difficult to insert and remove • require good hygiene practices • may irritate the ear canal • easily misplaced • more difficult to see and monitor usage	Disadvantages: • less portable and heavier • more inconvenient for use with other personal protective equipment • more uncomfortable in hot, humid work area • more inconvenient for use in confined work areas • may interfere with the wearing of safety or prescription glasses; wearing glasses results in breaking the seal between the ear muff and the skin and results in decreased hearing protection

2.0 Care and Use

- 2.1 Follow the manufacturer's instructions.
- 2.2 Check hearing protection regularly for wear and tear.
- 2.3 Replace ear cushions or plugs that are no longer pliable.
- 2.4 Replace a unit when head bands are so stretched that they do not keep ear cushions snugly against the head.
- 2.5 Disassemble ear muffs to clean.
- 2.6 Wash ear muffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Sound-attenuating material inside the ear cushions must not get wet.
- 2.7 Use a soft brush to remove skin oil and dirt that can harden ear cushions.
- 2.8 Squeeze excess moisture from the plugs or cushions and then place them on a clean surface to air dry.

S3NA-511-PR Heat Stress

1.0 Purpose and Scope

- 1.1 Establishes a heat stress prevention program to help ensure that employees know and recognize the symptoms of heat stress-related illnesses and are prepared to take appropriate corrective action.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Acclimated:** Workers who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.
- 2.2 **Chemical Protective Clothing (CPC):** Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the worker with potentially hazardous materials in the workplace. Such materials include: Tyvek® coveralls (all types) and polyvinyl chloride (PVC) coveralls and rain suits.
- 2.3 **Unacclimated:** Workers who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.
- 2.4 **Heat Cramps:** A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.
- 2.5 **Heat Exhaustion:** A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.
- 2.6 **Heat Rash:** A heat-induced condition characterized by a red, bumpy rash with severe itching.
- 2.7 **Heat Stress.** The combination of environmental and physical work factors that constitute the total heat load imposed on the body.
- 2.8 **Heat Stroke:** The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.
- 2.9 **Sunburn:** Is caused by unprotected exposure to ultraviolet light that is damaging to the skin. The injury is characterized by red painful skin, blisters, and/or peeling.

3.0 Attachments

- 3.1 S3NA-511-FM Heat Stress Monitoring Log
- 3.2 S3NA-511-WI1 Temperature Thresholds
- 3.3 S3NA-511-WI2 Symptoms and Treatment
- 3.4 S3NA-511-ST Heat Exposure

4.0 Procedures

4.1 Restrictions

- 4.1.1 Staff working in extreme heat or sun for extended periods of time away from a shelter or vehicle must not work alone.
- 4.1.2 Staff shall not be exposed to levels that exceed those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.
- 4.1.3 Clothing corrections shall be applied in accordance with the heat stress and strain section of the ACGIH Standard.

4.2 Roles and Responsibilities

4.2.1 Project Managers'/field task managers' responsibilities:

- Evaluate the need for heat stress prevention measures and incorporate as appropriate into the Health and Safety Plan.
- Implement heat stress prevention measures, as applicable, at each work site.
- Develop/coordinate a work-rest schedule, as applicable.
- Ensure heat stress hazard assessments/evaluations were completed for the planned activities.
- Assign personnel physically capable of performing the assigned tasks.
- Ensure that personnel are properly trained in the recognition of heat stress-related symptoms.

4.2.2 Region SH&E Managers' responsibilities:

- Provide heat stress awareness training.
- Assist project teams develop appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.2.3 Site Supervisors' responsibilities:

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned employees.
- Ensure that employees have been trained on the recognition of heat stress-related illness.
- Ensure that adequate supplies of appropriate fluids are readily available to employees.
- Ensure that a proper rest area is available.
- Conduct heat stress monitoring, as applicable.
- Implement the work-rest schedule.
- Ensure that first aid measures are implemented once heat stress symptoms are identified.
- Ensure personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat stress-related illnesses.

4.2.4 Employees' responsibilities:

- Observe each other for the early symptoms of heat stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly rested and hydrated condition.
- Report all suspected heat stress-related illnesses.

4.3 Controls

4.3.1 If staff are or may be exposed, the supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of workers, and
- Develop and implement a heat stress exposure control plan.

4.3.2 If staff are or may be exposed, the supervisor shall implement engineering controls (e.g., shelters, cooling devices, etc.) to reduce the exposure of staff to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

4.3.3 If engineering controls are not practicable, the supervisor shall reduce the exposure of workers to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If staff are or may be exposed, the supervisor shall provide and maintain an adequate supply of cool, potable water close to the work area for the use of a heat exposed worker.

4.3.5 If a staff person shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant, if available, or by a physician.

- 4.3.6 Heat stress can be a significant field site hazard, especially for workers wearing CPC. The workforce will gradually work up to a full workload under potentially stressful conditions to allow for proper acclimation.
- 4.3.7 Site personnel shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Workers must be encouraged to immediately report any heat stress that they may experience or observe in fellow workers. Supervisors must use such information to adjust the work-rest schedule to accommodate such problems.
- 4.3.8 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow workers to loosen or remove protective clothing, and sufficient seating should be available for all personnel. During breaks, workers must be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

4.4 **Symptoms and Treatment**

- 4.4.1 Workers who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin), shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.
- 4.4.2 Anyone exhibiting symptoms of heat stroke (red, dry skin, or unconsciousness) must be taken immediately to the nearest medical facility, taking steps to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).
- 4.4.3 Severe heat stress (heat stroke) is a life-threatening condition that must be treated by a competent medical authority.

4.5 **Prevention**

- 4.5.1 All staff working in extreme heat or sun should understand the following guidelines for preventing and detecting heat exhaustion and heat stroke.
- If you experience heat exhaustion or heat stroke you must immediately seek shelter and water.
 - Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
 - Try to schedule work for the coolest part of the day, early morning and evening.
- 4.5.2 Prevention of heat-related illnesses:
- Avoid strenuous physical activity outdoors during the hottest part of the day.
 - Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
 - Avoid sudden changes of temperature. Air out a hot vehicle before getting into it.
 - If you take diuretics, ask your doctor about taking a lower dose during hot weather.
 - Drink 8 to 10 glasses of water per day. Drink even more if you are working or exercising in hot weather.
 - Avoid caffeine and alcohol as they increase dehydration.
 - If you exercise strenuously in hot weather, drink more liquid than your thirst seems to require.

4.6 **Personal Protective Equipment**

- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

4.7 **Work-Rest Schedule Practices**

- Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.
- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 oz. per hour during the work shift; fluid replacement at frequent intervals is most effective.

- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.
- Additional salt is usually not needed and salt tablets should not be taken.
- Replacement fluids should be cool, but not cold.
- Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.
- Dry clothing or towels will be available to minimize chills when taking breaks.
- Manual labor will not be performed during breaks, other than paperwork or similar light tasks.
- Other controls that may be used include:
 - Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
 - Erecting a cover or partition to shade the work area.
 - Wearing cooling devices such as vortex tubes or cooling vests beneath protective garments. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

4.8 Evaluating the Work-Rest Schedule's Effectiveness

- 4.8.1 Once a work-rest schedule is established, the work supervisor must continually evaluate its effectiveness through observation of workers for signs/symptoms of heat stress. Measurement of each worker's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate, and is accomplished as follows:
- 4.8.2 At the start of the workday each worker's baseline pulse rate (in beats per minute – bpm) is determined by taking a pulse count for 15 seconds and multiplying the result by four or an automated pulse count device may be utilized. Worker pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:
- Each worker's maximum heart rate at the start of any break should be less than [180 minus worker's age] bpm. If this value is exceeded for any worker, the duration of the following work period will be decreased by at least 10 minutes.
 - At the end of each work period all workers' heart rates must have returned to within +10% of the baseline pulse rate. If any worker's pulse rate exceeds this value the break period will be extended for at least 5 minutes, at the end of which pulse rates will be remeasured and the end-of-break criteria again applied.
- 4.8.3 Use a clinical thermometer or similar device to measure the oral/ear temperature at the beginning (before drinking liquids) and end of each break period and apply the following criteria:
- If the oral temperature exceeds 99.6°F, shorten the next work cycle by one-third without changing the rest period.
 - If the oral temperature still exceeds 99.6°F (36.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
- 4.8.4 Use of an automated or similar blood pressure device will be used to assess each employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:
- If the blood pressure of an employee is outside of 90/60 to 150/90, then the employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be remeasured and the end-of-break criteria again applied.
- 4.8.5 All physiological monitoring of heat stress will be documented using *S3NA-511-FM Heat/Cold Stress Monitoring Log*.
- #### 4.9 Training
- 4.9.1 Project staff and their supervisors that may be exposed to the hazard will be oriented to the hazard and the controls prior to work commencing.
- 4.9.2 Those personnel potentially exposed to heat stress will receive training including, but not limited to
- Sources of heat stress, influence of protective clothing, and importance of acclimatization.

- How the body handles heat.
- Recognition of heat-related illness symptoms.
- Preventative/corrective measures.
 - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
 - All employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses.

5.0 Records

5.1 None

6.0 References

- 6.1 S3NA-003-PR SH&E Training
- 6.2 S3NA-208-PR Personal Protective Equipment
- 6.3 S3NA-314-PR Working Alone and Remote Travel

S3NA-511-FM Heat Stress Monitoring Log

The purpose of this form is to track entry into hot zones wearing chemically protective clothing and monitor employees for heat stress-related illness. It is the responsibility of the foreman or supervisor-in-charge to ensure that each person entering the hot zone completes the required information. Vital signs must be taken by a competent person.

Project Name:			Foreman/Supervisor:				Work/Rest Schedule1: IN (min) OUT (min)									
Date:	Water Provided ²		Acclimated ³		Initial Vitals ³	Vital Signs and Time In/Out ⁴										
Employee Name	Yes	No	Yes	No	Vitals	In	Out	Vitals	In	Out	Vitals	In	Out	Vitals	In	Out
					P			P			P			P		
					BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		
					P			P			P			P		
					BP			BP			BP			BP		
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1. Please refer to S3NA-511-PR, Heat Stress. Section 6.3 provides specific details on how to develop a work-rest schedule.

2. Each employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.

3. A worker is "acclimated" if he/she has worked in a hot environment for at least 7 to 10 consecutive days. If a worker is acclimated, check "Yes." If a worker is not acclimated, check "No" and reduce the "Min In" by 50 percent for that employee until the 7- to 10-day period is reached.

4. "Vitals" refers to employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work operations in the hot zone. Each time the employee exits the hot zone, vitals must be taken and evaluated for heat stress criteria. Section 6.4 of S3NA-511-PR *Heat Stress* provides specific instructions for taking and evaluating employee vital signs.

5. Body temperature vital signs will be recorded in °F.

S3NA-511-WI1 Temperature Thresholds

1.0 Work-Rest Schedule

The prevention of heat stress is best performed through supervisor observation of employees and routine heat stress awareness training activities. However, it is also necessary to implement a work routine that incorporates adequate rest periods to allow workers to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover. The frequency and length of work breaks must be determined by the work supervisor based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the workers (e.g., acclimated/not), and protective clothing being used.

1.1 Establishing a Work-Rest Schedule

1.1.1 AECOM permits the use of either of two techniques to initially determine an appropriate daily work-rest schedule. These methods are:

- Wet Bulb Globe Thermometer (WBGT) Method: This method is preferred, if a WBGT meter is available.
- Adjusted Temperature Method: This method should be used only if WBGT data is not available.

1.1.2 Either procedure will provide the work supervisor with a recommended routine; however, adjustments to this routine may be required to accommodate the specific daily conditions at the work site.

1.2 WBGT Work-Rest Schedule Guidelines

1.2.1 Table 1, the Non-CPC Activities WBGT Chart, is intended for use where personnel are not utilizing CPC. Where workers are required to utilize CPC, Table 2, the CPC Activities WBGT Chart, will be used.

1.2.2 WBGT readings are compared directly with the values the applicable WBGT Chart for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 1. Non-CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	85°F (29.4°C)	81°F (27.2°C)	78°F (25.6°C)	
75% Work – 25% Rest	86°F (30°C)	83°F (28.3°C)	81°F (27.2°C)	
50% Work – 50% Rest	88°F (31.1°C)	85°F (29.4°C)	83°F (28.3°C)	81°F (27.2°C)
25% Work – 75% Rest	90°F (32.2°C)	87°F (30.6°C)	86°F (30°C)	85°F (29.4°C)

Modified from ACGIH's 2002 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

Table 2. CPC Activities WBGT chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	74°F (23.3°C)	70°F (21.1°C)	67°F (19.4°C)	
75% Work – 25% Rest	75°F (23.9°C)	72°F (22.2°C)	70°F (21.1°C)	

50% Work – 50% Rest	77°F (25°C)	74°F (23.3°C)	72°F (22.2°C)	70°F (21.1°C)
25% Work – 75% Rest	79°F (26.1°C)	76°F (24.4°C)	75°F (23.9°C)	74°F (23.3°C)

Modified from ACGIH's 2002 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

1.3 Adjusted Temperature Work-Rest Schedule Guidelines

This method can be utilized where WBGT data is not available, and requires only that the ambient temperature be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 3. Adjustments are independent and cumulative, all applicable adjustments should be applied. The result is the Adjusted Temperature, which can be compared with the values in Table 4 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest schedule.

Table 3. Temperature Adjustment Factors

Time of Day	
Before daily temperature peak ¹	+2°F (+1.11°C)
10 am – 2 pm (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind (ignore if indoors or wearing CPC)	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity (ignore if wearing CPC)	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative Humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator)	+5°F (+2.78°C)
Level C (coveralls w/o hood, full-face respirator)	+8°F (+4.45°C)
Level C (coveralls with hood, full-face respirator)	+10°F (+5°C)
Level B with airline system	+9°F (+5.56°C)
Level B with SCBA	+9°F (+5.56°C) and right one column ²
Level A	+14°F (+7.78°C) and right one column ²
Other	Specified in the HASP
Miscellaneous	

¹ This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak it can be ignored.

² Locate the proper column based on work rate, then move one column to the right (next higher work rate) before locating the corresponding adjusted temperature.

Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

Table 4. Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Regimen	Adjusted Temperature			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
No specified requirements	< 80°F (22.67°C)	< 75 (23.88°C)	< 70 (21.11°C)	< 65 (18.33°C)
15 minute break every 90 minutes of work	80°F – 90°F (22.67°C) - (32.22°C)	75 – 85 (23.88°C) - (29.44°C)	70 – 80 (21.11°C) - (22.67°C)	65 – 75 (37.77°C) - (23.88°C)
15 minute break every 60 minutes of work	>90 – 100 (32.22°C) - (37.77°C)	> 85 – 95 (23.88°C) - (35°C)	>80 – 85 (22.67°C) - (23.88°C)	>75 – 80 (23.88°C) - (22.67°C)
15 minute break every 45 minutes of work	>100 – 110 (37.77°C) - (43.33°C)	>95 – 100 (35°C) - (37.77°C)	>85 – 90 (23.88°C) - (32.22°C)	>80 – 85 (22.67°C) - (23.88°C)
15 minute break every 30 minutes of work	>110 – 115 (43.33°C) - (46.11°C)	>100 – 105 (37.77°C) – (40.55°C)	>90 – 95 (32.22°C) - (35°C)	>85 – 90 (23.88°C) - (32.22°C)
15 minute break every 15 minutes of work	>115 – 120 (46.11°C) - (48.88°C)	>105 – 110 (40.55°C) - (43.33°C)	>95 -100 (35°C) - (37.77°C)	>90 – 95 (32.22°C) - (35°C)
Stop Work	>120 (48.88°C)	>110 (43.33°C)	>100 (37.77°C)	>95 (35°C)

Note: Time spent performing decontamination or donning/doffing CPC should not be included in calculating work or break time lengths.

S3NA-511-WI2 Symptoms and Treatment

1.0 Heat Stress-related Illness Symptoms

1.1 There are three stages of heat-related illness:

1.1.1 Heat Cramps

- Heat cramps are painful muscle cramps caused by over-exertion in extreme heat.
 - Muscle spasms, and
 - Pain in the hands, feet, and abdomen

1.1.2 Heat Exhaustion

- Heat exhaustion is the next stage. Symptoms include:
 - Cool, moist, pale, flushed or red skin
 - Heavy sweating
 - Headache
 - Nausea or vomiting
 - Dizziness, and
 - Exhaustion.
- Mood changes (irritable, or confused/can't think straight)
- Pale, cool, moist skin
- Heavy sweating
- Dizziness
- Nausea
- Fainting

1.1.3 Heat Stroke

- Heat stroke. Heat exhaustion can sometimes lead to heat stroke, which can be fatal and requires emergency treatment. Heat stroke happens when you stop sweating and your body temperature continues to rise, often to 105° F (40.5° C) or higher. Symptoms of heat stroke:
 - Vomiting
 - Decreased alertness level or complete loss of consciousness
 - High body temperature (sometimes as high as 105° F (40.5° C))
 - Skin may still be moist or the victim may stop sweating and the skin may be red, hot, and dry
 - Rapid, weak pulse, and
 - Rapid, shallow breathing.
- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Nausea
- Dizziness and confusion
- Strong rapid pulse
- Coma

2.0 Recommended Treatment for Heat Stress-related Illnesses

2.1 Heat Cramps

2.1.1 Treatment:

- Gently stretch the cramped muscle and hold the stretch for about 20 seconds, then gently massage the muscle. Repeat these steps if necessary.
- Take more frequent breaks and drink more water.
- Move victim to a cool place.
- Administer drinks of cool water.

- Apply manual pressure to cramped muscles.
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated.

2.1.2 Heat Exhaustion

- Treatment of heat exhaustion:
 - Get out of the sun to a cool location and drink lots of water, a little at a time.
 - Remove or loosen tight clothing.
 - If you are nauseated or dizzy, lie down.
- Move the victim to a cool place.
- Remove as much clothing as possible and elevate the feet.
- Administer drinks of cool water and fan to cool.
- Seek medical attention immediately.

2.1.3 Heat Stroke

- Treatment of heat stroke, or if a person's temperature exceeds 102° F (38.9 ° C) :
- Call for immediate medical help and then try to lower the temperature as quickly as possible:
 - Apply cool (not cold) water the person's whole body, then fan the person.
 - Stop cooling once the person's temperature appears to be down; be careful not to overcool.
 - Do not give aspirin or acetaminophen to reduce the temperature.
- Treat as a true medical emergency. Seek medical help immediately
- Reduce body temperature quickly
- Douse with cool water (not cold water)
- Wrap in wet sheet
- If available, use cold packs under arms, neck, and ankles
- Protect from injury during convulsion
- Ensure that the person's airway is open.
- Transfer to a medical facility immediately.

S3NA-511-ST Heat Exposure

The following Occupational Health and Safety regulations apply directly to heat stress hazards:

Jurisdiction	Regulation
United States	
OSHA	1910.132
Canada	
Alberta	n/a
British Columbia	OHS Regulation (1997) Sect 7.28 – 7.32, 8.21, 12.72, 12.73
Manitoba	Workplace Health and Safety Regulation (217/2006) Sect 4.12, 4.13
New Brunswick	OHS Regulation (91-191) Sect 44
Newfoundland/Labrador	OHS Regulation (C.N.L.R. 1165/96) Sect 10
Nova Scotia	n/a
NWT/NU Territories	n/a
Ontario	O. Reg. 213/91 Sect 112 O. Reg. 851 Sect 129 Heat Stress (Health and Safety Guidelines) (April 2003)
Prince Edward Island	OHS Regulations (EC180/87) Sect 42.1
Quebec	OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 121 – 124, Schedule 4, Schedule 5
Saskatchewan	OHS Regulation (R.R.S., c. O-1, r. 1) Sect 70
Yukon Territory	Occupational Health Regulations (O.I.C. 1986/164) Sect 9, 12

S3NA-513-PR Lead

1.0 Purpose and Scope

- 1.1 Control occupational exposures to lead to the lowest level practicable.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1.1 **Action Level (AL):** An airborne lead concentration of 30 micrograms per cubic meter of air ($30 \mu\text{g}/\text{m}^3$) (or more stringent as per the local regulations), calculated as an 8-hour time weighted average (TWA), irrespective of mitigation provided by any respiratory protection that might be used.
- 2.1.2 **Demolition:** The wrecking or taking out of any load-supporting structural members and any related razing, removing, or stripping of lead products.
- 2.1.3 **HAZWOPER:** Any on-site contamination investigation or clean-up activities subject to the operational requirements of *S3NA-509-PR Hazardous Waste Operations and Emergency Response*.
- 2.1.4 **Lead Containing Material:**
 - Structural or decorative components containing lead in excess of 1% by weight.
 - Paint or other surface coatings that contain lead equal to or in excess of 1.0 milligram per centimeter squared ($1.0 \text{ mg}/\text{cm}^2$) or 0.5% by weight.
 - Bulk materials containing lead in excess of 0.1% or for soils any lead-in-soil concentration in excess of 1,000 mg/kg.
 - "Lead" means metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.
- 2.2 **Permissible Exposure Limit (PEL):** The maximum exposure concentration to which an individual may be exposed to for an 8-hour time weighted average (TWA) without experiencing adverse health effects. For normal work shifts (8 hours or less), the PEL for lead is 50 micrograms per cubic meter of air ($50 \mu\text{g}/\text{m}^3$), or more stringent as per local regulations.
- 2.3 **Renovation:** The modifying of any building component that does not impact structural supports.

3.0 Attachments

- 3.1 None

4.0 Procedure

4.1 SH&E Department Responsibilities

- 4.1.1 Provide technical assistance in the identification of lead-containing materials and the evaluation of lead exposure hazards as requested by management personnel.
- 4.1.2 Review and approve all lead exposure hazard assessments prior to the start of work activities.
- 4.1.3 Review and approve all lead exposure mitigation plans and exposure monitoring activities to ensure compliance with federal, state, and local regulations.
- 4.1.4 Monitor compliance with the various aspects of this procedure and provide technical assistance regarding implementation of the requirements set forth in this procedure.

4.2 Project Managers' (field task managers, supervisors) Responsibilities

- 4.2.1 Confirm that the presence of lead-containing materials at AECOM work sites is identified (where reasonably possible) prior to commencing field activities, that prior to initiating any task involving disturbance of or contact with lead-containing materials (or immediately upon identification of previously unknown lead-containing materials) a lead exposure task hazard assessment is developed and approved by the **SH&E Department**, and that the applicable requirements are observed for each task where the lead exposure assessment indicates that the airborne lead concentrations can exceed the Action Level or other significant lead exposure hazards are present.
- 4.2.2 Confirm that employees developing work procedures and/or conducting work activities involving lead-containing materials possess any required state specific registrations or certifications.
- 4.2.3 Confirm that employees assigned to perform any work activities involving lead-containing materials have been trained in the job-specific hazards of lead exposure, have received proper medical surveillance, and are trained and properly fit tested in the use of any designated respiratory protection devices.
- 4.2.4 Provide the training program as initial training prior to the time of job assignment or prior to the start up date for this requirement, whichever comes last.
- 4.2.5 Provide the training program at least annually for each employee who is subject to lead exposure at or above the action level on any day.

4.3 Employee Responsibilities

- 4.3.1 Do not disturb or handle any lead-containing materials without appropriate personal protective equipment (PPE), training in the job-specific hazards of lead exposure, medical monitoring, and respirator fit test.
- 4.3.2 Immediately notify the **Project Manager** of the presence or suspected presence of previously unidentified lead containing materials in the workplace, and cease all work activities involving disturbance or contact with the materials until further direction is received.

4.4 Activity-Specific Requirements

The following operation-specific requirements pertain to activities where the presence of lead-containing materials is identified, suspected, or recognized as a significant operational occurrence.

4.4.1 HAZWOPER Activities

Lead may be present at HAZWOPER sites as a soil or groundwater contaminant or as a building material. If such contamination is noted, the following requirements must be observed:

- The site-specific health and safety plan (HASP) must provide a specific analysis of the lead exposure hazard for each task involving the disturbance or handling of lead-contaminated materials.
- If any potential is identified for worker lead exposures to exceed the AL, then specific lead exposure control and monitoring procedures must be developed for the work activity and included in the HASP.
- If workers may be exposed in excess of the AL, they must complete baseline medical monitoring and lead awareness training.

4.4.2 Demolition or Renovation Activities

The past widespread use of lead-containing materials in buildings is widely recognized as the source of a significant exposure hazard for personnel performing demolition and renovation activities. Accordingly, the following requirements will be observed:

- Prior to commencement of demolition or activities, a thorough inspection and sampling program will be completed throughout the demolition area to identify the presence of lead-containing materials.
- Where feasible, lead-containing materials will be removed prior to commencement of general work activities.
- The hazards of any remaining lead will be analyzed and an exposure control and monitoring plan developed to prevent worker lead exposures in excess of the PEL (required) and the AL (where feasible). The exposure control plan must be approved by the SH&E Department prior to implementation.

- Prior to commencing demolition activities the appropriate notifications must be filed with the federal, state, and local regulatory agencies as when necessary. The **Project Manager** is required to determine the appropriate reporting requirements.
- If workers may be exposed in excess of the AL, they must complete baseline medical monitoring and lead awareness training.
- Disposal of lead containing materials must meet federal, provincial, territorial, state, and local regulatory requirements. The project manager is required to address this in the project work plan.

4.4.3 Other Activities

If the presence of lead-containing material is identified or suspected at any work location, and there is the potential for this material to become disturbed during planned work activities, then the following requirements must be observed:

- A lead exposure hazard assessment will be completed for each task in which lead-containing material may be disturbed.
- If any exposure assessment indicates the potential for worker exposures to exceed the AL, then appropriate exposure mitigation procedures must be identified to keep exposures to less than the PEL (required) and the AL (where feasible). Mitigation procedures must be reviewed and approved by the **SH&E Manager** prior to implementation.
- If workers may be exposed in excess of the AL, they must complete baseline medical monitoring and lead awareness training.
- The **SH&E Department** will determine if any exposure-monitoring procedures must be implemented during work activities.

4.5 Worker Exposure Control Program

The following requirements pertain to all workers performing tasks where the associated lead exposure assessment indicates the potential for lead exposures to exceed the AL.

4.5.1 Medical Monitoring Requirements

- Prior to commencing work where lead exposure may exceed the AL, each employee will have completed a biological monitoring procedure for blood lead and ZPP (Zinc Protoporphyrin) concentrations. This testing may include baseline and exit collections. The specific requirements will be defined by AECOM's Corporate Medical Provider and SH&E Manager prior to project initiation. Workers must have a medical clearance from AECOM's Corporate Medical Provider prior to performing work involving potential lead exposures at or above the AL.

4.5.2 Medical Removal

- AECOM will temporarily remove an employee from work where there is excess exposure to lead as determined by a physician's written medical opinion that the employee should be removed from such exposure. The physician's determination may be based on biological monitoring results, the employee's inability to wear a respirator, evidence of illness, other signs or symptoms of lead-related dysfunction or disease or any other reason deemed medically sufficient by the physician.

4.5.3 Training

Each worker who may be exposed shall complete training consisting of the following elements:

- Lead exposure limits and other regulatory requirements.
- Job-specific lead hazards and exposure prevention measures.
- The health hazards associated with lead exposure.
- The quantity, location, manner of use, release, and storage of lead in the workplace and the specific nature of operations that could result in exposure to lead, especially exposures above the PEL.
- The project-specific engineering controls and work practices associated with the employee's job assignment.
- The measures employees can take to protect themselves from exposure to lead, including modification of such habits as smoking and personal hygiene, and specific procedures that AECOM has implemented to protect employees from exposure to lead such as appropriate work practices, emergency procedures, and the provision of personal protective equipment.
- The purpose, proper selection, fitting, proper use, and limitations of respirators and protective clothing.

- The purpose and a description of the medical surveillance program.
- The employee's rights of access to records, as per *S3NA-604-PR Medical Records*.

4.5.4 Respiratory Protection

Where respiratory protection is specified for use in controlling worker exposures to lead each employee must:

- Be medically qualified for use of the specified respiratory protection.
- Complete respirator training and fit testing.
- Be assigned an appropriate respirator for use during field operations.

4.5.5 Personal Protective Equipment

In any operation where workers may experience airborne lead concentrations above the AL, or where the possibility of skin or eye irritation exists, employees shall be provided with the following:

- Disposable coveralls or similar full-body work clothing
- Gloves, hoods, and boots or disposable shoe coverlets
- Face shields, goggles, or other appropriate protective equipment necessary for safe job performance
- Clean change rooms equipped with separate storage facilities that will prevent cross contamination from protective work clothing and equipment to street clothes
- All protective clothing shall be cleaned, laundered, properly disposed of, and repaired or replaced as necessary. AECOM will provide all necessary PPE that is incidental to the work at no cost to the employee.

4.5.6 Air Monitoring

- Operations involving the potential airborne exposure to lead shall be required to conduct initial and ongoing personal air sampling to represent employee exposure

4.6 Safe Work Practices

4.6.1 Regulated Areas

- Access to lead-contaminated work areas shall be regulated and limited to authorized persons. A daily roster of all persons entering such areas shall be kept. AECOM employees shall not enter or remain in regulated areas when any of the safety systems such as ventilation or containment is not functional.
- In each work area, where the AL is exceeded, the following warning sign shall be posted:

**WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

4.6.2 General Work Practices

- Contaminated protective equipment such as respirators, airline hoses, etc., shall not be removed from the regulated area until it has been cleaned.
- Employees shall not be permitted to exit the regulated area until contaminated equipment and clothing have been removed in accordance with the preceding bullets and employees have showered and washed their hands and face with soap and water.
- Removal of lead from protective clothing or equipment by blowing, shaking, or any other means which could disperse lead into the air is prohibited.
- No food or beverages shall be present or consumed in the regulated area.
- No tobacco products shall be present or used and cosmetics shall not be applied in the regulated area.
- All employees shall be required to shower at the end of each work shift.
- During the operation, all employees shall be required to wash their hands and face prior to eating, drinking, smoking, or applying cosmetics.
- Whenever possible, wet methods shall be used when handling or processing lead compounds. Water spray, fogging, or water collection systems, etc., shall be used (e.g., lead contaminated soil shall be thoroughly wetted for excavation operations).

- Dry sweeping of lead or lead-contaminated materials is prohibited. When wet methods cannot be used, HEPA filter vacuum cleaners shall be required.
- Containers of contaminated protective clothing and equipment are to be labeled as follows:
CAUTION: CLOTHING CONTAMINATED WITH LEAD. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE OR FEDERAL REGULATIONS

5.0 Records

- 5.1 The employer shall establish and maintain an accurate record of all monitoring as per *S3NA-602-PR Exposure Monitoring*.
- 5.2 The employer shall maintain or assure that the physician maintains those medical records for at least 40 years, or for the duration of employment plus 20 years, whichever is longer.

6.0 References

- 6.1 **United States:** Title 29, Code of Federal Regulations, Sections 1910.1025 and 1926.62
- 6.2 CalOSHA Title 8 1532.1
- 6.3 Canadian Centre for Occupational Health and Safety
- 6.4 S3NA -208-PR Personal Protective Equipment Program
- 6.5 S3NA-418-PR Welding, Cutting and Other Hot Work
- 6.6 S3NA-519-PR Respiratory Protection Program
- 6.7 S3NA-605- PR Medical Surveillance Program

S3NA-518-PR Radiation Gauge Source Program

1.0 Purpose and Scope

- 1.1 Portable gauges are used in various AECOM business lines involved in agriculture, construction, and civil engineering to measure things like the moisture or compaction in soil, and the density of asphalt in paving mix.
- 1.2 While gauge source license requirements vary based upon Regulatory Agencies, radioactive material sources, project location (i.e. Federal property, Agreement State, etc.), and length of project, this procedure provided AECOM with a standard approach to managing Gauge Source Programs.
- 1.3 This procedure provides a set of guidelines for all AECOM Authorized Operators of portable gauging devices that contain radioactive sealed sources (i.e., byproduct and/or accelerator produced material).
- 1.4 The procedure establishes requirements for AECOM gauge source license holders to provide information on their program, inventory, license, etc. to AECOM's Corporate Radiation Safety Officer (Corporate RSO).
- 1.5 This procedure applies to all AECOM North America based employees and operations.

2.0 Terms and Definitions

- 2.1 **Accelerator Produced Material:** Material that has been bombarded with energetic particles (accelerated) to create energies that are suitable for certain technological and medical applications
- 2.2 **Agreement State:** A State that has entered into an agreement with the Nuclear Regulatory Commission (NRC) which gives the State the authority to license radioactive materials used, possessed, and stored within its State borders and jurisdiction.
- 2.3 **ALARA:** As Low As Reasonably Achievable. Acronym for methods used to minimize exposure to radioactive materials through time, distance and shielding.
- 2.4 **Authorized Operators:** Employee who has successfully completed a gauge manufacturer's training course and has been trained in the specific provisions of this standard operating procedure (SOP) and the requirements of AECOM's respective Radioactive Materials License.
- 2.5 **Byproduct Material:** Any radioactive material yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear materials.
- 2.6 **Corporate Radiation Safety Officer (RSO):** AECOM employee responsible for AECOM's North American Corporate Radiation Safety Program (S3NA-516-PR).
- 2.7 **Leak Test:** A physical process in which a sample is collected on the outside of the gauge's sealed source(s) shielding to determine the presence of radioactive leakage.
- 2.8 **Licene Radiation Safety Officer (RSO):** AECOM employee named as RSO on an AECOM radioactive materials license. This employee is responsible for developing, maintaining, auditing, implementing, and amending an appropriate Radiation protection Plan in accordance with AECOM's Corporate Radiation Safety Program and license conditions.
- 2.9 **Portable Gauges:** Various instruments manually used in the measurement of material properties. Typical portable gauges owned, leased, and operated by AECOM include (but not limited to): nuclear density and/or moisture gauges, XRF Spectrum Analyzers, and Electron Capture Detectors.
- 2.10 **Project Manager:** Employee responsible for the management of the project activities, including but not limited to health and safety as well as the technical and financial performance of the project.
- 2.11 **Radioactive Material (RAM) License:** License issued by a regulating agency for the possession, use and/or storage of portable gauging and measurement equipment that contains radioactive sealed sources.

- 2.12 **Radioactive Sealed Source:** Any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material that is created from either byproduct and/or accelerator-produced material.
- 2.13 **Reciprocity:** The act of one regulatory agency honoring the license of another regulatory agency.
- 2.14 **Regulatory Agency:** A government body with designated authority for radioactive material within designated boundaries. Regulatory Agencies for portable gauging and measuring equipment include the NRC, the US Department of Energy, Agreement States, and military bases.
- 2.15 **Thermo luminescent Dosimeter (TLD):** A type of dosimeter for measuring the external exposure to gamma, X-ray, and β radiation. Energy absorbed from the radiation is stored and emitted at the time of analysis as light. The amount of light emitted is proportional to the energy absorbed and hence to the dose received by the individual wearing the TLD.
- 2.16 **Transport Index (TI):** The maximum radiation level in millirem/hour at a distance of one meter from all external surfaces of the prepared portable gauge package for shipping and/or transport. It is a dimensionless number placed on the label of a package to designate the degree of control to be exercised during shipment or transportation.

3.0 Attachments

- 3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 Corporate RSO is responsible for:

- Maintaining and ensuring compliance with AECOM's Corporate Radiation Safety Program (S3NA-516-PR Radiation Safety Program).
- Maintaining and ensuring compliance with AECOM's Radiation Gauge Source Program by providing a single point of contact and repository for information on all AECOM gauge source licenses and programs.
- Reviewing this procedure on an annual basis and revising it as necessary based on the results of the annual review.
- Approving all RAM license RSOs, including RSOs named on specific and general gauge source licenses.

4.1.2 License RSO

Each **License RSO** is responsible for ensuring that the conditions of AECOM's RAM License and the requirements of this SOP are successfully met. Specifically, the **License RSO** is responsible for:

- Providing copies of all licenses and compliance documents (audits, inventories, leak tests, training records, amendments, procedures, dose reports, etc.) to the **Corporate RSO**.
- Preparing and maintain the License Radiation Protection Plan (RPP).
- Completing compliance reports (annual or other) as required by regulatory authorities.
- Stopping unsafe licensed activities.
- Amending RAM Licenses to reflect current regulatory requirements, industry standards and procedures, and AECOM health and safety requirements.
- Obtain necessary reciprocity licensing for work in areas regulated by other Regulatory Agencies.
- Ensuring that all users of portable gauges containing sealed sources have been authorized to operate such equipment.
- Ensuring initial and refresher training is provided for **Authorized Operators**.
- Ensuring that all records are properly filed and maintained.
- Conducting annual program audits.
- Reviewing the license Radiation Protection Plan on an annual basis and revising it as necessary based on the results of the annual review.
- Notifying Regulating Agency and **AECOM Corporate RSO** if a gauge is lost, stolen, stuck or damaged.

- Notifying either the US Department of Transportation (USDOT) or the CNSC if a transportation accident involving a gauge occurs.

4.1.3 **Authorized Operator**

- Conducting their work in accordance with the procedures established by this procedure, the License RPP, and the conditions and operating procedures of specific RAM License.
- Implementing and following all site specific health and safety requirements.
- Coordinate all shipping/transportation of portable gauges to and from project site.

4.1.4 **Project Manager (field task manager, supervisor)**

- Contact the **License RSO** prior to portable gauge usage at a project site to insure all licensing requirements are complete prior to receipt of the portable gauge at the facility, authorized operators have been selected, and if requirements for dosimetry and radiation surveys are needed/met.
- Ensure gauge users are **Authorized Operators** and have current certifications and training.
- Contact the **License RSO** prior to the anticipated end of the portable gauge use to insure proper regulatory tracking and notification.
- Contact the **License RSO** regularly with portable gauge usage for proper and timely billing of equipment to project.

4.2 **Radiation Protection Plan**

All RAM Licenses shall have an associated RPP that is prepared and approved in accordance with the AECOM Corporate Radiation Safety Program. The RPP shall describe in detail the subjects described in Sections 4.2.1 through 4.2.9.

4.2.1 **ALARA Policy Statement**

It is AECOM's policy to plan and conduct its radiological activities safely and in such a fashion as to protect the health and safety of its employees, subcontractors, members of the public, and the environment. To achieve this, AECOM shall ensure that efforts are taken to reduce radiological exposures and releases to the environment as low as is reasonably achievable, taking into account social, technical, economic, practical and public policy considerations. AECOM is committed to implementing a radiological control program that reflects this policy.

4.2.2 **Personnel Monitoring**

The RPP will define the method for tracking dose to **Authorized Operators**. Typically, and often required by a license, all **Authorized Operators** will wear a personnel monitoring device, such as a thermoluminescent dosimeter (TLD) badge, to measure radiation exposure when using or transporting gauges. The badges shall be exchanged at intervals not to exceed 3 months. The **License RSO** who authorizes a person to operate a gauge containing a radioactive source shall provide the **Authorized Operator** with a dosimeter that:

- Has been issued by a licensed dosimetry service [in the US, National Voluntary Laboratory Accreditation Program (NVLAP) accreditation is required];
- Has not been used by another person since its last reading;
- Is of a type suitable for recording any dose of radiation that the person is likely to receive as a result of the operation of the exposure device; and
- Is designed so that it can be worn on the trunk of the body.

Upon receipt of the results of the analysis by the dosimetry service, the **License RSO** shall review the results for conformance to license and exposure requirements. A copy of the dosimetry service's report will be maintained in the RAM License file and a copy shall be forward to the **Corporate RSO**. At any time, at the request of the employee, the **License RSO** will provide copies of any and/or all personnel radiation dosimetry records for that employee.

Alternate methods for tracking dose must be defined in the RPP and approved by the **Corporate RSO**.

4.2.3 **Radiation Detection Instruments**

AECOM will maintain radiation survey meters for use in the event on an incident involving a gauge. The survey meters will be calibrated annually and checked for functionality before use (e.g., with the

gauge source or a check source). The **License RSO** will provide **Authorized Operators** with a radiation survey meter that:

- Is capable of measuring a dose rate of gamma radiation from the sealed source of between 2 mrem/hr (20 μ Sv/hr) and 10 rem/hr (100 mSv/hr), and
- Indicates that the power level of its batteries is sufficient for its operation.

4.2.4 Sealed Source Leak Testing

- Leak testing (i.e., a check for removable radioactive contamination) will be performed to determine whether there is any radioactive leakage from the source(s) in the gauge. Leak tests shall be collected on all AECOM-owned and leased portable gauges.
- Leak tests will be collected by the **License RSO** or an **Authorized Operator** using an approved kit, such as Troxler Leak Test Kit 3880, in accordance with the kit supplier's instructions. Leak tests will be analysed by an organization authorized by the applicable regulatory agency (NRC, CNSC, or Agreement State).
- Leak tests shall be collected at frequencies in accordance with license requirements.
- Leak test results will be maintained for a period of three (3) years or in accordance with license requirements.

4.2.5 Material Receipt and Accountability

- All **AECOM License RSOs** will complete an inventory of all sealed sources and portable gauges corresponding with the specific RAM Licenses at a minimum once every six months.
- Radioactive materials must be tracked from "cradle to grave." **AECOM License RSOs** shall maintain records of receipt, transfer, and disposal of gauges for a period of three (3) years. Source inventories must also be performed at intervals not to exceed six months. Inventory records will include the following information:
 - Radionuclide and amount of material in each sealed source.
 - Manufacturer, model number and serial number of each device containing radioactive material.
 - Date inventory was performed.
- Inventory records will be maintained by the **License RSO** with other program documents for three (3) years.

4.2.6 Public Dose

- **AECOM License RSOs** and **Authorized Operators** must ensure that following:
 - Gauges are used, transported, and stored in such a way that no member of the public receives a dose of more than 100 mrem (1 mSv) in one year;
 - The dose in unrestricted areas does not exceed 2 mrem (20 μ Sv) in any one hour; and
 - Gauges that are not in storage are controlled and secured from unauthorized use or removal.
- Members of the public include persons who live, work, or may be near locations where gauges are used or stored. This may include AECOM employees or subcontractors whose assigned duties do not include use of gauges, but work in the vicinity where gauges are used or stored.
- In general, gauges should be stored as far away as possible from areas occupied by members of the public. **AECOM License RSOs** must ensure that radiation levels in areas adjacent to gauge storage locations will not exceed the dose limits provided above.
- **License RSOs** should demonstrate in the RPP how compliance the public dose limits will be determined (e.g., provide public dose calculation worksheet).

4.2.7 Maintenance

- AECOM is not licensed to perform any maintenance or cleaning on any portable gauge containing a sealed source unless the source is safely shielded within the gauge. Any maintenance or cleaning will always be performed with the radioactive source in the safe shielded position in accordance with the manufacturer's directions or recommendations.
- **License RSOs** will implement and maintain procedures for routine maintenance (cleaning and lubrication) of licensed gauges according to the manufacturer's recommendations and instructions. The **License RSO** will send gauges to the manufacturer to perform non-routine maintenance or repair operations that require removal of the source or source rod from the gauge.

4.2.8 Transportation

- **License RSOs** shall incorporate appropriate transportation procedures into the license RPP and operating procedures. These procedures must ensure that gauges are transported in compliance with US DOT or CNSC regulations.

4.2.9 Audit Program

- AECOM will verify, on an annual basis, that our activities are being conducted in accordance with the conditions of our RAM Materials License. The **RAM License RSO**, another **RAM License RSO**, or an independent third party may conduct the audit. The audit will include a review of records to ensure that AECOM has properly documented our activities and that this documentation can adequately demonstrate regulatory compliance. Verify with license requirements if annual audit must be completed by an independent party. Copies of completed audits to maintained in the license files.

4.3 Operational Procedures

To limit radiation dose to **Authorized Operators** and the public, each **License RSO** must ensure that an operating procedure(s) is implemented and maintained. A copy of the operating procedure(s) should be distributed to gauge users before initial use of equipment and maintained at the job site. Operating procedures should include the following requirements:

4.3.1 Dosimeters

- Always wear assigned personnel dosimetry device (e.g., TLD) when using or transporting the gauge.
- Never wear another person's dosimeter.
- Never store a dosimeter near the gauge or other radiation source.

4.3.2 Storage

- Before removing the gauge from its place of storage, ensure that in gauges with movable source rods, the rod is locked in the shielded position, and the transport case is locked.
- Sign out the gauge in a logbook, stating the date(s) of use, name(s) of **Authorized Operator(s)** who will be responsible for the gauge, and the temporary job site(s) where the gauge will be used.
- When the gauge is not in use at a temporary job site, place the gauge in a second storage location (e.g., locked in a trunk of a car or locked in a storage shed).
- After making changes affecting the gauge storage area (e.g., changing the location of the gauges within the area, removing shielding, adding gauges, changing the occupancy of adjacent areas, moving the storage area to a new location), reevaluate compliance with public dose limits and ensure proper security of gauges.
- All required signage including Notice of Employee postings, Caution Radiation postings and specific RAM License postings shall be properly located and maintained. Remove all postings when the gauge is removed from the facility.

4.3.3 Transportation

- Prior to transporting the gauge, ensure that each gauge source is in the fully shielded position. Ensure that the source rod is locked in the shielded position and that the gauge is placed into the case and lock the case.
- Block and brace the gauge to prevent movement during transportation and lock the gauge in or to the vehicle. Follow all regulatory requirements regarding transportation.
- Lock the case in or to the vehicle.

4.3.4 Use and Maintenance

- Use the gauge according to the manufacturer's instructions and recommendations.
- Keep gauges away from heavy equipment that could inadvertently run over the unit and potentially expose the source.
- Do not touch the end of the source rod with your fingers, hands, or any part of your body or place any part of the body in the radiation field of the unshielded source.
- If gauges are used for measurements with the unshielded source extended more than 3 feet (1 meter) below the ground surface, use piping, tubing or other casing material to line the hole from the lowest depth of 12 inches (0.3 meters) above the surface. If the piping, tubing, or other casing material cannot extend 12 inches (0.3 meters) above the surface, cap the hole liner or take other

steps to ensure that the hole is free of debris (and it is unlikely that debris will enter the cased hole), so that the unshielded source can move freely (e.g., use a dummy probe to verify that the hole is free of obstructions).

- Unless absolutely necessary, do not look under the gauge when the source rod is being lowered into the ground. If you must look under the gauge to align the source rod with the hole, keep all body parts as far from the unshielded source as possible to minimize radiation exposure.
- After completing each measurement in which the source is unshielded, immediately return the source to the shielded position.
- Return the gauge to its proper storage location at the end of the work shift.
- Log the gauge into the daily use log when it is returned to storage. Perform routine cleaning and maintenance according to the manufacturer's instructions and recommendations.

4.3.5 Security

- Always maintain constant surveillance and immediate control of the gauge when it is not in storage or secured in the transport vehicle.
- Never leave an unsecured gauge unattended.
- Always keep unauthorized persons away from the area when the gauge is being used.

4.4 Emergency Procedures

Lost or stolen gauges and gauges damaged by heavy equipment used at the job site are the most common emergencies that present a potential radiation safety risk. Other emergencies include the failure of the source in the neutron probe to return to the shielded position as a result of being damaged or stuck below the ground surface.

To limit radiation dose to **Authorized Operators** and the public, each **License RSO** must ensure that an emergency procedure(s) is implemented and maintained. A copy of the emergency procedure(s) should be distributed to gauge users before initial use of equipment and maintained at the job site. Emergency procedures should include the following requirements:

4.4.1 Lost or Stolen Gauge

- The **Authorized Operator** must notify the **License RSO** as soon as it is determined that a gauge is missing.
- The **License RSO** will immediately notify the rental firm, if applicable, and contact appropriate Regulating Agency to notify them of the missing or stolen gauge.
- The **License RSO** will notify the **AECOM Corporate RSO** and follow all AECOM incident reporting procedures.
- The **Authorized Operator** and the **License RSO** will discuss the reasons for the theft/loss and make the necessary changes in the gauge storage area and/or gauge transportation procedures.

4.4.2 Damaged Gauge

- Refer to the RAM License specific operating procedures for guidance on gauge damage procedures for specific portable gauges.
- Immediately secure the area and keep people at least 15 feet (5 meters) from the gauge until the situation is assessed and radiation levels are known. However, perform first aid for injured individuals and remove them from the area only when medically necessary to do so.
- If any heavy equipment is involved, detain the equipment and operator until it is determined there is no contamination present.
- Gauge users and other potentially contaminated individuals should not leave the scene until emergency assistance arrives.
- Visually inspect the gauge to determine the position of the source rod (exposed or shielded), and the position of the source shutter (open or closed), and the extent of damage, if any, to the source housing and/or shield.
- In all cases, immediately contact the **License RSO** and the **License RSO** will contact the Regulatory Agency and make reports within the required reporting timeframe.
- The **License RSO** will notify the **AECOM Corporate RSO** and follow all AECOM incident reporting procedures.
- The **License RSO** must arrange for a radiation survey to be conducted as soon as possible.

- Before shipping a damaged gauge, contact the **AECOM Corporate RSO** and the gauge recipient for special requirements.

4.4.3 Stuck Source

- Use the gauge manufacturer's recommended procedures for retrieving a stuck source. When it becomes apparent that efforts to recover the source will be unsuccessful, the **License RSO** will contact the Regulatory Agency.
- The **License RSO** will notify the **AECOM Corporate RSO** and follow all AECOM incident reporting procedures.

4.5 Employee Training and Qualification

Only those AECOM employees, or subconsultants, who have been authorized by a **License RSO** to operate portable gauges, will be permitted to operate gauges at jobsites on behalf of AECOM. The **License RSO** must keep records of all employee training.

The **License RSO** shall have either documented gauge safety training as outlined below or documented RSO training.

4.5.1 Initial Training

- Employees who wish to operate a portable gauging device must successfully complete the following instruction before operating the device:
 - A gauge manufacturer's training course (that meets the criteria in the section entitled "Training for Individuals Working In or Frequenting Restricted Areas" in Draft NUREG-1556, Vol 1, dated September 1996) for the specific gauge to be operated.
 - Instruction by the **AECOM License RSO** on the contents of this standard operating procedure
 - Completion of HAZMAT DOT shipping training for portable gauges (US operators)
- If employees have received initial training in an alternative course or previously through another employer, the **RSO** may still require the employee to participate in the gauge manufacturer's training course.

4.5.2 Annual Refresher Training

- The **License RSO** will conduct, on an annual basis, a refresher training course for all authorized operators of portable gauges containing sealed sources. The refresher course will include the following topics:
 - Changes in CNSC, NRC, or state regulations.
 - Changes in AECOM's license or license conditions.
 - Review of the contents of this standard operating and emergency procedure including a "dry run" of AECOM's emergency procedures.
 - Review of deficiencies identified during annual audit of the license's radiation safety program (as it relates to the use of portable gauges).
 - Review requirements for the transport of sealed sources in portable gauges.

4.5.3 Radiation Awareness Training

- AECOM personnel in offices or other locations where gauge sources are stored shall receive Radiation Awareness (RA) training in accordance with the AECOM Corporate Radiation Safety Program (S3NA-516-PR) and applicable license and RPP requirements. RA training will cover, at a minimum, the hazards associated with the stored radiation sources, recognition of radiation warning signs, location of stored sources, and emergency procedures.

4.6 Gauge Disposal and Transfer

- All portable gauges assigned for disposal or transfer must be transferred to regulatory licensed entity approved for the possession, storage, and disposal for the given source types. Gauges containing licensed radioactive material and shall not be disposed in the trash. Contact the **License RSO** to properly dispose of a portable gauge that contains a radioactive source. Update all inventory records following gauge disposal or transfer.

5.0 Records

- 5.1 AECOM understands that our records are evidence of our efforts to maintain compliance with the conditions of the respective RAM Licenses and applicable regulations. As such, the License RSO will be responsible for maintaining the following records. Records shall be maintained in a manner that is conducive to being audited by the licensing authority or the AECOM Corporate RSO. Copies of records should be provided to the Corporate RSO.
- 5.1.1 Employee's initial and refresher training records will be maintained for a period of no less than 3 years after the individual terminates employment with AECOM.
- 5.1.2 Equipment inventory records will be maintained for at least 3 years from the date of the inventory.
- 5.1.3 Annual audit reports will be maintained for 3 years.
- 5.1.4 Leak test reports will be maintained for 3 years.
- 5.1.5 Calibration records for each radiation survey meter used at job sites, if necessary, will be maintained for 3 years.
- 5.1.6 Personnel monitoring results.
- 5.1.7 Radiation screening records, if generated, will be maintained for 3 years.

6.0 References

- 6.1 AECOM Corporate Radiation Safety Program (S3NA-516-PR) US Code of Federal Regulations Title 10, Part 20 (10 CFR 20), Standards for Protection Against Radiation Canadian Radiation protection Regulations (SOR-2000-203).
- 6.2 Canadian Nuclear Substances and Radiation Devices Regulations (SOR-2000-203). Working Safety With Nuclear Gauges, Canadian Nuclear Safety Commission, <http://www.nuclearsafety.gc.ca/eng/readingroom/publications/gauges/index.cfm>

S3NA-519-PR Respiratory Protection Program

1.0 Purpose and Scope

- 1.1 This procedure establishes methods that AECOM will use to prevent employee exposure to hazardous concentrations of airborne contaminants or to supply breathing-quality air to employees working in oxygen-deficient atmospheres.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Air-purifying respirator:** A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.
- 2.2 **Approved:** Equipment tested and listed by the Bureau of Mines, jointly by the Mining Enforcement and Safety Administration (MESA), and the National Institute for Occupational Safety and Health (NIOSH), or jointly by the Mine Safety and Health Administration (MSHA) and NIOSH.
- 2.3 **Assigned protection factor (APF):** The ratio of the ambient concentration of an airborne substance (outside the respirator) to the concentration of the substance inside the respirator. NIOSH defines this as 10 for an approved half-face respirator and 50 for an approved full-face respirator.
- 2.4 **Atmosphere-supplying respirator:** A respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.
- 2.5 **Breakthrough:** The first perception of an odor, taste or irritation experienced while wearing an air-purifying respirator. Breakthrough is generally an indication that the cartridges are saturated and are no longer filtering out the contaminant. Breakthrough can also be an indication of an improperly functioning respirator.
- 2.6 **Confined space:** An enclosure, such as a storage tank, process vessel, boiler, silo, tank car, pipeline, tube, duct, sewer, underground utility vault, tunnel, or pit, that has limited means of egress and poor natural ventilation and that may contain hazardous contaminants or be oxygen deficient.
- 2.7 **Canister or cartridge:** A container that has a filter, sorbent, or catalyst, or a combination of these items and that removes specific contaminants from the air passed through the container.
- 2.8 **Demand respirator:** An atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.
- 2.9 **Emergency situation:** Any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.
- 2.10 **Employee exposure:** Exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.
- 2.11 **End-of-service-life indicator (ESLI):** A system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.
- 2.12 **Escape-only respirator:** A respirator intended to be used only for emergency exit.
- 2.13 **Filter or air purifying element:** A component used in respirators to remove solid or liquid aerosols from the inspired air.
- 2.14 **Filtering facepiece (dust mask):** A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.
- 2.15 **Fit factor:** A quantitative estimate of the fit of a particular respirator to a specific individual, typically estimating the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

- 2.16 **Fit test:** The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)
- 2.17 **Helmet:** A rigid respiratory inlet covering that also provides head protection against impact and penetration.
- 2.18 **HASP:** Health and Safety Plan
- 2.19 **Hazardous atmosphere:** Any atmosphere, either immediately or not immediately dangerous to life or health, that is oxygen-deficient or that contains a toxic or disease-producing contaminant exceeding the legally established permissible exposure limit (PEL) or, where applicable, the Threshold Limit Value (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH).
- 2.20 **High efficiency particulate air (HEPA) filter:** A filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.
- 2.21 **Hood:** A respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.
- 2.22 **Immediately dangerous to life or health (IDLH):** An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.
- 2.23 **Loose-fitting facepiece:** A respiratory inlet covering that is designed to form a partial seal with the face.
- 2.24 **Maximum use concentration (MUC):** The protection factor (PF) of an approved respirator assembly times the permissible exposure limit (PEL). $MUC = PF \times PEL$
- 2.25 **Negative pressure respirator (tight fitting):** A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.
- 2.26 **Oxygen deficient atmosphere:** An atmosphere with oxygen content below 19.5% by volume.
- 2.27 **Powered air-purifying respirator (PAPR):** A respirator that contains a blower that passes ambient air through an air-purifying component. Air-purifying respirators may be half-face (covering the nose and mouth) or full-face (covering the eyes, nose, and mouth).
- 2.28 **Physician or other licensed health care professional (PLHCP):** An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by paragraph (e) of this section.
- 2.29 **Positive pressure respirator:** A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.
- 2.30 **Powered air-purifying respirator (PAPR):** An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.
- 2.31 **Program administrator:** The individual that has the responsibility to verify full compliance with this SOP and determines the need for medical evaluations or any other additional medical attention in regards to the use of a respirator.
- 2.32 **Pressure demand respirator:** A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.
- 2.33 **Qualitative fit test (QLFT):** A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.
- 2.34 **Quantitative fit test (QNFT):** An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
- 2.35 **Respiratory inlet covering:** That portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.
- 2.36 **Self-contained breathing apparatus (SCBA):** An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

- 2.37 **Service life:** The period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.
- 2.38 **Supplied-air respirator (SAR) or airline respirator:** An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.
- 2.39 **Tight-fitting facepiece:** A respiratory inlet covering that forms a complete seal with the face.
- 2.40 **User seal check:** An action conducted by the respirator user to determine if the respirator is properly sealed to the face.

3.0 Attachments

- 3.1 S3NA-519-FM1 Respiratory Equipment Fit Test
- 3.2 S3NA-519-FM2 Respiratory Equipment Maintenance Log
- 3.3 S3NA-519-FM3 Respiratory Equipment Inspection
- 3.4 S3NA-519-WI1 Fit Testing Protocol
- 3.5 S3NA-519-WI2 User Seal Check Procedures
- 3.6 S3NA-519-WI3 Respirator Cleaning Procedures

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Program Administrator.** The AECOM Americas **SH&E Director** is the Respiratory Protection Program Administrator. The **Program Administrator** shall:
- Verify full compliance with this SOP.
 - Determine the need for medical evaluations or any other additional medical attention related to the use of a respirator.
 - Perform the program evaluations described in this SOP.
- 4.1.2 **District/office manager and project manager (including Operations Field Manager, supervisors, etc)** shall:
- Verify compliance with the respiratory protection program set forth in this procedure.
 - Verify that only those employees who are medically qualified, properly trained, and fit tested are assigned to respirator work.
 - Verify that respirators are provided, repaired, or replaced as may be required due to wear and deterioration.
- 4.1.3 **Region SH&E Manager** shall:
- Monitor compliance with the various aspects of this program.
 - Provide technical assistance regarding respirator selection and use, evaluate the effectiveness of this program, and support respirator training and fit testing.
 - Audit company compliance with this procedure.
- 4.1.4 **Employees** shall:
- Will use the provided respiratory protection in accordance with instructions and training received.
 - Will guard against damage to the respirator.
 - Will report immediately any malfunction of the respirator to the supervisor or other responsible person.

4.2 Medical Surveillance

No employee shall be assigned to a task that requires the use of a respirator unless it has been determined that he/she is physically able to perform the work while using the required respirator.

- 4.2.1 Prior to wearing a respirator, **employees** will complete an initial baseline medical surveillance examination performed by a PLHCP in accordance with the requirements of the Medical Surveillance Program (*S3NA-605- PR Medical Surveillance Program*).
- 4.2.2 **Employees** who continue to use respiratory protection will receive an annual medical surveillance examination.
- 4.2.3 Additional medical examinations will be provided to employees who wear respirators if/when:
- An **employee** reports medical signs or symptoms that are related to ability to use a respirator;
 - A PLHCP, supervisor, or the respirator program administrator determines that an employee needs to be reevaluated;
 - Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or
 - A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature, etc.) that may result in a substantial increase in the physiological burden placed on an employee.
- 4.2.4 All medical surveillance examinations shall occur during normal working hours; shall be convenient, understandable, and confidential; and the employee will be given chance to discuss results with examining physician.
- 4.3 Training**
- 4.3.1 Project staff that may be exposed to the hazard will be oriented to the hazard and the controls prior to beginning work.
- 4.3.2 Atmospheric testing will be carried out by someone trained in the use, calibration, and interpretation of the test equipment.
- 4.3.3 **Employees** who may be required to use a breathing apparatus shall be properly trained in the operation, maintenance, cleaning and storage of the apparatus.
- 4.3.4 All staff will receive an orientation to the hazards on the job site as well as initial Field Safety training which outlines appropriate PPE requirements.
- 4.3.5 **Employees** who wear respiratory protection must receive training before they are assigned to a task that requires the use of respiratory protection.
- 4.3.6 Retraining shall be administered annually, and when the following situations occur:
- Changes in the workplace or the type of respirator render previous training obsolete;
 - Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or
 - Any other situation arises in which retraining appears necessary to verify safe respirator use.
- 4.3.7 Frequency of Training
- All employees who may have the need to wear respiratory protection are required to participate in AECOM's internal SH&E training program.
 - In addition, AECOM's SH&E Department will conduct respirator training classes, as necessary, for those who may need to wear respiratory protection but did not participate in AECOM's HAZWOPER training classes.
- 4.3.8 Basic Respirator Training Program
- Respirator training classes will include, at a minimum, the following:
- Instruction in the nature of the respiratory hazards, whether acute, chronic, or both, and a description of potential health effects if the respirators are not used.

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator.
- The limitations and capabilities of the respirator.
- Proper fitting, including demonstrations and practice in wearing, adjusting, determining the fit of, and performing a user seal check (in accordance with *S3NA-519-WI1 Fit Testing Protocol*) each time respirator is donned.
- How to inspect, put on, use and remove the respirator.
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions.
- The procedures for maintenance and storage of the respirator.
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.
- The general requirements of the OSHA and OH&S Respiratory Protection Standard.

4.4 **Respirator Selection**

- 4.4.1 AECOM will maintain air purifying respirators and cartridges from at least two providers (i.e. MSA and North).
- 4.4.2 Prior to fit testing, the employee shall be allowed to pick the most comfortable respirator from the brands offered.
- 4.4.3 The type of respirator most commonly used by AECOM staff is a cartridge type air purifying respirator (APR). Many different types of APRs exist, and field staff should always fit test an APR prior to use.

4.5 **Fit Testing Procedures**

- 4.5.1 A respirator that doesn't fit properly will not provide adequate protection.
- 4.5.2 Four types of tests can be used:
 - Positive Pressure Sealing Check: Close off the exhalation valve and exhale gently. The fit is satisfactory if a slight positive pressure can be built up inside the face piece for a full 10 seconds without detecting any outward leakage of air between the sealing surface of the face piece and the wearer's face.
 - Negative Pressure Sealing Check: Close off the inlet opening of the cartridges by covering them with the palm of the hands. Inhale gently and hold breath for at least 10 seconds. The face piece should collapse slightly with no detection of inward leakage of air into the face piece.
 - Isoamyl Acetate Test (banana oil test): A tube or bottle of banana oil is held in front of and around the mask. The fit is adequate if the wearer does not detect the odour of bananas. During the test, the wearer should be demonstrating movements that approximate a normal working situation, including deep breathing, side-to-side and up-and-down head movements, and talking.
 - Irritant Smoke Test (Stannic Chloride Test): The procedure is similar to that of the banana oil test except that an irritant smoke is used. The wearer of the mask will cough (involuntary reaction) if he/she detects the irritant smoke in the mask.
- 4.5.3 Fit Testing Frequency

Additional fit tests will be performed:

 - Whenever there is an indication that changes in the **employee's** physical condition might have an effect on respirator fit. (Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.)
 - Whenever there is an indication that changes in the **employee's** physical condition might have an effect on respirator fit. (Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.)
 - If the **employee** notifies his/her supervisor or Regional SH&E Manager that the fit of his/her respirator is unacceptable.

4.5.4 Fit Testing Records

A written record of each fit test performed must be maintained in the **employee's** health and safety records. *S3NA-519-FM1 Respiratory Equipment Fit Test* will be used to document each fit test.

4.6 Interference with Gas-Tight Seal

Respiratory protection can only be worn when it can be determined that there is no obstruction of contact between the wearer's skin and the sealing surfaces of the mask whatsoever. Such obstruction can include facial hair, head hair, and the temple bars of eye glasses.

4.6.1 Respirator wearers cannot be afforded protection from hazardous airborne contaminants when conditions prevent a complete gas-tight face seal.

4.6.2 Although eyeglass temple bars will interfere with the formation of a gas-tight face seal in the case of full-face respirators, this problem is correctable by use of internally mounted spectacle kits. Management and supervisors shall verify that **employees** under their supervision who regularly wear eyeglasses, and who will require the use of a full-face respirator, are provided with appropriate spectacle kits at company expense.

The use of contact lenses in hazardous atmospheres or in operations involving intense heat, molten metals or the potential for chemical splash shall be prohibited.

4.6.3 Because facial hair (even beard stubble) will interfere with a gas-tight seal, employees shall be required to be clean-shaven whenever the use of respiratory protection is specified.

4.6.4 Respiratory Protection will only be assigned to those **employees** without physical obstructions to a gas-tight face seal to jobs that may require the use of respiratory protection. Candidates for employment shall be made aware that their versatility may be limited if they cannot wear a respirator and that this can affect their job assignments.

4.7 Specification of Proper Level of Respiratory Protection

4.7.1 The **Region SH&E Manager** or his/her designated and qualified representative is responsible for specifying the proper selection and use of all respiratory protective devices, including half-face and full-face air purifying respirators, airline respirators, and self-contained breathing apparatus. This information is generally specified as part of the written site-specific Health and Safety Plan (HASP).

4.7.2 **Employees** engaged in activities not covered by a HASP must consult with the **Region SH&E Manager** or his/her designated representative to determine the proper equipment prior to use. Whenever appropriate, exposure levels will be measured to verify that the actual use conditions are within the limitations of the approvals specified by NIOSH/MSHA for the selected respirator.

4.7.3 Conditions Required for Air-Purifying Respirator (APR) Use

Air-purifying respirators (APR) shall only be specified for use when it can be determined that the following conditions exist:

- The oxygen concentration is greater than 19.5%.
- The contaminant is known and its concentration can be quantified.
- The airborne contaminant concentration is below its IDLH.
- A canister or cartridge is available which is approved for the contaminant.
- The contaminant concentration is below the concentration for which the canister is approved.
- The contaminant concentration is below the Maximum Use Concentration (MUC) of the respirator.

In all cases where OSHA has specified that a particular respirator be used (asbestos, formaldehyde, benzene, arsenic, lead, etc.), that respirator, or one providing equal or better protection, shall be specified.

4.7.4 APR Filter and Chemical Cartridges

An adequate supply of the following cartridges shall be maintained in stock at each office location where respiratory protective equipment:

- High efficiency particulate air (HEPA) filter cartridges;
- Organic vapor cartridges; and
- Combination HEPA/acid gas/organic vapor cartridges

4.7.5 Change Out Schedule

Filter cartridges shall be changed out whenever an increase in breathing resistance is detected by the user.

When available, chemical cartridges that are equipped with end-of-service life indicators (ESLI) shall be utilized. In those cases, cartridges should be changed when indicated by the ESLI.

In the absence of cartridges equipped with an ESLI, employees shall change chemical cartridges on the following schedule:

- Immediately if breakthrough is perceived;
- In accordance with the change out schedule developed by the Regional SH&E Manager in the site-specific Health and Safety Plan (HASP); and
- After each day's use.

The change out schedule will be based upon the anticipated contaminant concentration, environmental conditions, employee work rate, and the specific data provided by manufacturer

When powered air-purifying respirators (PAPRs) are worn, the same rules apply with the exception that filter cartridges should be changed when airflow through the filter elements decreases to an unacceptable level, as indicated by the manufacturer's test device.

4.8 Air-Supplying Respirator Use

4.8.1 Conditions Requiring Use of Air-Supplying Respirators

Air-supplying respirators will be specified for use when it has been determined that any of the following conditions exist:

- The oxygen concentration is less than 19.5%;
- The contaminant is unknown or its concentration cannot be quantified;
- The airborne contaminant concentration is above its IDLH;
- An air-purifying respirator canister or cartridge that removes the contaminant is not available;
- The contaminant concentration is above the concentration for which an air-purifying canister or cartridge is approved; or
- The contaminant concentration is above the Maximum Use Concentration (MUC) of a full-face air-purifying respirator.

No employee may engage in an operation requiring the use of an air-supplied respirator unless a representative of the SH&E Department has reviewed the operation and approved its use.

The determination of the type of air-supplying respirator (i.e., SCBA, air-line, demand, pressure demand, etc.) which is appropriate for the job, outside standby persons, communication, proper training and equipment, notification procedures, and necessary action all require planning. Mandatory equipment including SCBA or SAR with auxiliary air supply & emergency appropriate retrieval equipment or equivalent rescue means will be made by the **Region SH&E Manager** or his/her designated representative at the time of review. The need for any additional precautions (i.e.,

equipment specific training, on-site H&S support, etc.) will also be determined by the **Region SH&E Manager**.

4.9 **Minimum Procedures for IDLH atmospheres**

- 4.9.1 One **employee** or, when needed, more than one employee shall be located outside the IDLH atmosphere. This employee shall be responsible for communicating with the **employees** in the IDLH atmosphere, alerting rescue services if needed, and restricting entrance to the IDLH area by untrained and unapproved persons.
- 4.9.2 Visual, voice, or signal line communication shall be maintained between the **employee(s)** in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.
- 4.9.3 The **employee(s)** located outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue or to initiate onsite rescue services.
- 4.9.4 If on-site rescue services are to be used, the **Site Safety Officer** shall confirm that the service is available to respond prior to any employees entering the IDLH area.
- 4.9.5 **Employee(s)** located outside the IDLH area and/or on-site rescue services shall be equipped with:
- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
 - Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
 - Equivalent means for rescue where retrieval equipment would create a hazard to the workers in the IDLH area.

4.10 **Breathing Air Quality**

Compressed air used for respiration shall be of high purity and shall meet, as a minimum, the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Specification G-7.1 (ANSI Z86.1).

Oxygen shall NOT be used as a source of breathing air at any time in open-circuit SCBAs or air-line respirators.

4.10.1 **Compressor Supplied Breathing Air**

All compressors used for filling SCBA air cylinders or for supplying air-line respirators shall be equipped with the following safety and standby devices:

- The compressor intake shall be located to verify that only respirable (uncontaminated) air is admitted. This requires attention to the location of the compressor intake with respect to compressor engine exhaust, chemical storage or use areas, and suitable intake screening or filtration.
- Alarms to indicate compressor failure (such as low-pressure air horns, etc.) shall be installed in the system.
- A receiver of sufficient capacity to enable the respirator wearer to exit from a contaminated atmosphere shall be provided.

If an oil-lubricated compressor is used to supply breathing air, it shall be equipped with both of the following devices:

- A continuous reading carbon monoxide monitoring system set to alarm should the carbon monoxide concentration exceed 10 ppm; and,
- A high temperature alarm which will activate when the discharge air exceeds 110% of the normal operating temperature in degrees Fahrenheit.

An in-line purifying filter assembly to remove oil, condensed water, particulates, odors, and organic vapors shall be used in conjunction with the air compressor.

Routine inspection and maintenance of air compressor shall be performed.

4.10.2 Compressed Air Cylinders

Breathing air cylinders shall be legibly identified with the word AIR by means of stenciling, stamping, or labeling as near to the valve end as practical.

Cylinders shall be stored and handled to prevent damage to the cylinder or valve.

Cylinders shall be stored upright with the protective valve cover in place and, in such a way (e.g. supported with substantial rope or chain in the upper one third of the cylinder, or in racks designed for this purpose) as to prevent the cylinder from falling.

Cylinders shall not be dropped, dragged, rolled, or allowed to strike each other or to be struck violently. Cylinders shall never be exposed to temperatures exceeding 125° F. Cylinders with visible external damage, evidence of corrosion damage, or exposure to fire shall not be accepted or used.

Only cylinders within current hydrostatic test periods shall be used. Steel cylinders must be hydrostatically tested every five years and fiberglass wrapped aluminum cylinders must be tested every three years.

4.10.3 Compressed Air Cylinder Systems for Air-Line Respirators

Compressed air cylinder systems used to supply air-line respirators shall be equipped with low pressure warning bells (e.g., Scott Pak-Alarm) or similar warning devices to indicate air pressure in the manifold below 500 psi. When such systems are used, one employee shall be assigned as safety standby within audible range of the low pressure alarm.

Air-line hose couplings shall be incompatible with outlets for other gas systems to prevent inadvertently supplying air-line respirators with nonrespirable gases or oxygen.

The air pressure at the hose connection to air-line respiratory equipment shall be within the range specified in the approval of the equipment by the manufacturer.

4.10.4 Compressed Air Cylinder Systems for Recharging SCBAs

When a cascade system is used to recharge SCBA air cylinders, it shall be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3000 psi.

4.10.5 Escape/Egress Units

Escape/egress unit respirators are intended for use in areas where escape with a short-term (5 minutes) air supply is necessary.

They may be used as adjuncts to airline pressure demand respirators as a backup air supply or as independent emergency devices in areas where respiratory protection is not normally required.

Appropriate training shall be conducted and documented prior to assigning employees to tasks or locations subject to the use of these respirators.

Escape/egress units (5 minutes) shall never be used to enter a hazardous atmosphere or as primary standby respirators for confined space entry.

4.10.6 Respirator Inspection, Cleaning, Maintenance, and Storage

When respirator use is required, only properly cleaned and maintained NIOSH/MSHA approved respirators shall be used.

4.10.7 Inspection

- Respirators should be inspected before and after use. Those for emergency use should be inspected once per month.
- All connections, including gaskets, o-rings should be checked for damage and tightness.
- The face piece should be inspected for cracks and rubber or elastomer parts should be checked for deterioration and pliability.
- All respirators shall be inspected routinely by the user before, during, and after each use. Defects shall be reported to supervision. No defective respirator shall be issued or worn.

- Routinely used respiratory equipment shall be inspected by an individual qualified by experience or training to do the work.

4.10.8 Cleaning and Maintenance

- Respirator facepiece assemblies shall be cleaned and sanitized minimally after each day of use in accordance with the requirements specified in *S3NA-519-WI3 Respirator Cleaning Procedures*.
- Respiratory equipment shall not be passed from one person to another until it has been cleaned and sanitized.
- Respiratory equipment shall be maintained according to manufacturer's instructions.
- Where respirators are assigned to individual employees, management shall verify compliance with cleaning and maintenance requirements by periodic inspection and field audits of respiratory equipment.
- Respirators must be cleaned after each use and then placed into a clean bag for storage.
- Prior to cleaning, the filters, cartridges, or canisters must be removed and discarded.
- The respirator should then be inspected for any damaged parts (repair should only be done by trained personnel with the proper tools) and cleaned with a hot water/mild detergent solution.
- In field situations, a premoistened towelette (e.g., baby wipes) can be used. The mask should then be rinsed with clean warm water and dried.
- Alcohol should never be used to clean masks as it can damage the face pieces and rubber parts.

4.10.9 Storage

- Store clean respirators so that they are protected from dust, excessive moisture, damaging chemicals, temperature extremes and direct sunlight. They should be placed in a sealed plastic bag and stored in the original box.

When not in use, respirator facepieces shall be placed in clean Ziploc-style bags and stored to protect against dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals.

4.11 Hygiene

Employees must leave the work area to wash, change cartridges, or if they detect breakthrough or resistance.

4.12 Program Evaluation

4.12.1 The **Region SH&E Manager** will conduct evaluations of the workplace as necessary to verify that the provisions of the current written program are being effectively implemented and that it continues to be effective.

4.12.2 The **Region SH&E Manager** will regularly (i.e., during annual training) consult employees required to use respirators to assess their views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include but are not limited to:

- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the employee is exposed;
- Proper respirator use under the workplace conditions the employee encounters; and
- Proper respirator maintenance.

4.13 Costs

- 4.13.1 The costs for training, medical examinations, fit testing, respirators, and cleaning materials should be considered as operational costs for the respective AECOM business lines.

5.0 Records**5.1 Medical Records**

Medical records under this section will be maintained at a minimum in accordance with 29 CFR 1910.1020 – Access to Employee Exposure and Medical Records (*S3NA-604 Medical Records*).

5.2 Fit Test Records

Fit test records will include the name of the employee tested; the type of fit test performed; the specific style, make, model, and size of the respirator tested; the date of the test; and the pass/fail results for QLFTs or QNFT test documentation (i.e., strip charts).

5.3 Training Records

- Respiratory protection training records will be maintained by the employee with copies provided to their SH&E Coordinators or Administrators.
- On-site records of training and fit testing will be maintained as necessary.
- For situations where training is required by and provided by clients, copies of SH&E Records shall be maintained by AECOM.

6.0 References

- 6.1 The following standards apply to respiratory equipment:

Association	Standard
Canadian Standards Association (CSA)	Z180.1-00, Compressed Breathing Air and Systems Z94.4-02, Selection, Use and Care of Respirators
Department of Labor - Occupational Safety and Health Administration	29 Code of Federal Regulation 1910. 134 29 Code of Federal Regulation 1926.103

S3NA-519-FM1 Respiratory Equipment Fit Test

Date of Testing:		Respirator Type(s):	
Employee Name:		Location:	
Method & Testing Agent:			
Test Exercise	Pass / Fail	Test Exercise	Pass / Fail
Sensitivity Check		Normal Breathing	
Deep Breathing		Turning Head (side to side)	
Moving Head (up/down)		Rainbow Passage*	
Bending Over		Normal Breathing	
Successful Respirator Fit Determined: ☐ Yes ☐ No			
I certify that I have been tested with the respirator(s) listed above. I have also had the opportunity to ask questions and those questions have been answered to my satisfaction. I also understand that the above fit test is voided if respirator limitations are not followed or the respirator is not worn or if conditions (e.g., facial hair) prevent a good face seal.			
Employee Signature:		Date:	
Signature of Tester:		Date:	

***Rainbow Passage.** "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."

Date:	MSA Comfo II HM	MSA Ultra Twin FM	North 7700 HM	North 7600 FM	HM	FM
Tester:	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐	S ☐ M/L ☐	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐
Qualitative Test Agent(s): IAA ☐ Smoke ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐
Quantitative Test Device	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor

Date:	MSA Comfo II HM	MSA Ultra Twin FM	North 7700 HM	North 7600 FM	HM	FM
Tester:	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐	S ☐ M/L ☐	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐
Qualitative Test Agent(s): IAA ☐ Smoke ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐
Quantitative Test Device	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor

Date:	MSA Comfo II HM	MSA Ultra Twin FM	North 7700 HM	North 7600 FM	HM	FM
Tester:	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐	S ☐ M/L ☐	S ☐ M ☐ L ☐	S ☐ M ☐ L ☐
Qualitative Test Agent(s): IAA ☐ Smoke ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐	Pass ☐ Fail ☐
Quantitative Test Device	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor	Overall Fit Factor

Instructions

1. Complete the employee information at the top of the record (one record per employee).
2. Enter the date of the test and the name of the person conducting the fit test.
3. Circle the brand and model of respirator tested (e.g., MSA Comfo II, North 7700, etc.) or enter another brand and model in one of the last two columns.
4. Circle the size of the respirator tested.
5. For qualitative fit tests, circle the test agent used - IAA = Isoamyl Acetate, Smoke = Irritant Smoke (Stannic Chloride) and the outcome of the test (i.e., Pass or Fail).
6. For quantitative fit tests, enter the name of the instrument used and the overall fit factor measured by the test.
7. Keep a copy in the employee's training files and enter subsequent (e.g., annual) tests until the record is filled.

[illegible]

S3NA-519-FM3 Respiratory Equipment Inspection

Date:		Inspected by:		
Air Purifier Unit #:				
		N/A	Pass	Fail
Examine Face Piece for:				
Excessive dirt		☐	☐	☐
Cracks, tears, holes, or distortion from improper storage		☐	☐	☐
Inflexibility (stretch and massage to restore flexibility)		☐	☐	☐
Cracked or badly scratched lenses in full face pieces		☐	☐	☐
Incorrectly mounted full-face piece lens or broken or missing mounting clips		☐	☐	☐
Lens sealed properly in receptacle, retaining clamp secured		☐	☐	☐
Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s) (if appropriate)		☐	☐	☐
Examine the Head Straps or Head Harness for:				
Breaks		☐	☐	☐
Loss of elasticity		☐	☐	☐
Broken or malfunctioning buckles and attachments		☐	☐	☐
Excessively worn serrations on the head harness that might permit slippage (full face pieces only)		☐	☐	☐
Tears in headband at cradle attachment		☐	☐	☐
Examine the Inhalation and Exhalation Valves for:				
Foreign material, such as detergent residue, dust particles, or human hair under the valve seat		☐	☐	☐
Cracks, tears, or distortion in the valve material		☐	☐	☐
Improper insertion of the valve body in the face piece		☐	☐	☐
Cracks, breaks, or chips in the valve body, particularly in the sealing surface		☐	☐	☐
Missing or defective valve cover		☐	☐	☐
Examine the Air Purifying Elements for:				
Incorrect cartridge, canister, or filter for the hazard		☐	☐	☐
Incorrect installation, loose connection, missing or worn gaskets, or cross-threading in the holder		☐	☐	☐
Expired shelf life date on cartridge or canister		☐	☐	☐
Defects Noted:				
Unit Deemed Suitable for Use		☐ Yes		☐ No

S3NA-519-WI1 Fit Testing Protocol

1.0 Selection

- 1.1 The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
- 1.2 Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension, and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.
- 1.3 The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape and if fitted and used properly will provide adequate protection.

2.0 Comfort

- 2.1 The test subject shall be instructed to hold each chosen face piece up to the face and to eliminate those that obviously do not give an acceptable fit.
- 2.2 The more acceptable face pieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort.
- 2.3 If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.
- 2.4 Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:
 - Position of the mask on the nose
 - Room for eye protection
 - Room to talk
 - Position of mask on face and cheeks

3.0 Fit Test Criteria

- 3.1 The following criteria shall be used to help determine the adequacy of the respirator fit:
 - Chin properly placed;
 - Adequate strap tension, not overly tightened;
 - Fit across nose bridge;
 - Respirator of proper size to span distance from nose to chin;
 - Tendency of respirator to slip;
 - Self-observation in mirror to evaluate fit and respirator position.
- 3.2 The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in *S3NA-519-WI2 User Seal Check Procedures* or those recommended by the respirator manufacturer that provide equivalent protection to the procedures in *S3NA-519-WI2 User Seal Check Procedures*.
- 3.3 Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side to side and up and down slowly while taking in a few slow deep breaths. Another face piece shall be selected and retested if the test subject fails the user seal check tests.
- 3.4 The test shall not be conducted if there is any hair growth between the skin and the face piece sealing surface, such as stubble beard growth, beard, mustache, or sideburns that cross the

respirator sealing surface. Any type of apparel that interferes with a satisfactory fit shall be altered or removed.

- 3.5 If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.
- 3.6 If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.

4.0 Exercise Regimen

- 4.1 Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.
- 4.2 The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use and that could interfere with respirator fit.

5.0 General Test Exercises

- 5.1 The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP protocol. The test subject shall perform exercises, in the test environment, in the following manner:
- 5.1.1 **Normal breathing.** In a normal standing position, without talking, the subject shall breathe normally.
- 5.1.2 **Deep breathing.** In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.
- 5.1.3 **Turning head side to side.** Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.
- 5.1.4 **Moving head up and down.** Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).
- 5.1.5 **Talking.** The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.
- 5.1.6 **Rainbow Passage.** "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."
- 5.1.7 **Grimace.** The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT.)
- 5.1.8 **Bending over.** The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.
- 5.1.9 **Normal breathing.** In a normal standing position, without talking, the subject shall breathe normally (this is the same as the first test).
- 5.2 Each test exercise shall be performed for one minute except for the grimace exercise, which shall be performed for 15 seconds.
- 5.3 The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.
- 5.4 The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test and the fit test must be repeated.

6.0 Qualitative Fit Test (QLFT) Protocols

6.1 General

6.1.1 AECOM will ensure that persons administering QLFT are able to calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

6.1.2 AECOM will ensure that that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

6.2 Irritant Smoke (Stannic Chloride) Protocol

6.2.1 This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

6.2.2 General Requirements and Precautions:

- The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).
- Only stannic chloride smoke tubes shall be used for this protocol.
- No form of test enclosure or hood for the test subject shall be used.
- The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.
- The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

6.2.3 Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

- The test operator shall break both ends of a ventilation smoke tube containing stannic chloride and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute or to an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.
- The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.
- The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

6.2.4 Irritant Smoke Fit Test Procedure

- The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).
- The test subject shall be instructed to keep his/her eyes closed.
- The test operator shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the face piece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

- If the person being tested has not had an involuntary response and/or has not detected the irritant smoke, proceed with the test exercises.
- The General Test Exercises (Section 5.0) shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.
- If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.
- Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.
- If a response is produced during this second sensitivity check, then the fit test is passed.

7.0 Quantitative Fit Test (QNFT) Protocols

7.1 General

- AECOM will confirm that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly, and ensure that test equipment is in proper working order.
- AECOM will ensure that QNFT equipment is kept clean and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

7.2 Ambient Aerosol Condensation Nuclei Counter (CNC) Quantitative Fit Testing Protocol

7.2.1 The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount TM) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device installed on the respirator to allow the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator, and a minimum fit factor pass level of at least 500 is required for a full face piece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

7.2.2 Portacount Fit Test Requirements

- Check the respirator to make sure the sampling probe and line are properly attached to the face piece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) according to the manufacturer's instructions.
- Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.
- Check the following conditions for the adequacy of the respirator fit: chin properly placed; adequate strap tension, not overly tightened; fit across nose bridge; respirator of proper size to span distance from nose to chin; tendency of the respirator to slip; self-observation in a mirror to evaluate fit and respirator position.
- Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting face piece, try another size of the same model respirator, or another model of respirator.
- Follow the manufacturer's instructions for operating the Portacount and proceed with the test.
- The test subject shall be instructed to perform the exercises in General Test Exercises (Section 5.0).

- After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

7.2.3 **Portacount Test Instrument**

- The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.
- Since the pass or fail criterion of the Portacount is user programmable, the test operator shall confirm that the pass or fail criterion meet the requirements for minimum respirator performance.
- A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

S3NA-519-WI2 User Seal Check Procedures

1.0 Requirements

- 1.1 The individual who uses a tight-fitting respirator is to perform a user seal check to confirm that an adequate seal is achieved each time the respirator is put on.
- 1.2 Either the positive and negative pressure checks listed here or the respirator manufacturer's recommended user seal check method shall be used.
- 1.3 User seal checks are not substitutes for qualitative or quantitative fit tests.

2.0 Facepiece Positive and/or Negative Pressure Checks

2.1 Positive pressure check

- 2.1.1 Close off the exhalation valve and exhale gently into the facepiece.
- 2.1.2 The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal.
- 2.1.3 For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

2.2 Negative pressure check

- 2.2.1 Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold your breath for 10 seconds.
- 2.2.2 The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand.
- 2.2.3 The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove.
- 2.2.4 If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

3.0 Manufacturer's Recommended User Seal Check Procedures

- 3.1 The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures, provided that the employer demonstrates that the manufacturer's procedures are equally effective.

S3NA-519-WI3 Respirator Cleaning Procedures

1.0 Requirements

- 1.1 These procedures are general in nature. The cleaning recommendations provided by the manufacturer may be used for the respirators used by their employees, provided such procedures are as effective as those listed here.
- 1.2 Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth (i.e., confirm that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user).

2.0 Procedures for Cleaning Respirators

- 2.1 Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
- 2.2 Wash components in warm (43°C [110°F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
- 2.3 Rinse components thoroughly in clean, warm (43°C [110°F] maximum), preferably running water. Drain.
- 2.4 When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
- Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43°C (110°F); or,
 - Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43°C (110°F); or,
 - Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.
- 2.5 Rinse components thoroughly in clean, warm (43°C [110°F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
- 2.6 Components should be hand dried with a clean, lint-free cloth or air-dried.
- 2.7 Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.
- 2.8 Test the respirator to ensure that all components work properly.
- 2.9 After the fit test, wipe down the respirator with a sanitary swab.

S3NA-520-PR Spill Response, Incidental

1.0 Purpose and Scope

- 1.1 This procedure defines the role of AECOM employees in the event of a chemical spill in AECOM offices, laboratories, or storage areas and during field investigations, including the appropriate containment procedures that AECOM employees will follow.
- 1.2 This procedure applies to all AECOM North America-based employees and operations.

2.0 Terms and Definitions

- 2.1 **Emergency Response:** A response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence that results, or is likely to result, in an uncontrolled release of a hazardous substance or whenever a release requires that a federal or state agency be notified, such as:
 - 2.1.1 A release at or above a reportable quantity (RQ) of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance (40 CFR 302.8) is required to be reported to the National Response Center (NRC).
 - 2.1.2 A hazardous chemical release at or above an RQ under the Emergency Planning and Community Right-to-Know Act (EPCRA) (Title III under the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 350-372) is required to be reported to state and local officials.
 - 2.1.3 A release in violation of a facilities Spill Prevention, Control, and Countermeasure (SPCC) Plan (40 CFR 112).
- 2.2 **Incidental Releases:** A response to a spill or release of a hazardous substance (in quantities below its RQ) where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area using equipment and materials available to them at the time or the spill or release. Any spill or release that cannot be managed with the personnel, materials, and equipment at the site shall be considered an Emergency Response.
 - 2.2.1 Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses. Handling of incidental releases shall be in accordance with applicable standard operating procedures.

3.0 Attachments

- 3.1 None

4.0 Procedure

4.1 Roles and Responsibilities

- 4.1.1 **Supervisor/Project Manager** shall become the individual in charge at the incident until relieved by more qualified personnel. All AECOM emergency responders and their communications shall be coordinated and controlled through this individual. The individual in charge shall implement the Incident Command System (ICS) and shall be responsible for the following tasks:
 - Designate a safety officer who is knowledgeable about the operations being implemented at the emergency response site and who will have specific responsibility to identify and evaluate hazards and to provide direction on the safety of operations for the emergency at hand. If the safety officer judges activities to be an Immediately Dangerous to Life or Health (IDLH) and/or to involve an imminent danger condition, the safety officer shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.

- Identify all hazardous substances or conditions present and address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance, and handling procedures.
- Implement appropriate emergency operations.
- Limit the number of emergency response personnel at the emergency site.
- Implement the buddy system in groups of two or more.
- Provide standby, backup personnel with equipment ready to provide assistance or rescue. Qualified basic life support personnel, as a minimum, shall also be standing by with medical equipment and transportation as necessary.
- Verify that personal protective equipment (PPE) meets, at a minimum; the criteria contained in 29 CFR 1910.156(e) when worn while performing firefighting operations beyond the incipient stage for any incident.
- Determine if employees, who are engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard, wear positive pressure self-contained breathing apparatus, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection is appropriate.
- When deemed necessary for meeting the tasks at hand, an approved, self-contained, compressed air breathing apparatus may be used with approved cylinders from other approved, self-contained, compressed air breathing apparatuses provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatuses shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.
- Ensure that the PPE worn is appropriate for the hazards to be encountered.
- Implement appropriate decontamination procedures after emergency operations have terminated.
- Responsibility for the emergency response shall be transferred upon arrival of a more qualified AECOM Incident Commander or a Public Service Incident Commander.

4.1.2 Region Safety, Health and Environmental Manager is responsible for the following:

- Provide technical assistance to the Incident Commander regarding the correct way to respond to the spill.
- Decide whether AECOM or an outside emergency response company will clean up the spill.
- Prepare project-specific Spill Response Plans when required.
- Report spills, as necessary, to state/provincial environmental agencies.
- Review the incident report and facilitate the post-response discussion.
- Review and revise this SOP as necessary based on recommendations from post-response discussions.

4.1.3 AECOM Employees are responsible for the following:

- Follow precautions and safe handling practices to avoid spills.
- Alert Supervisor/Project Manager to any deteriorating hazardous materials containers within the office or project area.
- Report all spills and leaks to the Supervisor/Project Manager immediately.
- Secure the spill area as quickly as possible and prevent the migration of exterior spilled materials or substances to drains or other openings.

4.1.4 First Responder Awareness Level are those employees who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response by notifying the proper authorities of the release. They take no further action beyond notifying the authorities of the release.

4.1.5 First responders at the awareness level shall have sufficient training or experience to demonstrate competency in the following areas:

- An understanding of what hazardous substances are and the risks associated with them in an incident.
- An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.
- The ability to recognize the presence of hazardous substances in an emergency.
- The ability to identify the hazardous substances, if possible.
- An understanding of the role of the first responder awareness individual in the employer's emergency response plan, including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.
- The ability to realize the need for additional resources and to make appropriate notifications to the communication center.

4.1.6 **First Responder Operations Level** are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures.

First responders at the operational level shall receive at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level:

- Knowledge of the basic hazard and risk assessment techniques.
- Know how to select and use proper PPE provided to the first responder operational level.
- An understanding of basic hazardous materials terms.
- Know how to perform basic control, containment, and/or confinement operations within the capabilities of the resources and PPE available with their unit.
- Know how to implement basic decontamination procedures.
- An understanding of the relevant standard operating procedures and termination procedures.

4.1.7 **Hazardous Materials Technicians** are employees who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch, or otherwise stop the release of a hazardous substance.

Hazardous materials technicians shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas:

- Know how to implement the employer's emergency response plan.
- Know the classification, identification, and verification of known and unknown materials by using field survey instruments and equipment.
- Be able to function within an assigned role in the Incident Command System.
- Know how to select and use proper specialized chemical PPE provided to the hazardous materials technician.
- Understand hazard and risk assessment techniques.
- Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and PPE available with the unit.
- Understand and implement decontamination procedures.
- Understand termination procedures.
- Understand basic chemical and toxicological terminology and behavior.

4.1.8 **Hazardous Materials Specialists** are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician; however, those

duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with federal, state, local, and other government authorities.

- 4.1.9 Hazardous materials specialists shall receive at least 24 hours of training equal to the technician level and in addition have competency in the following areas:
- Know how to implement the local emergency response plan.
 - Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment.
 - Know the state emergency response plan.
 - Be able to select and use proper specialized chemical PPE provided to the hazardous materials specialist.
 - Understand in-depth hazard and risk techniques.
 - Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and PPE available.
 - Be able to determine and implement decontamination procedures.
 - Have the ability to develop a site safety and control plan.
 - Understand chemical, radiological, and toxicological terminology and behavior.
- 4.1.10 **On Scene Incident Commander**, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas:
- Know and be able to implement the employer's incident command system.
 - Know how to implement the employer's emergency response plan.
 - Know and understand the hazards and risks associated with employees working in chemical protective clothing.
 - Know how to implement the local emergency response plan.
 - Know the state emergency response plan and of the Federal Regional Response Team.
 - Know and understand the importance of decontamination procedures.
- 4.1.11 **Skilled Support Personnel** who are skilled in the operation of certain equipment (such as mechanized earth moving or digging equipment or crane and hoisting equipment), who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by AECOM's employees, and who will be or may be exposed to the hazards at an emergency response scene are not required to meet the training required. However, these Skilled Support Personnel shall be provided an initial briefing at the site prior to their participation in the emergency response. At a minimum, the initial briefing shall include instruction in the wearing of appropriate PPE, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to AECOM's own employees shall also be provided to any Skilled Support Personnel.
- 4.1.12 **Specialist Employees** are AECOM employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge shall receive training or demonstrate competency in the area of their specialization annually.
- 4.2 **Emergency Response Plan**
- 4.2.1 An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to performing emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, and OSHA personnel. The plan shall be reviewed and approved by the Regional SH&E Manager prior to issue.
- 4.2.2 If contract does not require AECOM to provide emergency response services, then AECOM'S SH&E Procedures *S3NA-101-PR Emergency Response Planning, Offices* and *S3NA-203-PR Emergency*

Response Planning, Field shall apply and employees shall evacuate from the danger area whenever an emergency occurs.

4.2.3 Upon completion of the emergency response, all followup remediation work shall be done in accordance with AECOM SH&E Procedure *S3NA-509-PR Hazardous Waste Operations and Emergency Response*.

4.2.4 At a minimum, the emergency response plan shall address the following:

- Pre-emergency planning and coordination with outside parties
- Personnel roles, lines of authority, training, and communication
- Emergency recognition and prevention
- Safe distances and places of refuge
- Site security and control
- Evacuation routes and procedures
- Decontamination
- Emergency medical treatment and first aid
- Emergency alerting and response procedures
- Critique of response and follow-up
- PPE and emergency equipment

4.2.5 (Note: Local and state emergency response plans may need to be review and incorporated into the plan.)

4.3 **Training**

4.3.1 Training for responders shall be provided by AECOM's Regional SH&E Manager or by individuals who have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach. Employees who receive responder training shall also receive annual refresher training if their responding responsibilities continue.

4.3.2 Employees receiving initial and refresher responder training shall be issued a certificate indicating training competency. Copies of all training records shall be maintained by the Site Safety Officer.

4.4 **Medical Surveillance**

4.4.1 All employees participating in an emergency response shall participate in AECOM'S *S3NA-605-PR Medical Surveillance Program*.

4.5 **Chemical Protective Clothing**

4.5.1 Chemical protective clothing shall be worn in accordance with AECOM'S *S3NA-208-PR Personal Protective Equipment Program*.

4.6 **Spill Response Equipment**

4.6.1 All AECOM offices that store chemicals at their facility shall have the appropriate spill response equipment. Such equipment may include the following:

- Overpack containers of varying capacities
- Absorbent material such as vermiculite or commercially prepared, absorbent containing pillows, rolls, sheets, or booms
- Acid and base neutralizing agents
- Chemically resistant gloves for solvents, alcohols, and acids
- Polycoated Tyvek coveralls
- Safety goggles
- Respiratory protection

4.6.2 Spill response equipment shall be placed adjacent to areas where chemicals are routinely handled, stored, and/or where shipments are received. Similar types of spill response equipment shall also be

available in any AECOM vehicle or rented vehicle in which chemicals are being transported. Access to the spill response equipment shall be designed to avoid likely spill locations.

4.7 Spill Response Equipment for Field Programs

- 4.7.1 The amount of chemicals being used during a field program will dictate the types and quantity of spill response equipment that is brought to the site. If several squirt bottles of decontamination solutions are all that is being brought to a site, a few spill pillows and a one-gallon bucket may be sufficient to respond to a spill of these materials. If gallons of chemicals are being delivered to the site in drums or bulk tanks, a greater variety of spill response equipment will be needed. As indicated previously, during these types of field programs, a separate spill plan will be incorporated into the project health and safety plan (HASP) and will provide a greater level of detail regarding the specific spill response effort for that field program.

4.8 Immediate Response

- 4.8.1 Evacuate all personnel that will not be involved in the clean up from the immediate area of the spill or release.
- 4.8.2 Take all reasonable measures to confine, repair, and remedy the effects of the spill; cleanup must be done by knowledgeable personnel and is in accordance with the product label and MSDS.
- 4.8.3 Use the appropriate equipment and PPE so that you do not expose yourself to any chemicals or hazardous substances.
- 4.8.4 Clean up teams shall be organized outside the spill area and re-enter for cleanup activities.
- 4.8.5 If it is not practicable to maintain the airborne concentration of a flammable gas or vapour below the applicable exposure limit, for example, in a temporary situation or an emergency,
- Only the minimum number of workers necessary for the work may be exposed,
 - Every worker exposed must be adequately trained and equipped to safely perform the required duties,
 - The concentration of the flammable gas or vapor must not exceed 20% of the lower explosive limit (LEL), and
 - In a life-threatening emergency only, exposure of emergency response workers is permitted above 20% of the LEL, provided that only those qualified and properly trained and equipped workers necessary to correct the unsafe condition are exposed to the hazard and every possible effort is made to control the hazard while this is being done.

4.9 First Aid

- 4.9.1 In the event of an incident, refer to the MSDS labels to ensure proper first aid is administered for the hazardous material and call the nearest Poison Centre or 911.
- 4.9.2 The American National Standards Institute (ANSI) Standard for Emergency Eyewash and Shower Equipment (ANSI Z358.1-1998) recommends that the affected body part must be flushed immediately and thoroughly for at least 15 minutes using a large supply of clean fluid under low pressure. However, other references recommend a minimum 20-minute flushing period if the nature of the contaminant is not known. The flushing or rinsing time can be modified if the identity and properties of the chemical are known. For example, at least
- 5 minutes flushing time for mild irritants.
 - 20 minutes for moderate to severe irritants.
 - 20 minutes for nonpenetrating corrosives.
 - 60 minutes for penetrating corrosives.
 - If irritation persists, repeat the flushing procedure.
- 4.9.3 It is important to note that ingestion of any chemical is not likely to occur in the workplace. If ingestion does occur, evidence indicates that inducing vomiting is not necessary in most situations where there has been an occupational chemical ingestion. Induction of vomiting should only be recommended if the chemical has very high, short-term (acute) toxicity, and medical follow-up is not readily available. In these cases, first aiders should receive special training on how to safely and effectively induce vomiting in the appropriate circumstances.
- 4.9.4 In the unlikely event that there is an on-site release of a hazardous substance (e.g., H₂S):

- Get out of the area (in an upwind direction).
- Sound an alarm.
- Assess situation.
- Put on a breathing apparatus.
- Rescue victim(s).
- Revive victim(s).
- Get medical aid.

4.10 Reporting

- 4.10.1 Should there be a spill or leak involving a hazardous product, employees shall immediately notify the Supervisor and SH&E Incident Reporting Line.
- 4.10.2 "Dangerous occurrences" must be reported immediately to the police, employer, vehicle owner/lesser and the dangerous goods owner. Such events would include spills, bulk container damage, fire, explosion, and transportation accidents involving dangerous goods.
- 4.10.3 Confirm and seek direction on external reporting requirements.
- A major release of a hazardous substance must be reported to the appropriate provincial or territorial governing body for Occupational Health and Safety.
 - All spills and releases must be reported to the governing regulatory body. Each jurisdiction has regulations governing the minimum quantities for reporting based on the type of product spilled or released.
- 4.10.4 If you have knowledge of spill, release, or unlawful discharge, notify authorities immediately. Reporting does not imply guilt or assign blame. You will need to report the following details.
- Location and time of spill.
 - Description of circumstances leading to spill.
 - Type and quantity of material or substance spilled.
 - Details of any action taken at the site of the spill.
 - Description of location of spill and immediately surrounding the area.
 - Any additional information in respect of the spill that the Minister, environmental protection officer or person designated by regulations requires.

5.0 Records

- 5.1 None

6.0 References

- 6.1 40 CFR 302.8
- 6.2 40 CFR 350-372
- 6.3 40 CFR 112
- 6.4 S3NA-101-PR Emergency Response Planning, Office
- 6.5 S3NA-203-PR Emergency Response Planning, Field
- 6.6 S3NA-208-PR Personal Protective Equipment Program
- 6.7 S3NA-509-PR Hazardous Waste Operations and Emergency Response
- 6.8 S3NA-605-PR Medical Surveillance Program

Jurisdiction	Name	Phone
Alberta	Environmental Service Response Centre	1-800-222-6514
British Columbia	Provincial Emergency Program	1-800-663-3456
Manitoba	Conservation Emergency Response Program	1-204-944-4888

New Brunswick	Canadian Coast Guard	1-800-565-1633
Newfoundland & Labrador	Canadian Coast Guard	1-800-563-9089
NWT & Nunavut	Spill Report Line	1-867-920-8130
Nova Scotia	Canadian Coast Guard	1-800-565-1633
Ontario	Spill Action Centre	1-800-268-6060
Prince Edward Island	Canadian Coast Guard	1-800-565-1633
Quebec	Environmental Emergency Response	1-866-694-5454
Saskatchewan	Spill Report Centre	1-800-667-7525
Yukon Territory	Spill Report Centre	1-867-667-7244

Appendix G

Material Safety Data Sheets

Wastewater Treatment Plant

	Reagent	Delivery details	Supplier	Quantity required for treatment duration	Storage specifications	Containment area specifications
AECOM	93% Sulfuric Acid	Tanker	ChemTreat, Inc.	2,500 gal	2,500 gal bulk storage tanks in well ventilated area	yes
	50% Sodium Hydroxide	Tanker	ChemTreat, Inc.	2,500 gal	2,500 gal Store in cool, dry, well ventilated area	yes
	Sodium Bisulfate	Tanker	ChemTreat, Inc.	4,200 gal	4,200 gal Avoid freezing	yes
	Aluminum Chlorohydrate	Tanker	ChemTreat, Inc.	3,500 gal	3,500 gal Protect from heat and sources of ignition	yes

	MSDS Instructions			
	Storage & Handling	Spill	Incompatible Materials	Source
93% Sulfuric Acid	Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F). Protect against physical damage and water. Wear full protective rubber clothing and rubber gloves and boots, acid hood, and full face shield when loading or unloading tank trucks or railway cars.	Treat with extreme caution. Zone off contaminated area. Dike area with sand or earth. Acid may be neutralized with soda ash or lime. Neutralization or dilution of strong Sulfuric Acid will ALWAYS be accompanied by a very strong chemical reaction with release of heat and possible splattering of the acid. Organic or combustible materials such as sawdust or rags should never be used to soak up spills. Wear full protective clothing (acid protective slicker suit).	Water and most common metals, organic materials, carbides, chlorates, fulminates, nitrates, picrates, powdered metals, other combustible materials and strong oxidizing agents. Attacks many metals, releasing hydrogen. Acetic acid, acetone cyanohydrin, acetone and nitric acid and styrene monomer, vinyl acetate, nitric acid and toluene.	ChemTreat, Inc.
50% Sodium Hydroxide	Store in a cool, dry, well-ventilated area. Keep containers tightly closed when not in use and when empty. Protect from damage. Use corrosion-resistant structural materials and lighting and ventilation systems in the storage area. Containers made of nickel alloys are preferred. Steel containers are acceptable if temperatures are not elevated. Plastics or plastic-lined steel, or FRP tanks of Derakane vinyl ester resin may be suitable. Container contents may develop pressure after prolonged storage. Drums may need to be vented. Only trained personnel should perform venting.	Restrict access to area until completion of clean up. Ensure trained personnel conduct clean up. Ventilate area. Wear adequate personal protective equipment. Do not touch spilled material. Prevent entry into sewers or waterways. Land spill of sodium hydroxide: Solutions should be contained by diking with inert material, such as sand or earth. Solutions can be recovered or carefully diluted with water and cautiously neutralized with acids such as acetic acid or hydrochloric acid.	Sodium hydroxide reacts vigorously, violently or explosively with many organic and inorganic chemicals, such as strong acids, nitroaromatic, nitroparaffin and organohalogen compounds, glycols and organic peroxides. Reacts violently with water generating significant heat. Violently polymerizes acetaldehyde, acrolein or acrylonitrile. Produces flammable and explosive hydrogen gas if it reacts with sodium tetrahydroborate or certain metals. Can form spontaneously flammable chemicals upon contact with 1,2-dichloroethylene, trichloroethylene or tetrachloroethane. Can produce carbon monoxide upon contact with solutions of sugars.	ChemTreat, Inc.
Sodium Bisulfate	Store at ambient temperatures. Keep container securely closed when not in use. Label precautions also apply to empty container. Recondition or dispose of empty containers in accordance with government regulations. For Industrial use only. Do not store below 30°F. Wear appropriate Personal Protective Equipment (PPE) when handling this product. Do not get in eyes, or on skin and clothing. Wash thoroughly after handling. Do not ingest. Avoid breathing vapors, mist or dust.	Contain and recover liquid when possible. Flush spill area with water spray.	Strong oxidizers, Strong bases, Strong acids	ChemTreat, Inc.
Aluminum Chlorohydrate	Store at ambient temperatures. Keep container securely closed when not in use. Label precautions also apply to empty container. Recondition or dispose of empty containers in accordance with government regulations. For Industrial use only. Protect from heat and sources of ignition. Store in corrosive resistant container with a resistant inliner.	Contain and recover liquid when possible. Flush spill area with water spray.	Strong oxidizers, Strong bases	ChemTreat, Inc.

Material Safety Data Sheet

J. R. Simplot Company

AgriBusiness

Trade Name: Sulfuric Acid 93%

Registration No: None

M16020

SECTION 1

CHEMICAL PRODUCT AND COMPANY INFORMATION

Manufacturer or Formulator:	J.R. Simplot Company P.O. Box 70013 Boise, ID 83707	Product Name:	Sulfuric Acid 93%
		Common Name:	Sulfuric Acid 93%
Emergency Phone - Chemtrec:	1-800-424-9300	Chemical Type:	Inorganic Acid

SECTION 2

COMPOSITION INFORMATION

Chemical Name and Synonyms	C.A.S. No.	Chemical Formula	WT% Hazardous	TLV	PEL
Sulfuric Acid	7664-93-9	H ₂ SO ₄	93%	0.2 mg/m ³	1 mg/m ³ 8Hr TWA
			Non Hazardous		
Water	7732-18-5	H ₂ O	7%	Not Listed	Not Listed

SECTION 3

HAZARDS IDENTIFICATION

Ingestion: Moderately toxic. Corrosive to the mouth, throat and stomach. May cause gastrointestinal disturbances. Symptoms may include salivation, irritation, throat burns, nausea, abdominal pains, vomiting and diarrhea.

Inhalation: Highly toxic. May cause respiratory tract irritation, throat burns, constriction of the windpipe, severe pulmonary edema and death. May also cause inflammation of the stomach, bronchitis, and tooth erosion. Exposure may cause symptoms similar to those listed under "Ingestion."

Eye Contact: Extremely irritating and corrosive. Direct contact may cause conjunctivitis, corneal ulceration and permanent injury.

Skin Absorption: May destroy the epidermis and penetrate some distance into the skin and subcutaneous tissues and cause necrosis. Ulceration of the skin.

Skin Contact: May cause irritation or burns on skin. Prolonged contact may cause severe, deep burns to tissue; very corrosive effects. May cause dermatitis, ulceration. Burns may not become symptomatic for several hours after contact..

Effects of Overdose: **LOCAL:** Conjunctivitis, corneal necrosis, dermatitis, skin burns, ulceration. **RESPIRATORY:** Irritation of the nose and throat, laryngeal edema, bronchitis, pneumonia, pulmonary edema. **GASTROINTESTINAL:** Dental erosion, shock, anuria, burning in mouth, throat and abdomen; nausea, vomiting of blood and eroded tissue, perforation of gastrointestinal tract, albumin, blood and casts in urine.

SECTION 4

FIRST AID MEASURES

Emergency and First Aid Procedures: Treatment is symptomatic and no specific antidotes are known.

Ingestion: Rinse mouth with large amounts of water, DO NOT INDUCE VOMITING. If patient is conscious give milk mixed with egg whites or as much water as possible

Inhalation: Remove person from exposure area to fresh air and support breathing.

Eyes: IMMEDIATELY flush eyes with fresh running water for 15-20 minutes.

Skin: Give continuous flow of water to wash material off body. Remove contaminated clothing (under a shower if possible) and subject patient to deluge-type shower, if possible. Treat for shock. Prompt medical consultation is essential.

SECTION 5

FIRE FIGHTING MEASURES

Extinguishing Media: Fires involving small amounts of combustibles may be smothered with suitable dry chemicals. Use water on combustibles in vicinity of this material but use care, as water applied directly to their acid results in evolution of heat, causes splattering, and can further disperse aerosols.

Special Fire Fighting Procedures: Avoid any contact with acid. Wear full protective rubber clothing, gloves, boots, wear self-contained breathing apparatus.

Unusual Fire and Explosion Hazards: Not flammable but highly reactive and can cause ignition by contact with combustible materials. Reacts violently with water and organics. May release explosive hydrogen gas inside storage tanks, drums, tank cars, and tank trucks. This is a very powerful acidic oxidizer which can ignite or even explode on contact with many materials; i.e., acetic acid, acetone cyanhydrin, (acetone + HNO₃), (acetone + K₂Cr₂O₇), acetonitrile, acrolein, acrylonitrile, (acrylonitrile + H₂O), (alcohols + H₂O₂), allyl alcohol, allyl chloride, NH₄OH, 2-amino ethanol, NH₄tripperchromate, aniline, (bromates + metals, BrF₅, n-butylaldehyde, carbides, CoHC₂, chlorates, (metals + chlorates), ClF₃, chlorosulfonic acid, Cu₃N, diisobutylene, (dimethyl benzylcarbinol + H₂O₂), epichlorohydrin, ethylene cyanhydrin, ethylene diamine, ethylene glycol, ethylene imine, fulminates, HCl, H₂, IF₇ (indene + HNO₃ + glycerides, p-nitroluene, perchlorates, HClO₄, (C₆H₆ + permanganates), pentasilver trihydroxydiamino phosphate, (l-phenyl-2-methyl propyl alcohol + H₂O₂), P, P(OCN)₃, picrates, potassium-tert-butoxide, KClO₃, KMnO₄, (KMnO₄ + KCl), KMnO₄ + H₂O) beta-propiolactone, RbHC₂, propylene oxide, pyridine, NA, Na₂CO₃, NaOH, steel, styrene monomer, water, vinyl acetate, (HNO₃ + toluene).

SECTION 6

ACCIDENTAL RELEASE MEASURES

Environmental Precautions: No information available; however, Sulfuric Acid has a reportable quantity of 1000 lbs. and, in the event of an accidental release, should be kept out of all watercourses and bodies of water. Do not contaminate any watercourse or body of water by direct application, cleaning of equipment or disposal.

Steps to be taken in case material is released or spilled: Treat with extreme caution. Zone off contaminated area. Dike area with sand or earth. Acid may be neutralized with soda ash or lime. Neutralization or dilution of strong Sulfuric Acid will **ALWAYS** be accompanied by a very strong chemical reaction with release of heat and possible splattering of the acid. Organic or combustible materials such as sawdust or rags should never be used to soak up spills. Wear full protective clothing (acid protective slicker suit).

Trade Name: Sulfuric Acid 93%
Registration No: None

M16020

SECTION 7

HANDLING AND STORAGE

Precautions to be taken in handling and storing:

When diluting always add acid to water slowly, never the reverse. Protect against physical damage and water. Wear full protective rubber clothing and rubber gloves and boots, acid hood, and full face shield when loading or unloading tank trucks or railway cars. If exposure is low, acid gas canister may be satisfactory or a self-contained breathing apparatus in the pressure demand mode or a supplied air respirator. Consult the respirator manufacturer to determine the appropriate type of equipment for a given application. In any event always wear eye protection.

SECTION 8

EXPOSURE CONTROLS/PERSONAL PROTECTION

- Ventilation Protection:** Maintain adequate ventilation at all locations where acid is handled. Store in the open or in well ventilated buildings or sheds.
- Respiratory Protection:** Depends on type of exposure, can range from none to full protection. Self-contained breathing apparatus, or positive pressure hose mask, or air-line supplied with clean compressed air. Check with respirator manufacturer to determine the appropriate type of equipment for a given application.
- Protective Clothing:** When loading or unloading trucks or cleaning out tanks or towers, wear acid resistant slicker suit, rubber clothing with rubber hood or broad soft hat, rubber apron, rubber gloves, rubber boots, and full face shield.
- Suit Material Performance:** (suggested by E.P.A.--user should determine by specific use)
- | | |
|---------------------|-----------|
| Butyl..... | Poor |
| Butyl/Neoprene..... | Good |
| CPE | Excellent |
| Chlorobutyl..... | Good |
| Neoprene | Good |
- Eye Protection:** Chemical splash-proof goggles and/or full face shield.
- Other:** Safety shower and eyewash fountain checked daily in area.

SECTION 9

PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point:	530°F	Solubility in Water:	Complete (Exothermic)
Specific Gravity:	1.84 @ 60°F	% Volatiles (by volume):	100% @ 644°F
pH:	Less than 1.0	Vapor Pressure, mm Hg:	1 @ 294°F
Appearance:	Clear, colorless to cloudy	Melting Point:	-31° to 51°F
Extinguishing Media:	Use media suitable to extinguish source of fire.	Reaction with Water:	VIOLENT
Flashpoint:	Non-flammable. It may cause ignition on contact with combustible liquids or solids.		

SECTION 10

STABILITY AND REACTIVITY

- Stability (Normal Conditions):** Stable
- Conditions to Avoid:** High temperature, organic materials, powdered metals, and other combustible materials.
- Incompatibility (Material to Avoid):** Water and most common metals, organic materials, carbides, chlorates, fulminates, nitrates, picrates, powdered metals, other combustible materials and strong oxidizing agents. Attacks many metals, releasing hydrogen. Acetic acid, acetone cyanohydrin, acetone and nitric acid and styrene monomer, vinyl acetate, nitric acid and toluene.
- Hazardous Decomposition Products:** Hydrogen gas and hazardous fumes of SO_x
- Hazardous Polymerization:** Will not occur

SECTION 11

TOXICOLOGY

- Acute Oral Toxicity:** LD₅₀ (rat) is greater than 5,000 mg/kg (ppm); not acutely toxic by oral exposure. (TFI Product Testing Results, OECD Guideline 425)
- Acute Inhalation Toxicity:** LC₅₀ (rat, guinea pig) is 18-420 mg/m³; highly toxic by inhalation. (TFI Product Testing Results)
- Acute Aquatic Toxicity:** Fish 96-hour LC₅₀ is 42-500 mg/L (ppm); daphnia 24-hour EC₅₀: 29-88 mg/L; algae 10 mg/L. Slightly toxic to aquatic organisms. (TFI Product Testing Results)

SECTION 12

ECOLOGICAL INFORMATION

None Listed.

SECTION 13

DISPOSAL CONSIDERATIONS

- Waste Disposal Procedures:** If possible, avoid pouring or spraying water directly onto strong Sulfuric Acid. This **ALWAYS** results in a violent chemical reaction. It is always best to slowly pour the acid into water during disposal operations to avoid the violent reaction and splattering of acid. If water must be sprayed into the acid for dilution, flushing, etc., it should always be done from a distance with proper protective gear.

Disclaimer: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. **NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED.** It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

Trade Name: Sulfuric Acid 93%
Registration No: None

M16020

SECTION 14

TRANSPORT INFORMATION

Shipping name:	RQ Sulfuric Acid (with more than 51 percent acid), 8, UN1830 P.G. II		
Hazard Class:	8	C.A.S. Number:	7664-93-9
Reportable Quantity (RQ):	1000 lbs. - Sulfuric Acid	Sub. Hazard Class:	None
Packing Group	II	D.O.T. Number:	UN1830
EPA Regist No:	None	Labels Required:	Corrosive
Haz Waste No:	D002	Placard:	Corrosive

Refer to 49 CFR 172.101 Hazardous Materials Table for further provisions, packaging authorizations and quantity limitations.

SECTION 15

REGULATORY INFORMATION

Carcinogenicity: by IARC? Yes () No (X) by NTP? Yes () No (X)
IARC evaluates occupational exposures to strong, inorganic-acid mists containing Sulfuric Acid in "Group 1", as having carcinogenic potential. However, SULFURIC ACID ITSELF WAS NOT CLASSIFIED AS A GROUP I CARCINOGEN.

This product contains sulfuric acid, CAS No. 7664-93-9, which is subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

SECTION 16

OTHER INFORMATION

Flash Point (Test Method):	Not applicable	Flammable Limits	LOWER	UPPER
Autoignition Temperature:	Not applicable	(% BY VOLUME)	N/A	N/A
Hazard Rating (N.F.P.A.):	Health: 3	Fire: 0	Reactivity: 2	Specific: Use no water

This N.F.P.A. rating is a recommendation by the manufacturer using the guidelines or published evaluations prepared by the National Fire Protection Association (N.F.P.A.).

FIREFIGHTING TECHNIQUE

Concentrated vapors of Sulfuric Acid are extremely irritating to the respiratory tract and may cause breathing difficulty. Prevent human exposure to fire, smoke, fumes, or products of combustion. Evacuate nonessential personnel from the fire area. Maintain a safe distance from the fire and storage area because excessive heat may cause tank to rupture. Wear full face, self-contained breathing apparatus and impervious clothing (such as gloves, hood, suits, and rubber boots). Use water spray, dry chemical, foam, carbon dioxide, or halogenated extinguishing agents. If the tank is not leaking, keep cooled using a fog spray nozzle to minimize the reactivity of the water and acid. Under no circumstance should water or other liquid be introduced into acid tanks. Take care not to ignite hydrogen gas which can accumulate inside metal tanks containing acid.

SPECIAL HANDLING

Make sure all personnel involved in the spill cleanup follow good industrial hygiene practices.

A small spill can be handled routinely. Use adequate ventilation or wear an air-supplied respirator to prevent inhalation contact. Wear suitable protective clothing to prevent skin and eye contact. Use the following procedures:

- Any leak occurring in pipelines or equipment should be considered an acid leak and treated with extreme caution until the leak is proven not to be an acid leak.
- All contaminated areas should be immediately zoned off to avoid personnel exposure to the acid spray or stream.
- Adjust all appropriate valves to isolate the system and stop further leakage.
- Soda ash or lime should be spread around to neutralize any remaining acidity on the surface of the ground or concrete pad. The contaminated area should be covered with sand or gravel, and acidity neutralized with soda ash or lime.
- Sulfuric Acid leaks, spills or drainings must not come in contact with any acid soluble sulfide wastes (such as in sewers), because of danger of evolving hydrogen sulfide gas.

Large spills should be handled according to the predetermined plan. Part of this plan should include Section V, FIRE FIGHTING MEASURES.

CORROSIVITY TO MATERIALS OF CONSTRUCTION

Weaker strengths of Sulfuric Acid, particularly concentrations below 60° Baume, are highly corrosive to most metals with evolution of hydrogen gas.

STORAGE REQUIREMENTS

The following safety facilities should be readily accessible in all areas where Sulfuric Acid is handled or stored.

SAFETY SHOWERS--with quick opening valves which stay open. Water should be supplied through insulated lines to prevent freeze-ups in cold weather.

EYEWASH FOUNTAIN--or other means of washing the eyes with a gentle flow of tap water.

Sulfuric Acid may be safely stored in properly designed bulk storage tanks.

DISPOSAL OF UNUSED MATERIAL

Sulfuric Acid that cannot be used or chemically reprocessed should be disposed of in such a manner that will not adversely affect the environment.

MSDS Version Number: 8 (revision to Section 3)

Disclaimer: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. **NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED.** It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

Sodium Hydroxide Solution, 50%

SECTION 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Δ

Manufacturer's name and address:

Olin Corporation – Chlor Alkali Products
Division

CLEVELAND, TN OFFICE

490 Stuart Road NE
Cleveland, TN 37312-4918
U.S. • (423) 336-4850

Supplier's name and address:

Olin Canada, ULC d/b/a
Olin Chlor Alkali Products

MONTREAL, QC OFFICE

2020 University, Suite 2190
Montreal, Quebec H3A 2A5
Canada • (514) 397-6100

Product Name: Sodium Hydroxide Solution, 50%

CAS#: 1310-73-2

MSDS Code: NaOH(50)-E

Preparation date (M/D/Y): 10/02/08

Revision date (M/D/Y): 02/08/11

Synonyms: Caustic soda liquid 50%, Soda lye, Lye, Liquid Caustic, Sodium Hydrate

Product Use: Neutralizing agent, industrial cleaner, pulping and bleaching, soap manufacturing

Emergency Contacts (24 hr.)

FOR INFORMATION REGARDING ON SITE CHEMICAL EMERGENCIES INVOLVING A SPILL OR LEAK, CALL

Δ

Canada: 1-800-567-7455

U.S.: 1-800-424-9300 – CHEMTREC

SECTION 2 – COMPOSITION / INFORMATION ON INGREDIENTS

Δ

Hazardous Ingredient(s)	% (w/w)	ACGIH	CAS NO.
Sodium Hydroxide	49 – 52	2 mg/m ³ (TLV-C)	1310-73-2

SECTION 3 – HAZARD IDENTIFICATION

Emergency Overview: Odorless, clear, non-volatile liquid. EXTREMELY CORROSIVE! Causes severe burns on contact. Can cause blindness, permanent scarring and death. Aerosols can cause lung injury – effects may be delayed. Highly reactive. Can react violently with water and numerous commonly encountered materials, generating enough heat to ignite nearby combustible materials. Contact with many organic and inorganic chemicals may cause fire or explosion. Reacts with some metals to liberate hydrogen gas, which can form explosive mixtures with air. Will not burn. Harmful to aquatic life. Read the entire MSDS for a more thorough evaluation of the hazards.

Potential Health Effects:

Δ

Routes of exposure: Inhalation, skin contact, eye contact and ingestion.

SODIUM HYDROXIDE SOLUTION, 50%

Update/Review: February 8, 2011

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Inhalation: Sodium hydroxide does not readily form a vapor and inhalation exposure is likely to occur as an aerosol. Due to its corrosive nature, sodium hydroxide aerosols could cause pulmonary edema (severe, life-threatening lung injury). The development of pulmonary edema may be delayed up to 48 hours after exposure. The early symptoms of pulmonary edema include shortness of breath and tightness in the chest.

Skin Contact: EXTREMELY CORROSIVE! Sodium hydroxide is capable of causing severe burns with deep ulceration and permanent scarring. It can penetrate to deeper layers of skin and corrosion will continue until removed. The severity of injury depends on the concentration (solutions) and the duration of exposure. Burns may not be immediately painful; onset of pain may be delayed minutes to hours. Several human studies and case reports describe the corrosive effects of sodium hydroxide. A 4% solution of sodium hydroxide, applied to a volunteer's arm for 15 to 180 minutes, caused damage which progressed from destruction of cells of the hard outer layer of the skin within 15 minutes to total destruction of all layers of the skin in 60 minutes. Solutions as weak as 0.12% have damaged healthy skin within 1 hour.

Eye Contact: EXTREMELY CORROSIVE! The severity of injury increases with the concentration, the duration of exposure, and the speed of penetration into the eye. Damage can range from severe irritation and mild scarring to blistering, disintegration, ulceration, severe scarring and clouding. Conditions, which affect vision such as glaucoma and cataracts, are possible late developments. In severe cases, there is progressive ulceration and clouding of eye tissue which may lead to permanent blindness.

Ingestion: EXTREMELY CORROSIVE! Severe pain; burning of the mouth, throat and esophagus; vomiting; diarrhea; collapse and possible death may result.

Chronic Effects: SKIN: Repeated or prolonged skin contact would be expected to cause drying, cracking, and inflammation of the skin (dermatitis).

Existing Medical Conditions Possibly Aggravated by Exposure: Asthma, bronchitis, emphysema and other lung diseases and chronic nose, sinus or throat conditions. Skin irritation may be aggravated in individuals with existing skin disorders.

Carcinogenicity: Sodium hydroxide is not classified as a carcinogen by ACGIH (American Conference of Governmental Industrial Hygienists) or IARC (International Agency for Research on Cancer), not regulated as a carcinogen by OSHA (Occupational Safety and Health Administration), and not listed as a carcinogen by NTP (National Toxicology Program).

Δ **Other important hazards:** Refer to TOXICOLOGICAL INFORMATION (Section 11) for additional information.

SECTION 4 – FIRST AID MEASURES

General: If you feel unwell, IMMEDIATELY seek medical advice (show this document).

Inhalation: Move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice. Give artificial respiration ONLY if breathing has stopped. 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 device. Give Cardiopulmonary Resuscitation (CPR) only if there is no pulse AND no breathing. Obtain medical attention IMMEDIATELY. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure.

Skin Contact: Immediately flush skin with lukewarm water for at least 20 minutes, and up to 60 minutes if necessary. Under lukewarm water remove contaminated clothing, jewelry, and shoes. If irritation persists, repeat flushing. Obtain medical attention immediately. Discard contaminated clothing and shoes in a manner which limits further exposure.

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Eye Contact: Immediately flush eyes with lukewarm water for at least 20 minutes, and up to 60 minutes if necessary. Hold eyelids open during flushing. If irritation persists, repeat flushing. Obtain medical attention IMMEDIATELY. Do not transport victim until the recommended flushing period is completed unless flushing can be continued during transport.

Ingestion: DO NOT INDUCE VOMITING. If victim is alert and not convulsing, rinse mouth and give as much water as possible to dilute material (8 to 10 oz. or 240 to 300 mL). If spontaneous vomiting occurs, have victim lean forward with head down, rinse mouth and administer more water. IMMEDIATELY transport victim to an emergency facility.

SECTION 5 – FIRE FIGHTING MEASURES

Flammability	Not applicable. Not combustible (does not burn).
Flash Point (method)	Not applicable.
Flammable Limits (Lower)	Not applicable
Flammable Limits (Upper)	Not applicable
Auto Ignition Temperature	Not applicable
Combustion and Thermal Decomposition Products	Sodium oxide fumes
Rate of Burning	Not applicable
Explosive Power	Not applicable
Sensitivity to Mechanical Impact	Not sensitive ; stable material
Sensitivity to Static Charge	Not applicable

Fire and Explosion Hazards: Sodium hydroxide will not burn or support combustion. The reaction of sodium hydroxide with water and a number of commonly encountered materials (see Section 10) can generate sufficient heat to ignite nearby combustible materials. Sodium hydroxide can react with metals, such as aluminum, tin and zinc, to form flammable hydrogen gas.

Extinguishing Media: Use extinguishing media suitable for the surrounding fire. If water is used, care should be taken, since it can generate heat and cause spattering if applied directly to sodium hydroxide.

Special Information: Evacuate area and fight fire from a safe distance or a protected location. Approach fire from upwind. If possible, isolate materials not involved in the fire and protect personnel. Move containers from fire area if it can be done without risk.

Water can be used with extreme caution to extinguish a fire in an area where sodium hydroxide is stored. The water must not come into contact with the sodium hydroxide. Water can be used in flooding quantities as a spray or fog to keep fire-exposed containers cool and absorb heat. At high temperatures, fuming may occur, giving off a strong, corrosive gas. Do not enter without wearing specialized protective equipment suitable for the situation.

Evacuation: If tank or tank truck involved in a fire, ISOLATE and consider evacuation of one-half (1/2) mile (800 meters) in all directions.

Fire Fighting Protective Equipment: Firefighter's normal protective clothing (Bunker Gear) will not provide adequate protection. Chemical resistant clothing (e.g. chemical splash suit) and positive pressure self-contained breathing apparatus (MSHA/NIOSH approved or equivalent) may be necessary.

NOTE: Also see "Section 10 - Stability and Reactivity"

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SECTION 6 – ACCIDENTAL RELEASE MEASURES

Spills, Leaks, or Releases:

- Restrict access to area until completion of clean up. Ensure trained personnel conduct clean up. Ventilate area.
- Wear adequate personal protective equipment (See Section 8). Do not touch spilled material.
- Prevent entry into sewers or waterways.
- Land spill of sodium hydroxide: Solutions should be contained by diking with inert material, such as sand or earth. Solutions can be recovered or carefully diluted with water and cautiously neutralized with acids such as acetic acid or hydrochloric acid.
- Water spill: Neutralize with dilute acid.
- Comply with Federal, Provincial/State and local regulations on reporting releases.

Deactivating Chemicals: Weak acid solutions (acetic, hydrochloric or sulfuric acid).

Waste Disposal Methods: Dispose of waste material at an approved waste treatment/disposal facility, in accordance with applicable regulations. Do not dispose of waste with normal garbage or to sewer systems.

Note

- Clean-up material may be a RCRA Hazardous Waste on disposal.
- Spills are subject to CERCLA reporting requirements: RQ = 1000 lbs. (454 kg).

SECTION 7 – HANDLING AND STORAGE

Precautions: EXTREMELY CORROSIVE! Have emergency equipment (for fires, spills, leaks, etc.) readily available. Ensure all containers are labeled. Wear appropriate Personal Protection Equipment (*Refer to Section 8*). People working with this chemical should be properly trained regarding its hazards and its safe use.

Handling Procedures and Equipment: Use smallest possible amounts in designated areas with adequate ventilation. Keep containers closed when not in use. Empty containers may contain hazardous residues. Avoid generating mists. Transfer solutions using equipment, which is corrosion-resistant. Cautiously, transfer into sturdy containers made of compatible materials. Never return contaminated material to its original container. Considerable heat is generated when diluted with water. Proper handling procedures must be followed to prevent vigorous boiling, splattering or violent eruption of the diluted solution. Never add water to a sodium hydroxide solution. **ALWAYS ADD SODIUM HYDROXIDE TO WATER** and provide agitation. When mixing with water, stir small amounts in slowly. Use cold water to prevent excessive heat generation.

Storage Requirements: Store in a cool, dry, well-ventilated area. Keep containers tightly closed when not in use and when empty. Protect from damage. Store away from incompatible materials such as strong acids, nitroaromatic, nitroparaffinic or organohalogen compounds. See Section 10 for Incompatibles. Use corrosion-resistant structural materials and lighting and ventilation systems in the storage area. Containers made of nickel alloys are preferred. Steel containers are acceptable if temperatures are not elevated. Nickel is the preferred metal for handling this product. Plastics or plastic-lined steel, or FRP tanks of Derakane vinyl ester resin may be suitable. Container contents may develop pressure after prolonged storage. Drums may need to be vented. Trained personnel should only perform venting.

Storage Temperature: Avoid freezing. Do not expose sealed containers to temperatures above 40°C (104°F).

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SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

PREVENTIVE MEASURES

Recommendations listed in this section indicate the type of equipment which will provide protection against over exposure to this product. Conditions of use, adequacy of engineering or other control measures, and actual exposures will dictate the need for specific protective devices at your workplace.

Engineering Controls: Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants. The most effective measures are the total enclosure of processes and the mechanization of handling procedures to prevent all personal contact.

PERSONAL PROTECTIVE EQUIPMENT

Maintain eye wash fountain and quick-drench facilities in work area. Detailed requirements for personal protective equipment should be established on a site-specific basis.

Eye Protection: Wear full face-shield and chemical safety goggles when there is potential for contact.

Skin Protection: Wear appropriate personal protective clothing to prevent skin contact.

Guidelines for sodium hydroxide solutions, 30-70%:

RECOMMENDED (resistance to breakthrough longer than 8 hours): Butyl rubber; natural rubber, neoprene rubber, nitrile rubber, polyethylene, polyvinyl chloride, Teflon™, Viton™, Saranex™, 4H™, Barricade™, CPF 3™, Responder™, Trelchem HPS™, Tychem 10000™.

NOT RECOMMENDED for use (resistance to breakthrough less than 1 hour): Polyvinyl alcohol.

Respiratory Protection:

Up to 10 mg/m³: Supplied Air Respirator (SAR) operated in a continuous-flow mode, eye protection needed; or full face-piece respirator with high-efficiency particulate filter(s); or powered air-purifying respirator with dust and mist filter(s), eye protection needed; or full face-piece Self-Contained Breathing Apparatus (SCBA); or full face-piece SAR.

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Positive pressure, full face-piece SAR; or positive pressure, full face-piece SAR with an auxiliary positive pressure SAR.

ESCAPE: Full face-piece respirator with high-efficiency particulate filter(s); or escape-type SCBA.

EXPOSURE GUIDELINES

PRODUCT: Sodium hydroxide:

Δ	ACGIH Ceiling Exposure Limit (TLV-C)	2 mg/m ³
	OSHA PEL-TWA	2 mg/m ³
	NIOSH IDLH	10 mg/m ³
	NIOSH REL:	C 2 mg/m ³

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SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Alternate Name(s)	Caustic soda liquid 50%, Soda lye, Lye, Liquid Caustic, Sodium Hydrate
Chemical Name	Sodium hydroxide
Chemical Family	Alkali hydroxide
Molecular Formula	NaOH
Molecular Weight	40.01
Physical State and Appearance	Clear-to-slightly turbid liquid
Odor	Odorless
pH	14.0 (Aqueous solution: 5%)
Vapor Pressure	0.2 kPa (1.5 mm Hg) at 20 °C (68°F) (50% solution)
Vapor Density (Air = 1)	Not applicable
Boiling Point	140 °C (284 °F) (50% solution)
Freezing Point	12 °C (53.6 °F) (50% solution)
Solubility (Water)	Soluble in all proportions
Specific Gravity	1.53 (50% solution) 15.5 °C (60°F)
Evaporation Rate	Not applicable
Viscosity (cp):	78.3 at 20 °C (68°F)
Bulk Density (lbs/cu ft):	95.5
Coefficient of Oil/Water Distribution	Essentially zero

SECTION 10 – STABILITY AND REACTIVITY

Chemical Stability: Stable at room temperature.

Hazardous Decomposition Products: Thermal decomposition: sodium oxide fumes

Conditions to Avoid: Water. Keep away from incompatibles.

Incompatibility with other Substances: Sodium hydroxide reacts vigorously, violently or explosively with many organic and inorganic chemicals, such as strong acids, nitroaromatic, nitroparaffin and organohalogen compounds, glycols and organic peroxides. Reacts violently with water generating significant heat and dangerously spattering corrosive sodium hydroxide. Violently polymerizes acetaldehyde, acrolein or acrylonitrile. Produces flammable and explosive hydrogen gas if it reacts with sodium tetrahydroborate or certain metals such as aluminum, tin, or zinc. Can form spontaneously flammable chemicals upon contact with 1,2- dichloroethylene, trichloroethylene or tetrachloroethane. Can produce carbon monoxide upon contact with solutions of sugars, such as fructose, lactose and maltose.

Corrosivity to Metals: Corrosive to aluminum, tin, zinc, copper, and most alloys in which they are present including brass and bronze. Corrosive to steel at elevated temperatures above 40°C(104°F).

Stability and Reactivity Comments: Slowly attacks glass at room temperature.

Hazardous Polymerization: Will not occur. However, it can induce hazardous polymerization of acetaldehyde, acrolein, and acrylonitrile.

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SECTION 11 – TOXICOLOGICAL INFORMATION

For more toxicological information, refer to Section 3.

TOXICOLOGICAL DATA:

Toxicological Data: Sodium hydroxide

Toxicity data: LDLo - Lowest published lethal dose oral rabbit 500 mg /kg ;
LD₅₀ intraperitoneal mouse 40 mg/kg

Irritation data: Standard Draize Tests: 500 mg/24 hour(s) skin-rabbit severe;
400 µg eyes-rabbit mild; 1 percent eyes-rabbit severe;

Mutagenicity: There is no evidence of mutagenic potential.

Reproductive Effects: No information is available.

Teratogenicity and Fetotoxicity: No information is available.

Synergistic Materials: No information is available.

Skin and Respiratory Sensitization: No information is available.

Irritancy: Strong eye and skin irritant.

SECTION 12 – ECOLOGICAL INFORMATION

Ecotoxicological Information:

LC₁₀₀ Cyprinus Carpio 180 ppm/24 hr @ 25°C (77°F)

TLm mosquito fish 125 ppm/96 hr (fresh water);

TLm Bluegill 99 mg/L/48 hr (tap water)

Persistence and Degradation: Degrades readily by reacting with natural carbon dioxide in the air. Does not bioaccumulate.

SECTION 13 – DISPOSAL CONSIDERATIONS

Review federal, state and local government requirements prior to disposal.

Do not dispose of waste with normal garbage, or to sewer systems.

Whatever cannot be saved for recovery or recycling, including containers, should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options.

RCRA: Test waste material for corrosivity, D002, prior to disposal.

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SECTION 14 – TRANSPORT INFORMATION

	TDG	DOT
Shipping Name	SODIUM HYDROXIDE, SOLUTION	Sodium hydroxide, solution
Hazard Class/Division	8	8
Identification No.	UN1824	UN1824
Packing Group:	II	II
Reportable Quantity	Not Applicable	RQ: 1000 lbs. (454 kg)
ERAP	NONE	Not Applicable

- Δ **IATA/ICAO Shipping Description:** UN1824, Sodium hydroxide solution, Class 8, PG II is accepted for air transport.
- Δ **For Chemical Emergencies in Transportation Requiring Activation of Olin 24 Hour Emergency Response Plan Call:**
- U.S. 1-800-424-9300 – Chemtrec
Canada 1-800-567-7455

SECTION 15 – REGULATORY INFORMATION

Δ **CANADIAN INFORMATION:**

This product has been classified in accordance with the hazard criteria of the CPR (Controlled Products Regulations) and this MSDS (Material Safety Data Sheet) contains all the information required by the CPR.

Controlled Products Regulations (WHMIS) Classification:

E: Corrosive Material

CEPA / Canadian Domestic Substances List (DSL): Y

WHMIS Ingredient Disclosure List: Meets criteria for disclosure at 1% or greater.

Δ **USA INFORMATION:**

OSHA Classification: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200)

SARA Regulations sections 313 and 40 CFR 372: N

SARA Hazard Categories, SARA SECTIONS 311/312 (40 CFR 370.2):

ACUTE: Y

CHRONIC: N

FIRE: N

REACTIVE: Y

SUDDEN RELEASE: N

OSHA PROCESS SAFETY (29 CFR 1910.119): N

CERCLA SECTION 103 (40 CFR 302.4): Y

Reportable Quantity (RQ) under CERCLA: 1000 lbs. (454 kg)

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TSCA Inventory Status: Y

This product does not contain nor is it manufactured with ozone depleting substances.

△ EUROPEAN ECONOMIC COMMUNITY (EEC) INFORMATION:

EINECS Number: 215-185-5

CALIFORNIA PROP 65 COMPONENTS:

This product is not listed, but it may contain elements known to the State of California to cause cancer or reproductive toxicity as listed under Proposition 65 State Drinking Water and Toxic Enforcement Act. For additional information, contact Olin Technical Services (800-299-6546)

SECTION 16 – OTHER INFORMATION

- △ The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by technically knowledgeable personnel. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of any kind is given or implied and Olin will not be liable for any damages, losses, injuries or consequential damages that may result from the use of or reliance on any information contained herein. This Material Safety Data Sheet is valid for three years.

Revision Indicators:

- △ In the left margin indicates a revision or addition of information since the previous issue.

**National Fire Protection Association (NFPA) Rating
Hazardous Materials Identification System (HMIS) Rating**

	NFPA	HMIS	
HEALTH	3	3	4 = Extreme/Severe
FIRE	0	0	3 = High/Serious
REACTIVITY / INSTABILITY	1	1	2 = Moderate
SPECIAL HAZARDS	N/Ap	N/Ap	1 = Slight
			0 = Minimum
			W = Water Reactive
			OX = Oxidizer
			* = Chronic health hazard

△ REFERENCES:

1. Chemlist, STN Database, Chemical Abstract Service, 1999
2. "CHEMINFO", CCOHS, Canadian Centre for Occupational Health and Safety, Hamilton, Ontario, Canada, (2008).
3. DOSE, Royal Society of Chemistry, Aug 27, 1999.
4. HSDB- Hazardous Substances Data Bank, CCOHS, 2008.
5. RTECS-Registry of Toxic Effects of Chemical Substances, On-line search, Canadian Centre for Occupational Health and Safety RTECS database, Doris V. Sweet, Ed., National Institute for Occupational Safety and Health, U.S. Dept. of Health and Human Services, Cincinnati, Entry Update/ August 2007.
6. "2008 Threshold Limit Values and Biological Exposure Indices", American Conference of Government Industrial Hygienists, 2008.
7. Merck, 11th Edition, 1989

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Δ LEGEND:

ACGIH	- American Conference of Governmental Industrial Hygienists
AFFF	- Aqueous Film Forming Foam
AIHA	- American Industrial Hygiene Association
CAS #	- Chemical Abstracts Service Registry Number
CERCLA	- Comprehensive Environmental Response, Compensation, and Liability Act
CFR	- Code of Federal Regulations
DOT	- Department of Transportation
EINECS	- European Inventory of Existing Chemical Substances
EPA	- Environmental Protection Agency
ERAP	- Emergency Response Assistance Plan
IATA	- International Air Transportation Association
ICAO	- International Civil Aviation Organization
FRP	- Fiberglass Reinforced Plastic
HMIS	- Hazardous Materials Identification System
IARC	- International Agency for Research on Cancer
IDLH	- Immediately Dangerous to Life and Health
LC50	- The concentration of material in air expected to kill 50% of a group of test animals
LD ₅₀	- Lethal Dose expected to kill 50% of a group of test animals
MSHA	- Mine Safety and Health Administration
N/Ap	- Not Applicable
N/Av	- Not Available
NFPA	- National Fire Protection Association
NIOSH	- National Institute for Occupational Safety and Health
NTP	- National Toxicology Program
OSHA	- Occupational Safety & Health Administration
PEL	- Permissible Exposure Limit
PVC	- Polyvinyl chloride
RCRA	- Resource Conservation and Recovery Act
SARA	- Superfund Amendments and Reauthorization Act of the U.S. EPA
STEL	- Short Term Exposure Limit
TDG	- Transportation of Dangerous Goods Act/Regulations
TLV	- Threshold Limit Value
TSCA	- Toxic Substances Control Act
TWA	- Time Weighted Average
WEEL	- Workplace Environmental Exposure Level
WHMIS	- Workplace Hazardous Materials Identification System



MATERIAL SAFETY DATA SHEET

Section 1. Chemical Product and Company Identification

Product Name: ChemTreat RL124
Product Use: Reverse Osmosis Treatment
Supplier's Name: ChemTreat, Inc.
Emergency Telephone Number: (800) 424-9300 (Toll Free)
(703) 527-3887
Address (Corporate Headquarters): 4461 Cox Road
Glen Allen, VA 23060
Telephone Number for Information: (800) 648-4579
Date of MSDS: September 14, 2010

Section 2. Hazard(s) Identification



Signal Word: WARNING!

Hazard Statement(s): Causes eye irritation.
Causes skin irritation.
Harmful if inhaled.
May be harmful if swallowed.

Precautionary Statement(s): Wear protective gloves/clothing and eye/face protection. Do not breathe dust/fume/gas/mist/vapors/spray. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling. Use only outdoors or in a well-ventilated area.

Section 3. Composition/Hazardous Ingredients

Component	CAS Registry #	Wt. %
Sodium bisulfite	7631-90-5	15 - 40

Section 4. First Aid Measures

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.

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 advice/attention.

Skin: Wash with plenty of soap and water. Take off contaminated clothing and wash before re-use. If skin irritation occurs, seek medical advice/attention.

Ingestion: DO NOT INDUCE VOMITING. Rinse mouth. Call a POISON CENTER or doctor/physician if you feel unwell.

Notes to Physician: N/A

Additional First Aid Remarks: N/A

Section 5. Fire Fighting Measures

Flammability of the Product: Not flammable.

Suitable Extinguishing Media: Use extinguishing media suitable to surrounding fire.

Specific Hazards Arising from the Chemical: Use water spray to keep containers cool.

Protective Equipment: If product is involved in a fire, wear full protective clothing including a positive-pressure, NIOSH approved, self-contained breathing apparatus.

Section 6. Accidental Release Measures

Personal Precautions: Use appropriate Personal Protective Equipment (PPE).

Environmental Precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains, and sewers.

Methods for Cleaning up: Contain and recover liquid when possible. Flush spill area with water spray.

Other Statements: If RQ (Reportable Quantity) is exceeded, report to National Spill Response Office at 1-800-424-8802.

Section 7. Handling and Storage

Handling: Wear appropriate Personal Protective Equipment (PPE) when handling this product. Do not get in eyes, or on skin and clothing. Wash thoroughly after handling. Do not ingest. Avoid breathing vapors, mist or dust.

Storage: Store away from incompatible materials (see Section 10). Store at ambient temperatures. Keep container securely closed when not in use. Label precautions also apply to empty container. Recondition or dispose of empty containers in accordance with government regulations. For Industrial use only. Do not store below 30°F.

Section 8. Exposure Controls/Personal Protection

Exposure Limits

Component	Source	Exposure Limits
Sodium bisulfite	ACGIH TLV	5 mg/m ³ TWA

Carcinogenicity Category

Component	Source	Code	Brief Description
Sodium bisulfite			N/E

Engineering Controls:

Use only with adequate ventilation. The use of local ventilation is recommended to control emission near the source.

Personal Protection

Eyes:

Wear chemical splash goggles or safety glasses with full-face shield. Maintain eyewash fountain in work area.

Skin:

Maintain quick-drench facilities in work area.
Wear butyl rubber or neoprene gloves. Wash them after each use and replace as necessary. If conditions warrant, wear protective clothing such as boots, aprons, and coveralls to prevent skin contact.

Respiratory:

If misting occurs, use NIOSH approved organic vapor/acid gas dual cartridge respirator with a dust/mist prefilter in accordance with 29 CFR 1910.134.

Section 9. Physical and Chemical Properties

Physical State and Appearance:	Liquid, Yellow, Clear
Specific Gravity:	1.2350
pH:	3.9
Freezing Point:	30°F
Flash Point:	N/D
Odor:	Strong
Melting Point:	N/A
Boiling Point:	212°F
Solubility in Water:	Complete
Evaporation Rate:	<1
Vapor Density:	N/D
Molecular Weight:	N/D
Viscosity:	<100
Flammable Limits:	N/A
Autoignition Temperature:	N/A
Density:	10.30 lb/ga
Vapor Pressure:	<17.5

% VOC

N/D

Section 10. Stability and Reactivity

Chemical Stability: Stable at normal temperatures and pressures.

Incompatibility with Various Substances: Strong oxidizers, Strong bases, Strong acids

Hazardous Decomposition Products: Sulfur dioxide gas

Possibility of Hazardous Reactions: None known.

Section 11. Toxicological Information

Chemical Name	Exposure	Type of Effect	Concentration	Species
Sodium bisulfite	Oral	LD50	2000 mg/kg	Rat

Comments: None.

Section 12. Ecological Information

Species	Duration	Type of Effect	Test Results
Fathead Minnow	96h	LC50	>1000 mg/l
Sheepshead Minnow	96h	LC50	100 mg/l
Ceriodaphnia dubia	48h	LC50	390.4 mg/l
Mysid Shrimp	48h	LC50	70.7 mg/l

Comments: None.

Section 13. Disposal Considerations

Dispose of in accordance with local, state and federal regulations.



Section 14. Transport Information

DOT Classification

DOT Name: BISULFITES, AQUEOUS SOLUTIONS, N.O.S.
Technical Name: (SODIUM BISULFITE)
Hazard Class: Corrosive
UN/NA#: UN2693
Packing Group: PGIII

Section 15. Regulatory Information

Inventory Status

United States (TSCA): All ingredients listed.
Canada (DSL/NDSL): All ingredients listed.

Federal Regulations

SARA Title III Rules

Sections 311/312 Hazard Classes

Fire Hazard: No
Reactive Hazard: No
Release of Pressure: No
Acute Health Hazard: Yes
Chronic Health Hazard: No

Other Sections

Component	Section 313 Toxic Chemical	Section 302 EHS TPQ	CERCLA RQ
Sodium bisulfite	N/A	N/A	5000

State Regulations

California Proposition 65: None known.

Special Regulations

Component	States
Sodium bisulfite	MA, MN, NY, PA, WA

International Regulations

Canada

WHMIS Classification: D2B (Toxic Material)
E (Corrosive Material)

Controlled Product Regulations (CPR): This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

Section 16. Other Information

HMIS Hazard Rating

Health: 2
Flammability: 0
Physical Hazard: 0
PPE: X

Notes: The PPE rating depends on circumstances of use. See Section 8 for recommended PPE.
The Hazardous Material Information System (HMIS) is a voluntary, subjective alpha-numeric symbolic system for recommending hazard risk and personal protection equipment information. It is a subjective rating system based on the evaluator's understanding of the chemical associated risks. The end-user must determine if the code is appropriate for their use.

NSF: Certified to NSF/ANSI Standard 60
Maximum use rate for potable water – 50 mg/L
This product ships as NSF from:
Ashland, VA
Eldridge, IA
Nederland, TX
Vernon, CA

FDA: All ingredients in this product are authorized in 21 CFR 173.310 for use as "Boiler Water Additives" where the steam may contact food.

KOSHER: This product is certified by the Orthodox Union as kosher pareve. Only when prepared by the following ChemTreat facilities: Ashland, VA; Eldridge, IA; Nederland, TX; Vernon, CA.

FIFRA: N/A

Other: None

Abbreviations

Abbreviation	Definition
<	Less Than
>	Greater Than
ACGIH	American Conference of Governmental Industrial Hygienists
EHS	Environmental Health and Safety Dept
N/A	Not Applicable
N/D	Not Determined
N/E	Not Established
OSHA	Occupational Health and Safety Dept
PEL	Personal Exposure Limit
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weight Average
UNK	Unknown

Prepared by: Regulatory Affairs Department

Disclaimer

Although the information and recommendations set forth herein (hereinafter "information") are presented in good faith and believed to be correct as of the date hereof, ChemTreat, Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will ChemTreat, Inc. be responsible for damages of any nature whatsoever resulting from the use or reliance upon information. No representation or warranties, either expressed or implied, of merchantability, fitness for a particular purpose, or of any other nature are made hereunder with respect to information or the product to which information refers.

MATERIAL SAFETY DATA SHEET

Section 1. Chemical Product and Company Identification

Product Name: ChemTreat P891L
Product Use: Water Clarification Agent
Supplier's Name: ChemTreat, Inc.
Emergency Telephone Number: (800) 424-9300 (Toll Free)
(703) 527-3887
Address (Corporate Headquarters): 4461 Cox Road
Glen Allen, VA 23060
Telephone Number for Information: (800) 648-4579
Date of MSDS: September 14, 2010

Section 2. Hazard(s) Identification



Signal Word: WARNING!

Hazard Statement(s): May be harmful in contact with skin.
May be harmful if inhaled.
May be harmful if swallowed.

Precautionary Statement(s): No significant health risks are expected from exposures under normal conditions of use.

Section 3. Composition/Hazardous Ingredients

Component	CAS Registry #	Wt. %
Aluminum chlorohydrate	12042-91-0	30 - 60

Section 4. First Aid Measures

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.

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 advice/attention.

Skin: Wash with plenty of soap and water. Call a poison center or doctor/physician if you feel unwell.

Ingestion: DO NOT INDUCE VOMITING. Rinse mouth. Call a POISON CENTER or doctor/physician if you feel unwell.

Notes to Physician: N/A

Additional First Aid Remarks: N/A

Section 5. Fire Fighting Measures

Flammability of the Product: Not flammable.

Suitable Extinguishing Media: Use extinguishing media suitable to surrounding fire.

Specific Hazards Arising from the Chemical: None known.

Protective Equipment: If product is involved in a fire, wear full protective clothing including a positive-pressure, NIOSH approved, self-contained breathing apparatus.

Section 6. Accidental Release Measures

Personal Precautions: Use appropriate Personal Protective Equipment (PPE).

Environmental Precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains, and sewers.

Methods for Cleaning up: Contain and recover liquid when possible. Flush spill area with water spray.

Other Statements: None.

Section 7. Handling and Storage

Handling: Wear appropriate Personal Protective Equipment (PPE) when handling this product. Do not get in eyes, or on skin and clothing. Wash thoroughly after handling. Do not ingest. Avoid breathing vapors, mist or dust.

Storage: Store away from incompatible materials (see Section 10). Store at ambient temperatures. Keep container securely closed when not in use. Label precautions also apply to empty container. Recondition or dispose of empty containers in accordance with government regulations. For Industrial use only. Protect from heat and sources of ignition. Store in corrosive resistant container with a resistant liner.

Section 8. Exposure Controls/Personal Protection

Exposure Limits

Component	Source	Exposure Limits
Aluminum chlorohydrate		N/E

Carcinogenicity Category

Component	Source	Code	Brief Description
Aluminum chlorohydrate			N/E

Engineering Controls:

Use only with adequate ventilation. The use of local ventilation is recommended to control emission near the source.

Personal Protection

- Eyes:** Wear chemical splash goggles or safety glasses with full-face shield. Maintain eyewash fountain in work area.
- Skin:** Maintain quick-drench facilities in work area.
Wear butyl rubber or neoprene gloves. Wash them after each use and replace as necessary. If conditions warrant, wear protective clothing such as boots, aprons, and coveralls to prevent skin contact.
- Respiratory:** If misting occurs, use NIOSH approved organic vapor/acid gas dual cartridge respirator with a dust/mist prefilter in accordance with 29 CFR 1910.134.

Section 9. Physical and Chemical Properties

Physical State and Appearance:	Liquid, Colorless, Clear
Specific Gravity:	1.3350
pH:	3.7
Freezing Point:	27°F
Flash Point:	N/D
Odor:	Mild
Melting Point:	N/A
Boiling Point:	212°F
Solubility in Water:	Complete
Evaporation Rate:	N/D
Vapor Density:	N/D
Molecular Weight:	N/D
Viscosity:	N/A
Flammable Limits:	N/A
Autoignition Temperature:	N/A
Density:	11.13 lb/ga
Vapor Pressure:	N/D
% VOC	0

Section 10. Stability and Reactivity

Chemical Stability: Stable at normal temperatures and pressures.

Incompatibility with Various Substances: Strong oxidizers, Strong bases

Hazardous Decomposition Products: Hydrochloric acid

Possibility of Hazardous Reactions: None known.

Section 11. Toxicological Information

Chemical Name	Exposure	Type of Effect	Concentration	Species
N/D				

Comments: None.

Section 12. Ecological Information

Species	Duration	Type of Effect	Test Results
Ceriodaphnia dubia	48h	LC50	>2000 mg/l
Daphnia pulex	48h	LC50	7071 mg/l
Fathead Minnow	96h	LC50	>1000 mg/l
	48h	LC50	3675 mg/l

Comments: None.

Section 13. Disposal Considerations

Dispose of in accordance with local, state and federal regulations.

Section 14. Transport Information

DOT Classification

DOT Name: COMPOUND, INDUSTRIAL WATER TREATMENT, LIQUID
Technical Name: N/A
Hazard Class: Not D.O.T. Regulated.
UN/NA#: N/A
Packing Group: N/A

Section 15. Regulatory Information

Inventory Status

United States (TSCA): All ingredients listed.
Canada (DSL/NDSL): All ingredients listed.

Federal Regulations

SARA Title III Rules

Sections 311/312 Hazard Classes

Fire Hazard: No
Reactive Hazard: No
Release of Pressure: No
Acute Health Hazard: Yes
Chronic Health Hazard: No

Other Sections

Component	Section 313 Toxic Chemical	Section 302 EHS TPQ	CERCLA RQ
Aluminum chlorohydrate	N/A	N/A	N/A

State Regulations

California Proposition 65: None known.

Special Regulations

Component	States
Aluminum chlorohydrate	None

International Regulations

Canada

WHMIS Classification: N/A

Controlled Product Regulations (CPR): N/A

Section 16. Other Information

HMIS Hazard Rating

Health:	1
Flammability:	0
Physical Hazard:	0
PPE:	X

Notes: The PPE rating depends on circumstances of use. See Section 8 for recommended PPE.
The Hazardous Material Information System (HMIS) is a voluntary, subjective alpha-numeric symbolic system for recommending hazard risk and personal protection equipment information. It is a subjective rating system based on the evaluator's understanding of the chemical associated risks. The end-user must determine if the code is appropriate for their use.

NSF: Certified to NSF/ANSI Standard 60
Maximum use rate for potable water – 250 mg/L
This product ships as NSF from:
Ashland, VA
Eldridge, IA
Nederland, TX
Orangeburg, SC
Canada
Baltimore, MD
Bastrop, LA
Vernon, CA

FDA: GRAS – Using the Eligibility for Classification outlined in 21 CFR 170.30, ChemTreat has determined that this product is considered Generally Recognized as Safe (GRAS) and complies with 21 CFR 182.90, "Substance migrating to food from paper and paperboard products."

KOSHER: This product has not been evaluated for Kosher approval.

FIFRA: N/A

Other: None



Abbreviations

Abbreviation	Definition
<	Less Than
>	Greater Than
ACGIH	American Conference of Governmental Industrial Hygienists
EHS	Environmental Health and Safety Dept
N/A	Not Applicable
N/D	Not Determined
N/E	Not Established
OSHA	Occupational Health and Safety Dept
PEL	Personal Exposure Limit
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weight Average
UNK	Unknown

Prepared by: Regulatory Affairs Department

Disclaimer

Although the information and recommendations set forth herein (hereinafter "information") are presented in good faith and believed to be correct as of the date hereof, ChemTreat, Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will ChemTreat, Inc. be responsible for damages of any nature whatsoever resulting from the use or reliance upon information. No representation or warranties, either expressed or implied, of merchantability, fitness for a particular purpose, or of any other nature are made hereunder with respect to information or the product to which information refers.

MATERIAL SAFETY DATA SHEET

Section 1. Chemical Product and Company Identification

Product Name: ChemTreat P8007L
Product Use: Metal Precipitant
Supplier's Name: ChemTreat, Inc.
Emergency Telephone Number: (800) 424-9300 (Toll Free)
(703) 527-3887
Address (Corporate Headquarters): 4461 Cox Road
Glen Allen, VA 23060
Telephone Number for Information: (800) 648-4579
Date of MSDS: April 12, 2011

Section 2. Hazard(s) Identification



Signal Word: WARNING!

Hazard Statement(s): May be harmful in contact with skin.
May be harmful if inhaled.
May be harmful if swallowed.

Precautionary Statement(s): No significant health risks are expected from exposures under normal conditions of use.

Section 3. Composition/Hazardous Ingredients

Component	CAS Registry #	Wt. %
Proprietary	Proprietary	

Section 4. First Aid Measures

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.

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 advice/attention.

Skin: Wash with plenty of soap and water. Call a poison center or doctor/physician if you feel unwell.

Ingestion: DO NOT INDUCE VOMITING. Rinse mouth. Call a POISON CENTER or doctor/physician if you feel unwell.

Notes to Physician: N/A

Additional First Aid Remarks: N/A

Section 5. Fire Fighting Measures

Flammability of the Product: Not flammable.

Suitable Extinguishing Media: Use extinguishing media suitable to surrounding fire.

Specific Hazards Arising from the Chemical: None known.

Protective Equipment: If product is involved in a fire, wear full protective clothing including a positive-pressure, NIOSH approved, self-contained breathing apparatus.

Section 6. Accidental Release Measures

Personal Precautions: Use appropriate Personal Protective Equipment (PPE).

Environmental Precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains, and sewers.

Methods for Cleaning up: Contain and recover liquid when possible. Flush spill area with water spray.

Other Statements: None.

Section 7. Handling and Storage

Handling: Wear appropriate Personal Protective Equipment (PPE) when handling this product. Do not get in eyes, or on skin and clothing. Wash thoroughly after handling. Do not ingest. Avoid breathing vapors, mist or dust.

Storage: Store away from incompatible materials (see Section 10). Store at ambient temperatures. Keep container securely closed when not in use. Label precautions also apply to empty container. Recondition or dispose of empty containers in accordance with government regulations. For Industrial use only. Protect from heat and sources of ignition. Do not store above 95°F.

Section 8. Exposure Controls/Personal Protection

Exposure Limits

Component	Source	Exposure Limits
Proprietary		N/E

Carcinogenicity Category

Component	Source	Code	Brief Description
Proprietary			N/E

Engineering Controls:

Use only with adequate ventilation. The use of local ventilation is recommended to control emission near the source.

Personal Protection

- Eyes:** Wear chemical splash goggles or safety glasses with full-face shield. Maintain eyewash fountain in work area.
- Skin:** Maintain quick-drench facilities in work area.
Wear butyl rubber or neoprene gloves. Wash them after each use and replace as necessary. If conditions warrant, wear protective clothing such as boots, aprons, and coveralls to prevent skin contact.
- Respiratory:** If misting occurs, use NIOSH approved organic vapor/acid gas dual cartridge respirator with a dust/mist prefilter in accordance with 29 CFR 1910.134.

Section 9. Physical and Chemical Properties

Physical State and Appearance:	Liquid, Amber, Clear
Specific Gravity:	1.119 @ 20°C
pH:	10.8 @ 20°C, 10.0%
Freezing Point:	28°F
Flash Point:	N/D
Odor:	Strong
Melting Point:	N/A
Boiling Point:	212°F
Solubility in Water:	Complete
Evaporation Rate:	N/D
Vapor Density:	N/D
Molecular Weight:	N/D
Viscosity:	N/A
Flammable Limits:	N/A
Autoignition Temperature:	N/A
Density:	9.33 lb/ga
Vapor Pressure:	N/D
% VOC	0

Section 10. Stability and Reactivity

Chemical Stability:	Stable at normal temperatures and pressures.
Incompatibility with Various Substances:	Strong oxidizers, Strong acids
Hazardous Decomposition Products:	Oxides of nitrogen, Oxides of carbon, Oxides of sulfur
Possibility of Hazardous Reactions:	None known.

Section 11. Toxicological Information

Chemical Name	Exposure	Type of Effect	Concentration	Species
ChemTreat P8007L	Oral	LD50	>5000 mg/kg	Rat

Comments: None.

Section 12. Ecological Information

Species	Duration	Type of Effect	Test Results
Zebra fish	96h	LC50	>100 mg/l
Daphnia magna	48h	EC50	>100 mg/l

Comments: None.

Section 13. Disposal Considerations

Dispose of in accordance with local, state and federal regulations.

Section 14. Transport Information

DOT Classification

DOT Name:	COMPOUND, INDUSTRIAL WATER TREATMENT, LIQUID
Technical Name:	N/A
Hazard Class:	Not D.O.T. Regulated.
UN/NA#:	N/A
Packing Group:	N/A

Section 15. Regulatory Information

Inventory Status

United States (TSCA): All ingredients listed.
Canada (DSL/NDSL): All ingredients listed.

Federal Regulations

SARA Title III Rules

Sections 311/312 Hazard Classes

Fire Hazard: No
Reactive Hazard: No
Release of Pressure: No
Acute Health Hazard: Yes
Chronic Health Hazard: No

Other Sections

Component	Section 313 Toxic Chemical	Section 302 EHS TPQ	CERCLA RQ
Proprietary	N/A	N/A	N/A

Comments: None.

State Regulations

California Proposition 65: None known.

Special Regulations

Component	States
Proprietary	None

International Regulations

Canada

WHMIS Classification: N/A

Controlled Product Regulations (CPR): N/A

Section 16. Other Information

HMIS Hazard Rating

Health: 1
Flammability: 0
Physical Hazard: 0
PPE: X

Notes: The PPE rating depends on circumstances of use. See Section 8 for recommended PPE.
The Hazardous Material Information System (HMIS) is a voluntary, subjective alpha-numeric symbolic system for recommending hazard risk and personal protection equipment information. It is a subjective rating system based on the evaluator's understanding of the chemical associated risks. The end-user must determine if the code is appropriate for their use.

NSF: N/A

FDA: N/A

KOSHER: This product has not been evaluated for Kosher approval.

FIFRA: N/A

Other: None

Abbreviations

Abbreviation	Definition
<	Less Than
>	Greater Than
ACGIH	American Conference of Governmental Industrial Hygienists
EHS	Environmental Health and Safety Dept
N/A	Not Applicable
N/D	Not Determined
N/E	Not Established
OSHA	Occupational Health and Safety Dept
PEL	Personal Exposure Limit
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weight Average
UNK	Unknown

Prepared by: Regulatory Affairs Department



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MATERIAL SAFETY DATA SHEET

Section 1. Chemical Product and Company Identification

Product Name: ChemTreat P817E
Product Use: Water Clarification/Solids Conditioning Agent
Supplier's Name: ChemTreat, Inc.
Emergency Telephone Number: (800) 424-9300
Address (Corporate Headquarters): 4461 Cox Road
Glen Allen, VA 23060
Telephone Number for Information: (800) 648-4579
Date of MSDS: November 30, 2009

Section 2. Hazard(s) Identification



Signal Word: WARNING!

Hazard Statement(s): May be harmful in contact with skin.
May be harmful if inhaled.
May be harmful if swallowed.

Precautionary Statement(s): No significant health risks are expected from exposures under normal conditions of use.

Section 3. Composition/Hazardous Ingredients

Component	CAS Registry #	Wt. %
There are no hazardous ingredients in this product as defined in 29 CFR 1910.1200.	Proprietary	N/A

Section 4. First Aid Measures

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.

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 advice/attention.

Skin: Wash with plenty of soap and water. Call a poison center or doctor/physician if you feel unwell.

Ingestion: DO NOT INDUCE VOMITING. Rinse mouth. Call a POISON CENTER or doctor/physician if you feel unwell.

Notes to Physician: N/A

Additional First Aid Remarks: N/A

Section 5. Fire Fighting Measures

Flammability of the Product: Not flammable.

Suitable Extinguishing Media: Use extinguishing media suitable to surrounding fire.

Specific Hazards Arising from the Chemical: None known.

Protective Equipment: If product is involved in a fire, wear full protective clothing including a positive-pressure, NIOSH approved, self-contained breathing apparatus.

Section 6. Accidental Release Measures

Personal Precautions: Use appropriate Personal Protective Equipment (PPE).

Environmental Precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains, and sewers.

Methods for Cleaning up: Contain and recover liquid when possible. Flush spill area with water spray.

Other Statements: None.

Section 7. Handling and Storage

Handling: Wear appropriate Personal Protective Equipment (PPE) when handling this product. Do not get in eyes, or on skin and clothing. Wash thoroughly after handling. Do not ingest. Avoid breathing vapors, mist or dust. Material is very slippery if spilled.

Storage: Store away from incompatible materials (see Section 10). Store at ambient temperatures. Keep container securely closed when not in use. Label precautions also apply to empty container. Recondition or dispose of empty containers in accordance with government regulations. For Industrial use only. Keep from freezing. Do not store below 41°F. Do not store above 86°F.

Section 8. Exposure Controls/Personal Protection

Exposure Limits

Component	Source	Exposure Limits
There are no hazardous ingredients in this product as defined in 29 CFR 1910.1200.		N/E

Carcinogenicity Category

Component	Source	Code	Brief Description
There are no hazardous ingredients in this product as defined in 29 CFR 1910.1200.			N/E

Engineering Controls:

Use only with adequate ventilation. The use of local ventilation is recommended to control emission near the source.

Personal Protection

Eyes:

Wear chemical splash goggles or safety glasses with full-face shield. Maintain eyewash fountain in work area.

Skin:

Maintain quick-drench facilities in work area.
Wear butyl rubber or neoprene gloves. Wash them after each use and replace as necessary. If conditions warrant, wear protective clothing such as boots, aprons, and coveralls to prevent skin contact.

Respiratory:

If misting occurs, use NIOSH approved organic vapor/acid gas dual cartridge respirator with a dust/mist prefilter in accordance with 29 CFR 1910.134.

Section 9. Physical and Chemical Properties

Physical State and Appearance:	Liquid Emulsion, White, Opaque
Specific Gravity:	1.0720
pH:	6.0 – 8.0
Freezing Point:	0°F
Flash Point:	N/D
Odor:	Mild
Melting Point:	N/A
Boiling Point:	N/D
Solubility in Water:	Complete
Evaporation Rate:	N/D
Vapor Density:	N/D
Molecular Weight:	N/D
Viscosity:	N/A
Flammable Limits:	N/A
Autoignition Temperature:	N/A
Density:	8.94 lb/ga



Vapor Pressure:
% VOC

0.002 mmHg, @ 20C
10

Section 10. Stability and Reactivity

Chemical Stability: Stable at normal temperatures and pressures.

Incompatibility with Various Substances: Strong oxidizers

Hazardous Decomposition Products: Oxides of carbon, Oxides of nitrogen

Possibility of Hazardous Reactions: None known.

Section 11. Toxicological Information

Chemical Name	Exposure	Type of Effect	Concentration	Species
ChemTreat P817E	Oral	LD50	>5000 mg/kg	Rat

Comments: None.

Section 12. Ecological Information

Species	Duration	Type of Effect	Test Results
Algae	72h	IC50	>100 mg/l
Daphnia magna	48h	EC50	>100 mg/l
Mysid Shrimp	48h	LC50	6.8 mg/l
Inland Silverside	96h	LC50	320 mg/l
Fathead Minnow	96h	LC50	104 mg/l
Ceriodaphnia dubia	48h	LC50	0.58 mg/l

Comments: None.

Section 13. Disposal Considerations

Dispose of in accordance with local, state and federal regulations.
Not a RCRA-regulated hazardous waste when disposed in the original product form.

Section 14. Transport Information

DOT Classification

DOT Name: COMPOUND, INDUSTRIAL WATER TREATMENT, LIQUID
Technical Name: N/A
Hazard Class: Not D.O.T. Regulated.
UN/NA#: N/A
Packing Group: N/A

Section 15. Regulatory Information

Inventory Status

United States (TSCA): All ingredients listed.
Canada (DSL/NDSL): All ingredients listed.

Federal Regulations

SARA Title III Rules

Sections 311/312 Hazard Classes

Fire Hazard: No
Reactive Hazard: No
Release of Pressure: No
Acute Health Hazard: Yes
Chronic Health Hazard: No

Other Sections

Component	Section 313 Toxic Chemical	Section 302 EHS TPQ	CERCLA RQ
There are no hazardous ingredients in this product as defined in 29 CFR 1910.1200.	N/A	N/A	N/A

State Regulations

California Proposition 65: This product contains chemical(s) known to the State of California to cause cancer and/or to cause birth defects or other reproductive harm: residual acrylamide.

Special Regulations

Component	States
There are no hazardous ingredients in this product as defined in 29 CFR 1910.1200.	None

International Regulations

Canada

WHMIS Classification: N/A

Controlled Product Regulations (CPR): N/A

Section 16. Other Information

HMIS Hazard Rating

Health: 1
Flammability: 1
Physical Hazard: 0
PPE: X

Notes: The PPE rating depends on circumstances of use. See Section 8 for recommended PPE.
The Hazardous Material Information System (HMIS) is a voluntary, subjective alpha-numeric symbolic system for recommending hazard risk and personal protection equipment information. It is a subjective rating system based on the evaluator's understanding of the chemical associated risks. The end-user must determine if the code is appropriate for their use.

NSF: N/A

FDA: N/A

KOSHER: This product is certified by the Orthodox Union as kosher pareve.

FIFRA: N/A

Other: None

Abbreviations

Abbreviation	Definition
<	Less Than
>	Greater Than
ACGIH	American Conference of Governmental Industrial Hygienists
EHS	Environmental Health and Safety Dept
N/A	Not Applicable
N/D	Not Determined
N/E	Not Established
OSHA	Occupational Health and Safety Dept
PEL	Personal Exposure Limit
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weight Average
UNK	Unknown

Prepared by: Regulatory Affairs Department

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“...providing sulfide reagents for treatment of COPR and other metal-bearing wastes...”

Material Safety Data Sheet

FerroBlack (Hybrid)

Section 1: CHEMICAL PRODUCT and COMPANY IDENTIFICATION

1.1 Product Name:	FerroBlack
Chemical Family:	Inorganic salt solution
Synonyms:	IRON (II) SULFIDE, FERROUS SULPHIDE, IRON (II) SULPHIDE
Formula:	FeS
1.2 Manufacturer Information:	Redox Solutions, LLC
	11550 N. Meridian Street, Suite 180
	Carmel, IN 46032
1.3 Emergency Contact:	(317) 660-6867

Section 2: COMPOSITION, INFORMATION ON INGREDIENTS

2.1 Chemical Ingredients (% by wt.)

Ferrous Sulfide Slurry	CAS #:1317-37-9	7%-8%
Sodium Hydrosulfide	CAS #:16721-80-5	1%-2%
Water	CAS #:7732-18-5 71	80% -82%

Section 3: HAZARDS IDENTIFICATION

NFPA: **Health - 0** **Flammability - 0** **Reactivity - 2**

May be irritating to eyes and mucous membranes. Avoid inhalation of any fumes which may be given off when used or when bottle is opened. Consider toxic orally or by inhalation. LD/TD no data. PEL/TLV:TWA 1mg(Fe)/m³. No known carcinogenicity.

Section 4: FIRST AID MEASURES

4.1 EYES: Immediately flush with large quantities of water for 15 minutes. Hold eyelids apart during irrigation to insure thorough flushing of the entire area of the eye and lids. Obtain immediate medical attention.

4.2 SKIN: Immediately flush with large quantities of water. Remove contaminated clothing under a safety shower.

4.3 INGESTION: If swallowed, give water or milk and induce vomiting. Call a physician.

Section 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

FLASH POINT: Not flammable **METHOD USED:** NA

5.2 EXTINGUISHING MEDIA: Use extinguishing media appropriate for surrounding fire

Section 6: ACCIDENTAL RELEASE MEASURES

6.1 Releases: Confine and absorb small releases on sand, earth or other inert absorbent. Dispose in accordance with all applicable environmental regulations.

Section 7: HANDLING and STORAGE

7.1 Handling: Use only with adequate ventilation. Use protective clothing to prevent contact with skin or eyes.

7.2 Storage: Store in well ventilated areas. Do not store combustibles in the area of storage vessels. Keep away from any sources of heat or flame. Store tote and smaller containers out of direct sunlight at moderate temperatures [$<80^{\circ}\text{F}$ (27°C)]. (See addendum for materials of construction)

Section 8: EXPOSURE CONTROLS, PERSONAL PROTECTION

8.1 RESPIRATORY PROTECTION: None required if adequate ventilation is provided.

8.2 SKIN PROTECTION: Proper Gloves

8.3 EYE PROTECTION: Safety glasses with side-shield.

Section 9: PHYSICAL and CHEMICAL PROPERTIES

9.1 APPEARANCE: Black liquid with visible suspended solids

9.2 ODOR: No appreciable odor.

9.3 BOILING POINT: Not determined

9.4 VAPOR PRESSURE: Not determined (Believed to be minimal)

9.5 VAPOR DENSITY: Not determined

9.6 SOLUBILITY IN WATER: Insoluble.

9.7 SPECIFIC GRAVITY: 1.21

9.8 FREEZING POINT: Not determined

9.9 pH: 9.5 – 12.3

9.10 VOLATILE:

Not applicable

Section 10: STABILITY and REACTIVITY

10.1 STABILITY: This is a stable material

10.2 HAZARDOUS POLYMERIZATION: Will not occur.

10.3 INCOMPATIBILITY: Acids will cause the release of highly toxic Hydrogen Sulfide. Reacts violently with diazonium salts. Sodium Hydrosulfide solution is not compatible with copper, zinc, aluminum or their **alloys** (i.e. bronze, brass, galvanized metals, etc.). Corrosive to steel above 150° F (65.5° C). These materials of construction should not be used in handling systems or storage containers for this product.

Section 11: TOXICOLOGICAL INFORMATION

Not generally regarded as a health hazard.

Section 12: DISPOSAL CONSIDERATIONS

If released to the environment for other than its intended purpose, this product should be checked to see it meets the criteria of a reactive sulfide D003, Reactive waste.

Section 14: TRANSPORT INFORMATION

14.1 DOT Shipping Name: Non-hazardous, Non-Regulated Liquid (Ferrous Sulfide Slurry)

14.2 DOT Hazard Class: NA

14.3 UN/NA Number: NA

14.4 Packing Group: NA

14.5 DOT Placard: NA

14.6 DOT Label(s): NA

14.7 IMO Shipping Name: Not Determined

14.8 RQ (Reportable Quantity): NA

14.9 RR STCC Number: Not Determined

Section 13: DISCLOSURE

While the information and recommendations contained herein are based on data that is believed to be correct, Redox Solutions, LLC makes no guarantee or warranty of any kind, expressed or implied with respect to the information contained herein. We reserve the right to revise material safety data sheets periodically as new information becomes available. (MSDS Revised: 6/27/10)

MATERIAL SAFETY DATA SHEET

Date: 3/15/96

Revision: 2/1/06

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **MOLASSES, MOLASSES BLENDS & BINDERS**

Chemical Name: NA

Chemical Formula

Use:

Mixture of liquid

Agricultural commodities

Trade Name - Molasses/Molasses Blends

Company Identification:

Westway Feed Products, Inc.

14015 Park Drive, Suite 217

Tomball, TX 77377

(800) 654-9668

NFPA HAZARD CLASS: (0) Health, (0) Flammability, (0) and Reactivity

2. COMPOSITION, INFORMATION ON INGREDIENTS

CAS Registry No.

%(Approx.)

ACGIH TLV-TWA

Proprietary

NA

No data

See ingredient tag

3. HAZARDS IDENTIFICATION

Potential Health Effects

Eyes: Contact may cause mild irritant of stinging, watering and redness.

Skin: Contact may cause mild irritant of redness and burning.

Inhalation: No information available. Could maybe be an irritant to respiratory tract. Insufficient oxygen may be present in vessels containing the product due to the generation of carbon monoxide during fermentation

Ingestion: No information available. Studies would suggest gastrointestinal irritation; nausea, vomiting and diarrhea may be possible.

Potential Chronic Health Effects: No Potential chronic effects known. Urea is a naturally occurring chemical in the body. It is an end product of protein metabolism and is excreted in urine.

Cancer: No known contributing evidence available at this time.

4. FIRST AID MEASURES

Eyes: Flush eyes for 15 minutes.

Skin: Wash with soap and water.

Ingestion: No data

5. FIRE FIGHTING MEASURES

Flashpoint (Method used)

Flammable Limits in Air

Non-flammable	Non-flammable
Non-combustible	Non-combustible

.....

Extinguishing	Agents	-	NA

.....

Unusual Fire and Explosion Hazards - Fermentation occurs when diluted with water and is accelerated by heat. During fermentation carbon monoxide with possible traces of ethanol or volatile fatty acids (e.g., acetic, propionic, lactic, or butyric) is given off, which produces inhalation hazards and possible explosion hazards.

.....

6. ACCIDENTAL RELEASE MEASURES

.....

Small Spills: Absorb with commercial or other absorbent and shovel into container for proper disposal.

Large Spill: Stop the source of the spill. Dike up with absorbent material for containment. Prevent the release from entering a waterway or sewer. Recover useable product. Mop up or pump material into a container (metal/plastic bin) for proper disposition at an approved facility such as a municipal landfill or land application site. If solid crystals form as the material cools, add water to help clean up.

Release Notes: If spill could potentially enter any waterway such as small creeks, contact local authorities. For navigable waterways contact the US Coast Guard Nation Response Center 800-424-8802. Notify as appropriate federal, state and local agencies. Clean up any spills immediately.

.....

7. HANDLING AND STORAGE

.....

This material should be stored in a vented tank designed to contain a material with a specific gravity of 1.3 or greater. Material can ferment if excessive moisture contamination is allowed. Fermentation can yield carbon dioxide with possible traces of ethanol or volatile fatty acids (e.g. acetic, propionic, lactic, or butyric) and if exposed to a spark or flame may result in an explosion. These conditions should be avoided.

If maintenance of tank requires entry by personnel, OSHA's Confined Space standard (29CFR1910.146) shall be complied with. If welding is to be performed, the tank should be gas freed and only certified welders shall perform welding operations.

Handling: Avoid contact with eyes or prolonged skin contact.

Storage: Protect against physical or chemical contamination.

.....

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

.....

Respiratory Protection - None

Ventilation - Provide adequate ventilation to prevent accumulation of vapors.

Skin Protection - Rubber gloves

Eye Protection - Safety glasses

Hygiene - Wash any exposed area promptly with soap and water. Launder contaminated clothing

Other Control Measures - None

.....
9. PHYSICAL AND CHEMICAL PROPERTIES
.....

Appearance	Odor
Dark brown syrupy liquid	Sweet
.....	
Physical State	Specific Gravity
Liquid	1.45
.....	
Boiling Point	Freezing/Melting Point
Very high	Varies
.....	
Vapor Pressure	% Volatile, by Volume
Low	No data
.....	
Evaporation Rate	Vapor Density in Air
No data	Water vapor only
.....	
Solubility in Water	pH
Soluble	2.25 to 6.0
.....	

.....
10. STABILITY AND REACTIVITY
.....

Chemical Stability - Stable
Conditions to Avoid - Excess moisture or heat. Unventilated containers.

Incompatibility with Other Materials -

Reacts with concentrated nitric acid or concentrated sulphuric acid. Ferments when diluted with water.

Hazard Decomposition Products - Carbon monoxide, alcohol or fatty acid vapors

Hazardous Polymerization - NA
.....

.....
11. TOXICOLOGICAL INFORMATION
.....

None

.....
12. ECOLOGICAL INFORMATION
.....

Prevent releases to land or water. Results in high Biological Oxygen Demand (BOD) and potential oxygen depletion of aquatic systems.

.....
13. DISPOSAL CONSIDERATIONS
.....

Dispose of waste material at an approved municipal landfill or land application site.

.....
14. TRANSPORT INFORMATION
.....

Hazardous Materials Description/ Proper Shipping Name - NA

DOT Hazard Class - NA

DOT Identification Number - NA

This product is not a DOT hazardous material.

.....
15. REGULATORY INFORMATION
.....

Discharges to a water of the U.S. are regulated by the Environmental Protection Agency.

.....
16. OTHER INFORMATION
.....

Disclaimer:

WESTWAY FEED PRODUCTS provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. WESTWAY FEED PRODUCTS makes no representations or warranties, either express or implied, including without limitation any warranties of merchantability, fitness for a particular purpose with respect to the information set forth herein or the product to which the information refers. Accordingly, WESTWAY FEED PRODUCTS will not be responsible for damages resulting from use of or reliance upon this information.

MSDS Number: **F1802** * * * * * Effective Date: **09/08/09** * * * * * Supersedes: **05/04/07**

MSDS Material Safety Data Sheet From: Mallinckrodt Baker, Inc. 222 Red School Lane Phillipsburg, NJ 08865		24 Hour Emergency Telephone: 908-658-2151 CHEMTREC: 1-800-424-9300
		National Response in Canada CANUTEC: 513-495-6566
Mallinckrodt CHEMICALS J.T. Baker		Outside U.S. and Canada Chemtrec: 703-527-3887
NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.		
All non-emergency questions should be directed to Customer Service (1-800-562-2537) for assistance.		

FERROUS SULFATE

1. Product Identification

Synonyms: Iron (II) sulfate (1:1); sulfuric acid, iron (2+) salt (1:1), heptahydrate
CAS No.: 7720-78-7 (Anhydrous) 7782-63-0 (heptahydrate)
Molecular Weight: 278
Chemical Formula: FeSO₄ 7H₂O
Product Codes:
 J.T. Baker: 2063, 2070, 2074
 Mallinckrodt: 5055, 5056, 5401, 5572

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ferrous Sulfate	7720-78-7	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
 Flammability Rating: 0 - None
 Reactivity Rating: 1 - Slight
 Contact Rating: 2 - Moderate
 Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
 Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:

Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath.

Ingestion:

Low toxicity in small quantities but larger dosages may cause nausea, vomiting, diarrhea, and black stool. Pink urine discoloration is a strong indicator of iron poisoning. Liver damage, coma, and death from iron poisoning has been recorded. Smaller doses are much more toxic to children.

Skin Contact:

Causes irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact:

Causes irritation, redness, and pain.

Chronic Exposure:

Severe or chronic ferrous sulfate poisonings may damage blood vessels. Large chronic doses cause rickets in infants. Chronic exposure may cause liver effects. Prolonged exposure of the eyes may cause discoloration.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:

Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Maintain a constant temperature not to exceed 24 degrees centigrade (75 degrees fahrenheit). Fluctuating temperatures causes product oxidation. Do not use this product if coated with brownish-yellow basic ferric sulfate. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-ACGIH Threshold Limit Value (TLV):

1 mg/m³ (TWA) soluble iron salt as Fe

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a half facepiece particulate respirator (NIOSH type N95 or better filters) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest.. A full-face piece particulate respirator (NIOSH type N100 filters) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Blue green crystals.

Odor:

Odorless.

Solubility:

48.6 g/100 g water @ 50C (122F)

Density:

1.90

pH:

No information found.

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

> 300C (> 572F) Decomposes.

Melting Point:

57C (135F) Loses water

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Loses water in dry air and oxidizes upon exposure to moisture, forming a brown coating of extremely corrosive basic ferric sulfate.

Hazardous Decomposition Products:

Burning may produce sulfur oxides.

Hazardous Polymerization:

This substance does not polymerize.

Incompatibilities:

Alkalis, soluble carbonates, and oxidizing materials. Reacts in moist air to form ferric sulfate.

Conditions to Avoid:

Moisture.

11. Toxicological Information

Oral rat LD50: 319 mg/kg. Investigated as a tumorigen and mutagen.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Ferrous Sulfate (7720-78-7)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Ferrous Sulfate (7720-78-7)	Yes	Yes	Yes	Yes
-----\Chemical Inventory Status - Part 2\-----				
Ingredient	--Canada--			
	Korea	DSL	NDSL	Phil.
Ferrous Sulfate (7720-78-7)	Yes	Yes	No	Yes
-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Ferrous Sulfate (7720-78-7)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----
Ingredient CERCLA RCRA TSCA
----- 261.33 8(d)

Ferrous Sulfate (7720-78-7) 1000 No No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 0 Reactivity: 0

Label Hazard Warning:

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

Label Precautions:

Avoid contact with eyes, skin and clothing.

Wash thoroughly after handling.

Avoid breathing dust.

Keep container closed.

Use only with adequate ventilation.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent. Bulk pharmaceutical chemical.

Revision Information:

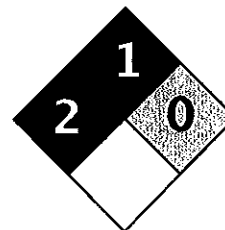
No Changes.

Disclaimer:

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Prepared by: Environmental Health & Safety

Phone Number: (314) 654-1600 (U.S.A.)



Health	2
Fire	1
Reactivity	0
Personal Protection	J

Material Safety Data Sheet

Ferrous sulfide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ferrous sulfide

Catalog Codes: SLF1171

CAS#: 1317-37-9

RTECS: Not available.

TSCA: TSCA 8(b) inventory: Ferrous sulfide

CI#: Not available.

Synonym:

Chemical Formula: FeS

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ferrous sulfide	1317-37-9	100

Toxicological Data on Ingredients: Ferrous sulfide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation.

Potential Chronic Health Effects:

Very hazardous in case of ingestion.

Hazardous in case of eye contact (irritant), of inhalation.

CARCINOGENIC EFFECTS: Not available.

MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact: No known effect on skin contact, rinse with water for a few minutes.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:

Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

SMALL FIRE: Use DRY chemical powder.

LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If

you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, acids.

Storage:

Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Splash goggles. Lab coat.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: TWA: 1 (mg/m³) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 87.92 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: Decomposes.

Melting Point: 1194°C (2181.2°F)

Critical Temperature: Not available.

Specific Gravity: 4.84 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.

LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:

Very hazardous in case of ingestion.

Hazardous in case of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Ferrous sulfide

Other Regulations: Not available..

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:

Not applicable.

Lab coat.

Not applicable.

Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 05:33 PM

Last Updated: 11/06/2008 12:00 PM

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Material Safety Data Sheet

Calmet® Calcium Polysulfide

Page 1 of 6

SECTION 1 PRODUCT & COMPANY IDENTIFICATION

In case of Emergency call CHEMTREC 1-800-424-9300

Supplier	Expo Chemical Co., Inc. 6807 Theall Road, Suite A Houston, Texas 77066 281-895-9200 or 877-258-EXPO (3976) www.expochem.com
Product Name	Calmet® Calcium Polysulfide
Chemical Name	Calcium Polysulfide
Formula	CaS _x
Molecular Weight	200.06
Synonyms	Lime Sulfur

SECTION 2 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	Percent	CAS #
Calcium Polysulfide	29	1344-81-6
Inerts	71	-

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not "Hazardous" per this OSHA standard may be listed. Where proprietary ingredients show, the identity may be made available as provided in this standard.

SECTION 3 HAZARDS IDENTIFICATION (POTENTIAL HEALTH EFFECTS)

EMERGENCY OVERVIEW

WARNING: MAY BE FATAL IF SWALLOWED; CORROSIVE TO SKIN; CAUSES IRREVERSIBLE EYE DAMAGE AND SKIN BURNS.

Eye	Chemically burned eye tissue as from Calcium Hydroxide (lye), may produce severe membrane irritation with corneal damage.
Skin	Chemically burned skin as from Calcium Hyrdroxide (lye), may produce systemic toxicity by skin absorption.
Ingestion	This material decomposes in the digestive tract to release Sulfur and Hydrogen Sulfide (H ₂ S). Signs and symptoms of toxicity may include headache, nausea, vomiting, drowsiness, amnesia, tremors, depressed respiration, convulsions, cyanosis and death due to respiratory paralysis. Severe irritation of the digestive tract may also occur.

SECTION 3 HAZARDS IDENTIFICATION, CONTINUED

Inhalation	Symptoms are those of Hydrogen Sulfide (H ₂ S). Inhalation of H ₂ S is irritating to the respiratory tract. If respiratory irritation or any signs or symptoms described in this bulletin occur, move the person to fresh air. If these effects continue, see a medical doctor immediately.
Existing Medical Conditions Possibly Aggravated by Exposure	Skin irritation may be aggravated in individuals with existing skin lesions. Breathing of H ₂ S gas may aggravate acute or chronic asthma and chronic pulmonary disease such as emphysema and bronchitis.

SECTION 4 FIRST AID MEASURES

Remove the patient from immediate source of exposure and assure that the individual is breathing. If not breathing, use artificial respiration. GET MEDICAL ATTENTION.	
Eye	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes using an eyewash fountain. Lift upper and lower lids and rinse well under them. GET MEDICAL ATTENTION.
Skin	Wash all affected areas with plenty of soap and water under a safety shower for at least 15 minutes, while removing contaminated clothing and shoes. Do not attempt to neutralize with chemical agents. Seek medical attention immediately. Discard any contaminated clothing and shoes.
Ingestion	If swallowed, do not give anything but water, see a physician immediately.
Inhalation	Remove victim to fresh air. If not breathing, administer cardiopulmonary resuscitation or artificial respiration. If breathing is difficult or irritation develops, GET MEDICAL ATTENTION.
Notes to Physicians	For severe Hydrogen Sulfide poisoning, successful treatment has involved initial inhalation of Amyl Nitrite pearls for 15 to 30 seconds of each minute until 10 mls of a 3% solution of Sodium Nitrite can be administered intravenously at 2.5 to 5 mls per minute. The Nitrate-induced Methemoglobin is thought to bind the toxic Hydro-Sulfide ion.

SECTION 5 FIRE FIGHTING MEASURES

Flash Point	Not determined.
Hazardous Decomposition Products	Normal combustion products are Carbon Dioxide and Water Vapor and may produce Oxides of Sulfur. Incomplete combustion or thermal decomposition can produce Carbon Monoxide, Oxyhydrocarbon derivatives and Sulfur derivatives including Hydrogen Sulfide.
Extinguishing Media	CO ₂ , Dry Chemical, Foam, Water Spray
Special Fire Fighting Procedures	Smoke from fires may present unusual hazards. avoid breathing smoke. Avoid contact with fall out and runoff. Minimize amount of water used for fire fighting. Do not enter

SECTION 5 FIRE FIGHTING MEASURES, CONTINUED

Special Fire Fighting Procedures, Continued	any enclosed area without full protective equipment, including self-contained breathing equipment. Contain and isolate runoff and debris for proper disposal. Prevent unauthorized entry to fire area. Keep fire-exposed containers cool with water spray. Read entire bulletin.
Additional Procedures	Persons who have been exposed to contaminated smoke should be immediately relieved from duty and checked for symptoms of poisoning. These should not be mistaken for heat exhaustion or smoke inhalation.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Spill	Follow the spill procedures on the container. DO NOT USE ACIDIC CLEANING MATERIALS. Cover spill with generous amount of absorbent such as clay or loam soil. Use a stiff broom to mix thoroughly. Sweep up and place in a disposable container. Scrub contaminated area with detergent soap and water using a stiff broom. Pick up liquid with more absorbent and place in disposable container.

SECTION 7 HANDLING AND STORAGE

Handling	Do not heat drums with any welding equipment as explosion may occur. Avoid breathing gas. Do not get in eyes, on skin, or on clothing.
Storage	Store in a cool, dry place in properly designed vessels.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective Equipment Should be Used During the Following Procedures	Manufacture or formulation of this product. Repair and maintenance of contaminated equipment. Clean up or leaks and spills. Any other activity that may result in hazardous exposures.
Respiratory Protection	Use NIOSH/MSHA approved full face respirator with H ₂ S gas cartridge. Use positive pressure self-contained breathing apparatus for emergency or other conditions requiring a higher level of protection.
Ventilation	Use local exhaust as needed to maintain airborne exposure below exposure limits.
Skin Protection	Full-body protective clothing, chemical-resistant gloves and boots.
Eye Protection	Chemical Worker's Goggles and full-face shield.
General	Maintain a sink, safety shower and eyewash fountain in the work area. Have oxygen readily available.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Color	Deep Red/Orange
Odor	Pungent Odor of Rotten Eggs
Specific Gravity	1.273 @ 20° C (H ₂ O = 1)
Solubility in Water	Soluble
pH	11.5 - 11.8

SECTION 10 STABILITY AND REACTIVITY

Stability	Stable to boiling point, will lose water above this temperature.
Conditions to Avoid	Elevated temperatures can cause containers to burst.
Incompatibility	Avoid contact with Acids. Hydrogen Sulfide gas will be generated, dangerous to inhale, explosive at critical concentration.
Hazardous Polymerization	None.

SECTION 11 TOXICOLOGICAL INFORMATION

Exposure Limits	Chemical Name(s)	AGGIM (TLV)	OSHA (TWA)
	Calcium Polysulfide	None	None
Oral LD ₅₀ (rat)	(M) 820 mg/kg (F) 820 mg/kg		
Dermal LD ₅₀ (rabbit)	> 2000 mg/kg		
Inhalation LC ₅₀ (rat - 4 hour exposure)	(M) 3.9 mg/L (F) 3.1 mg/L		
Skin Effects (rabbit)	Mildly irritating		
Eye Effects (rabbit)	Irreversible damage due to high pH		
Carcinogenicity	None determined		
Signs of Poisoning	See Section 3, Potential Health Effects		

SECTION 12 ECOLOGICAL INFORMATION

No data available.

SECTION 13 DISPOSAL

Waste Disposal	All contaminated materials should be placed in disposable containers and buried in an approved dumping area. Disposal should be in accordance with applicable Federal, State, and local regulations. Chemical additions, processing or otherwise altering this material may make the information presented in this MSDS incomplete, inaccurate or otherwise inappropriate.

SECTION 14 TRANSPORT INFORMATION

DOT Classification	Not Regulated for Transport
Proper Shipping Name	Lime Sulfur Solution
DOT Identification Number	NOS
National Motor Freight Classification, (NMFC)	102180

SECTION 15 REGULATORY INFORMATION

United States	TSCA: This product is listed on TSCA inventory.	
	SARA Title III Hazard Classification	
	Immediate (Acute) Health	Yes
	Delayed (Chronic) Health	No
	Fire	No
	Sudden Release of Pressure	No
	Reactive	Yes

SECTION 16 OTHER INFORMATION

HAZARD RATING	HEALTH	FLAMMABILITY	INSTABILITY/ REACTIVITY
HMIS	2	0	0
NFPA	2	0	0

LEGEND: 0 Insignificant 1 Slight 2 Moderate 3 High 4 Extreme

LEGEND

ACGIH = American Conference of Governmental Industrial Hygienists
ADR = Agreement on Dangerous Goods by Road (Europe)
ANSI = American National Standards Institute
ASTM = American Society for Testing and Materials
CAS = Chemical Abstract Services
CEPA = Canadian Environmental Protection Act

SECTION 16 OTHER INFORMATION, CONTINUED

LEGEND, Continued

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
CFR = Code of Federal Regulations
CHIP = Chemicals Hazard Information and Packaging Approved Supply List
CPR = Controlled Products Regulations
DOT = Department of Transportation
DSCG = Dangerous Substances Classification and Labeling (Europe)
DSD/DPD = Dangerous Substances Directives/Dangerous Preparations Directives (Europe)
DSL = Domestic Substance List
EEC/EU = European Economic Community/European Union
EINECS = European Inventory of Existing Commercial Chemical Substances
EPA = Environmental Protection Agency
EPCRA = Emergency Planning and Community Right to Know Act
HCS = Hazardous Communication System
HMIS = Hazardous Material Information System
IARC = International Agency for Research on Cancer
IRIS = Integrated Risk Information System
LD = Lethal Dose
 LD_{50}/LC_{50} = Lethal Dose/Lethal Concentration kill 50%
 LD_{Lo}/LC_{Lo} = Lowest Published Lethal Dose/Lethal Concentration
NAERG'96 = North American Emergency Response Guide Book (1996)
NFPA = National Fire Prevention Association
NIOSH = National Institute of Occupational Health and Safety
NPRI = National Pollutant Release Inventory
NSNR = New Substances Notification Regulations (Canada)
NTP = National Toxicology Program
OSHA = Occupational Safety and Health Administration
 P_{OW} = Octanol-Water Partition Coefficient
PEL = Permissible Exposure Limit
RCRA = Resource Conservation and Recovery Act
RTECS = Registry of Toxic Effects of Chemical Substances
SARA = Superfund Amendments and Reauthorization Act
SD = Single Dose
STEL = Short Term Exposure Limit (15 minutes)
TDG = Transportation Dangerous Goods (Canada)
 TD_{Lo}/TC_{Lo} = Lowest Published Toxic Dose/Toxic Concentration
TLM = Median Tolerance Limit
TLV = Threshold Limit Value
TLV-TWA = Threshold Limit Value-Time Weighted Average
TSCA = Toxic Substance Control Act
WHMIS = Workplace Hazardous Material Information Act

ALL STATEMENTS, TECHNICAL INFORMATION AND RECOMMENDATIONS CONTAINED HEREIN ARE BASED ON TESTS AND DATA WHICH THIS COMPANY BELIEVES TO BE CURRENTLY RELIABLE, BUT THE ACCURACY OR COMPLETENESS THEREOF IS NOT GUARANTEED AND NO WARRANTY OF ANY KIND IS MADE WITH RESPECT THERETO. THIS INFORMATION IS NOT INTENDED AS A LICENSE TO OPERATE UNDER OR A RECOMMENDATION TO PRACTICE OR INFRINGE ANY PATENT OF THE COMPANY OR OTHERS COVERING ANY PROCESS, COMPOSITION OF MATTER OR USE. SINCE EXPO CHEMICAL CO., INC. SHALL HAVE NO CONTROL OF THE USE OF THE PRODUCT DESCRIBED HEREIN, EXPO CHEMICAL CO., INC. ASSUMES NO LIABILITY FOR LOSS OR DAMAGE INCURRED FROM THE PROPER OR IMPROPER USE OF SUCH PRODUCT.

MSDS **Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865



24 Hour Emergency Telephone: 908-659-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-998-6589

Outside U.S. and Canada
Chemtrec: 703-527-3867

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2637) for assistance.

FERROUS SULFATE DRIED

1. Product Identification

Synonyms: Ferrous sulphate; iron sulfate; sulfuric acid, iron (2+) salt (1:1),

CAS No.: 7720-78-7

Molecular Weight: Not applicable to mixtures.

Chemical Formula: $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$

Product Codes: 5051, 5058, 5069, 5075, 5098, 6714

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ferrous Sulfate	7720-78-7	100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)

Flammability Rating: 0 - None

Reactivity Rating: 1 - Slight

Contact Rating: 2 - Moderate

Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:

Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath.

Ingestion:

Low toxicity in small quantities but larger dosages may cause nausea, vomiting, diarrhea, and black stool. Pink urine discoloration is a strong indicator of iron poisoning. Liver damage, coma, and death from iron poisoning has been recorded. Smaller doses are much more toxic to children.

Skin Contact:

Causes irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact:

Causes irritation, redness, and pain.

Chronic Exposure:

Severe or chronic ferrous sulfate poisonings may damage blood vessels. Large chronic doses cause rickets in infants. Chronic exposure may cause liver effects. Prolonged exposure of the eyes may cause discoloration.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:

Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a well closed container stored under cold to warm conditions, 2 to 40 C, (36 to 104F). Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-ACGIH Threshold Limit Value (TLV):

1 mg/m³ (TWA) soluble iron salt as Fe

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. **WARNING:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

White to slightly yellow tinged powder.

Odor:

Odorless.

Solubility:

Soluble in water.

Density:

No information found.

pH:

No information found.

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

Not applicable.

Melting Point:

500C (932F)

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Burning may produce sulfur oxides.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Alkalis, soluble carbonates, and oxidizing materials. Reacts in moist air to form ferric sulfate.

Conditions to Avoid:

Moisture.

11. Toxicological Information

Ferrous sulfate heptahydrate: Oral mouse LD50: 1520 mg/kg, investigated as a mutagen. Ferrous sulfate anhydrous: oral rat LD50: 319 mg/kg; investigated as a mutagen, tumorigen, reproductive effector.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	

Ferrous Sulfate (7720-78-7)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia

Ferrous Sulfate (7720-78-7)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	--Canada--		Phil.
		DSL	NDSL	
Ferrous Sulfate (7720-78-7)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Ferrous Sulfate (7720-78-7)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----

Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8(d)
Ferrous Sulfate (7720-78-7)	1000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
 Reactivity: No (Mixture / Solid)

Australian Hazchem Code: None allocated.

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 0 Reactivity: 0

Label Hazard Warning:

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE LIVER.

Label Precautions:

Avoid contact with eyes, skin and clothing.

Wash thoroughly after handling.

Avoid breathing dust.

Keep container closed.

Use only with adequate ventilation.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent. Bulk pharmaceutical chemical. Food additive.

Revision Information:

No Changes.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE

Containing One or More of the Following Components in a Nitrogen Balance Gas: Oxygen, 0.0015-23.5%; Methane, 0.0005-2.5%; Carbon Monoxide, 0.0005-1.0%; Hydrogen Sulfide, 0.001-0.025%

SYNONYMS: Not Applicable

CHEMICAL FAMILY NAME: Not Applicable

FORMULA: Not Applicable

Document Number: 50018

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
SUPPLIER/MANUFACTURER'S NAME:	AIR LIQUIDE AMERICA CORPORATION
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	1-410-228-6400
	General MSDS Information 1-713/868-0440
	Fax on Demand: 1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm	IDLH ppm	
Oxygen	7782-44-7	0.0015 - 23.5%	There are no specific exposure limits for Oxygen. Oxygen levels should be maintained above 19.5%.					
Methane	74-82-8	0.0005 - 2.5%	There are no specific exposure limits for Methane. Methane is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					
Hydrogen Sulfide	7783-06-4	0.001-0.025 %	10	15	20 C 10 (Vacated 1989 PEL)	50 ppm (10 minute maximum peak) 15 (Vacated 1989 PEL)	100	NIOSH REL: 10 ppm C (10 minutes) DFG-MAK: 15 ppm

NE = Not Established.

C = Ceiling Limit.

See Section 16 for Definitions of Terms Used.

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

2. COMPOSITION and INFORMATION ON INGREDIENTS (Continued)

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			OTHER ppm
			TLV ppm	STEL ppm	PEL Ppm	STEL ppm	IDLH ppm	
Carbon Monoxide	630-08-0	0.0005 - 1.0%	25	NE	50 35 (Vacated 1989 PEL)	200 C (Vacated 1989 PEL)	1200	NIOSH REL: 35 (TWA); 200 C DFG MAK: 30
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NE = Not Established.

C = Ceiling Limit.

See Section 16 for Definitions of Terms Used.

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This product is a colorless gas which has a rotten-egg odor (due to the presence of Hydrogen Sulfide). The odor cannot be relied on as an adequate warning of the presence of this product, because olfactory fatigue occurs after over-exposure to Hydrogen Sulfide. Hydrogen Sulfide and Carbon Monoxide (another component of this gas mixture) are toxic to humans in relatively low concentrations. Over-exposure to this gas mixture can cause skin or eye irritation, nausea, dizziness, headaches, collapse, unconsciousness, coma, and death. Additionally, releases of this product may produce oxygen-deficient atmospheres (especially in small confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation.

INHALATION: Due to the small size of an individual cylinder of this product, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. A potential health hazard associated with this product is the potential of inhalation of Hydrogen Sulfide, a component of this gas mixture. Such over-exposures may occur if this product is used in a confined space or other poorly-ventilated area. Over-exposures to Hydrogen Sulfide can cause dizziness, headache, and nausea. Over-exposure to this gas could result in respiratory arrest, coma, or unconsciousness, due to the presence of Hydrogen Sulfide. Continuous inhalation of low concentrations of Hydrogen Sulfide may cause olfactory fatigue, so that the odor is no longer an effective warning of the presence of this gas. A summary of exposure concentrations and observed effects are as follows:

CONCENTRATION OF HYDROGEN SULFIDE

0.3-30 ppm

50 ppm

Slightly higher than 50 ppm

100-150 ppm

200-250 ppm

300-500

500 ppm

> 600 ppm

> 1000 ppm

NOTE:

OBSERVED EFFECT

Odor is unpleasant.

Eye irritation. Dryness and irritation of nose, throat.

Irritation of the respiratory system.

Temporary loss of smell.

Headache, vomiting nausea. Prolonged exposure may lead to lung damage. Exposures of 4-8 hours can be fatal.

Swifter onset of symptoms. Death occurs in 1-4 hours.

Headache, excitement, staggering, and stomach ache after brief exposure. Death occurs within 0.5 - 1 hour of exposure.

Rapid onset of unconsciousness, coma, death.

Immediate respiratory arrest.

This product contains a maximum of 250 ppm Hydrogen Sulfide. The higher concentration values here are presented to delineate the complete health effects which have been observed for humans after exposure to Hydrogen Sulfide.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH

(BLUE)

3

FLAMMABILITY

(RED)

0

REACTIVITY

(YELLOW)

0

PROTECTIVE EQUIPMENT

B

EYES

RESPIRATORY

HANDS

BODY

See Section 8

For routine industrial applications

3. HAZARD IDENTIFICATION (Continued)

Inhalation over-exposures to atmospheres containing more than the Threshold Limit Value of Carbon Monoxide (25 ppm), another component of this gas mixture, can result in serious health consequences. Carbon Monoxide is classified as a chemical asphyxiant, producing a toxic action by combining with the hemoglobin of the blood and replacing the available oxygen. Through this replacement, the body is deprived of the required oxygen, and asphyxiation occurs.

Since the affinity of Carbon Monoxide for hemoglobin is about 200-300 times that of oxygen, only a small amount of Carbon Monoxide will cause a toxic reaction to occur. Carbon Monoxide exposures in excess of 50 ppm will produce symptoms of poisoning if breathed for a sufficiently long time. If this product is released in a small, poorly ventilated area (i.e. an enclosed or confined space), symptoms which may develop include the following:

CONCENTRATION OF CARBON MONOXIDE

All exposure levels:

200 ppm:

400 ppm:

1,000 -2000 ppm:

200-2500 ppm:

>2500 ppm:

OBSERVED EFFECT

Over-exposure to Carbon Monoxide can be indicated by the lips and fingernails turning bright red.

Slight symptoms (i.e. headache) after several hours of exposure.

Headache and discomfort experienced within 2-3 hours of exposure.

Within 30 minutes, slight palpitations of the heart occurs. Within 1.5 hours, there is a tendency to stagger.

Within 2 hours, there is mental confusion, headaches, and nausea. Unconsciousness within 30 minutes.

Potential for collapse and death before warning symptoms.

Additionally, if mixtures of this product contain less than 19.5% Oxygen and are released in a small, poorly ventilated area (i.e. an enclosed or confined space), an oxygen-deficient environment may occur. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The following effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN

12-16% Oxygen:

10-14% Oxygen:

6-10% Oxygen:

Below 6%:

OBSERVED EFFECT

Breathing and pulse rate increased, muscular coordination slightly disturbed.

Emotional upset, abnormal fatigue, disturbed respiration.

Nausea, vomiting, collapse, or loss of consciousness.

Convulsive movements, possible respiratory collapse, and death.

SKIN and EYE CONTACT: Hydrogen Sulfide, a component of this gas mixture, may be irritating to the skin. Inflammation and irritation of the eyes can occur at very low airborne concentration of Hydrogen Sulfide (less than 10 ppm). Exposure over several hours may result in "gas eyes" or "sore eyes" with symptoms of scratchiness, irritation, tearing and burning. Above 50 ppm of Hydrogen Sulfide, there is an intense tearing, blurring of vision, and pain when looking at light. Over-exposed individuals may see rings around bright lights. Most symptoms disappear when exposure ceases. However, in serious cases, the eye can be permanently damaged.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

ACUTE: Due to the small size of the individual cylinder of this product, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. However, Hydrogen Sulfide and Carbon Monoxide (components of this gas mixture) are toxic to humans. Over-exposure to this gas mixture can cause nausea, dizziness, headaches, collapse, unconsciousness, coma, and death. Due to the presence of Hydrogen Sulfide, over-exposures to this gas mixture can also irritate the skin and eyes; severe eye contamination can result in blindness.

CHRONIC: Severe over-exposures to Hydrogen Sulfide, a component of this gas mixture, which do not result in death, may cause long-term symptoms such as memory loss, paralysis of facial muscles, or nerve tissue damage. In serious cases of over-exposure, the eyes can be permanently damaged. Skin disorders and respiratory conditions may be aggravated by repeated over-exposures to this gas product. Refer to Section 11 (Toxicology Information) for additional information on the components of this product.

TARGET ORGANS: Respiratory system, blood system, central nervous system effects, cardiovascular system, reproductive system, skin, eyes.

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn.

No unusual health effects are anticipated after exposure to this product, due to the small cylinder size. If any adverse symptom develops after over-exposure to this product, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary.

SKIN EXPOSURE: If irritation of the skin develops after exposure to this gas mixture, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

EYE EXPOSURE: If irritation of the eye develops after exposure to this gas mixture, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Seek medical assistance immediately, preferably an ophthalmologist.

Victim(s) who experience any adverse effect after over-exposure to this product must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

FLASH POINT, (method): Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

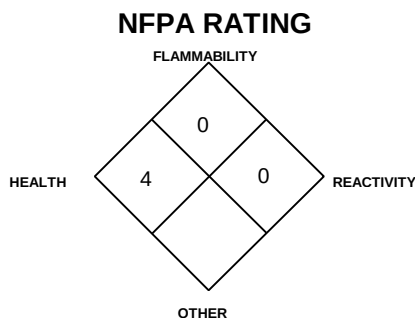
FIRE EXTINGUISHING MATERIALS: Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture contains toxic gases, Hydrogen Sulfide and Carbon Monoxide, and presents an health hazard to firefighters. This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not Sensitive.

Explosion Sensitivity to Static Discharge: Not Sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment.



6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this product presents significantly less risk of over-exposure to Hydrogen Sulfide and Carbon Monoxide, the toxic components of this product, and other safety hazards related to the remaining components of this product, than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel.

For emergency disposal, secure the cylinder and slowly discharge the gas to the atmosphere in a well-ventilated area or outdoors. Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for Hydrogen Sulfide, Carbon Monoxide, and Oxygen. Hydrogen Sulfide and Carbon Monoxide level must be below exposure level listed in Section 2 (Composition and Information on Ingredients) and Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.

If leaking incidentally from the cylinder, contact your supplier.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue, especially if work is done in a poorly ventilated area; exposures to fatal concentrations of this product could occur without any significant warning symptoms, due to olfactory fatigue or oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify cylinders containing a gas mixture with Hydrogen Sulfide or Carbon Monoxide. If there is a malfunction or another type of operational problem, contact nearest distributor immediately. Eye wash stations/safety showers should be near areas where this product is used or stored. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. All work practices should minimize releases of Hydrogen Sulfide and Carbon Monoxide-containing gas mixtures.

STORAGE AND HANDLING PRACTICES: Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C, 70°F). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage.

Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this product in well-ventilated areas. If this product is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of Oxygen, Hydrogen Sulfide, and Carbon Monoxide.

RESPIRATORY PROTECTION: No special respiratory protection is required under normal circumstances of use. Use supplied air respiratory protection if Carbon Monoxide levels exceed the exposure levels given in Section 2 (Composition and Information on Ingredients) or if oxygen levels are below 19.5%, or if either level is unknown during emergency response to a release of this product. If respiratory protection is required for emergency response to this product, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards. The following NIOSH respiratory protection recommendations for Hydrogen Sulfide and Carbon Monoxide are provided for further information.

NIOSH/OSHA RECOMMENDATIONS FOR HYDROGEN SULFIDE CONCENTRATIONS IN AIR:

UP TO 100 ppm: Powered air-purifying respirator with cartridge(s) to protect against hydrogen sulfide; gas mask with canister to protect against hydrogen sulfide; or SAR; or full-facepiece SCBA.

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Escape: Gas mask with canister to protect against hydrogen sulfide; or escape-type SCBA

NOTE: The IDLH concentration for Hydrogen Sulfide is 100 ppm.

NIOSH/OSHA RECOMMENDATIONS FOR CARBON MONOXIDE CONCENTRATIONS IN AIR:

UP TO 350 ppm Supplied Air Respirator (SAR)

UP TO 875 ppm Supplied Air Respirator (SAR) operated in a continuous flow mode.

UP TO 1200 ppm Gas mask with canister to protect against carbon monoxide; or full-facepiece SCBA; or full-facepiece Supplied Air Respirator (SAR).

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece Supplied Air Respirator (SAR) with an auxiliary positive pressure SCBA.

Escape: Gas mask with canister to protect against carbon monoxide; or escape-type SCBA.

NOTE: End of Service Life Indicator (ESLI) required for gas masks.

NOTE: The IDLH concentration for Carbon Monoxide is 1200 ppm.

EYE PROTECTION: Safety glasses.

HAND PROTECTION: No special protection is needed under normal circumstances of use.

BODY PROTECTION: No special protection is needed under normal circumstances of use.

9. PHYSICAL and CHEMICAL PROPERTIES

Unless otherwise specified, the following information is for Nitrogen, the main component of this gas mixture.

GAS DENSITY @ 32°F (0 °C) and 1 atm: .072 lbs/ ft³ (1.153 kg/m³)

BOILING POINT: -320.4°F (-195.8°C)

FREEZING/MELTING POINT @ 10 psig: -345.8°F (-210°C)

SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906

pH: Not applicable.

SOLUBILITY IN WATER vol/vol @ 32°F (0 °C) and 1 atm: 0.023

MOLECULAR WEIGHT: 28.01

EVAPORATION RATE (nBuAc = 1): Not applicable.

EXPANSION RATIO: Not applicable.

ODOR THRESHOLD: 0.13 ppm (Hydrogen Sulfide)

SPECIFIC VOLUME (ft³/lb): 13.8

VAPOR PRESSURE @ 70°F (21.1°C) (psig): Not applicable.

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

APPEARANCE AND COLOR: This product is a colorless gas which has an rotten egg-like odor, due to the presence of Hydrogen Sulfide.

HOW TO DETECT THIS SUBSTANCE (warning properties): Continuous inhalation of low concentrations of Hydrogen Sulfide (a component of this gas mixture) may cause olfactory fatigue, so that there are no distinct warning properties. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation. Wet lead acetate paper can be used for leak detection. The paper turns black in the presence of Hydrogen Sulfide. Cadmium chloride solutions can also be used. Cadmium solutions will turn yellow upon contact with Hydrogen Sulfide.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

DECOMPOSITION PRODUCTS: The thermal decomposition products of Methane include carbon oxides. The decomposition products of Hydrogen Sulfide include water and sulfur oxides. The other components of this gas mixture do not decompose, per se, but can react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Titanium will burn in Nitrogen (the main component of this product). Lithium reacts slowly with Nitrogen at ambient temperatures. Components of this product (Hydrogen Sulfide, Methane) are also incompatible with strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride). Carbon Monoxide is mildly corrosive to nickel and iron (especially at high temperatures and pressures). Hydrogen Sulfide is corrosive to most metals, because it reacts with these substances to form metal sulfides.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are available for the components of this product:

NITROGEN: There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the environment.

METHANE: There are no specific toxicology data for Methane. Methane is a simple asphyxiant, which acts to displace oxygen in the environment.

HYDROGEN SULFIDE:

LCLo (inhalation, human) = 600 ppm/30 minutes

LDLO (inhalation, man) = 5.7 mg/kg; central nervous system, pulmonary effects

LCLo (inhalation, human) = 800 ppm/5 minutes

LC₅₀ (inhalation, rat) = 444 ppm

LC₅₀ (inhalation, mouse) = 673 ppm/1 hour

LCLo (inhalation, mammal) = 800 ppm/5 minutes

CARBON MONOXIDE:

TCLo (inhalation, mouse) = 65 ppm/24 hours (7-18 preg): rep. effects

TCLo (inhalation, mouse) = 8 pph/1 hour (female 8D post): ter. effects

TCLo (inhalation, human) = 600 mg/m³/10 minutes

LCLo (inhalation, man) = 4000 ppm/30 minutes

TCLo (inhalation, man) = 650 ppm/45 minutes: central nervous system and blood system effects.

LCLo (inhalation, human) = 5000 ppm/5 minutes

LCLo (inhalation, dog) = 4000 ppm/46 minutes

LCLo (inhalation, rabbit) = 4000 ppm

LC₅₀ (inhalation, rat) = 1811 ppm/4 hours

LC₅₀ (inhalation, guinea pig) = 2450 ppm/4 hours

LC₅₀ (inhalation, guinea pig) = 5718 ppm/4 hours

LCLo (inhalation, mammal) = 5000 ppm/5 minutes

LD₅₀ (inhalation, wild bird) = 1334 ppm

11. TOXICOLOGICAL INFORMATION (Continued)

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: Hydrogen Sulfide, a component of this gas mixture, is irritating to the eyes, and may be irritating to the skin.

SENSITIZATION OF PRODUCT: The components of this gas mixture are not known to be skin or respiratory sensitizers.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas mixture on the human reproductive system.

Mutagenicity: This gas mixture is not expected to cause mutagenic effects in humans.

Embryotoxicity: This gas mixture contains components that may cause embryotoxic effects in humans; however, due to the small total amount of the components, embryotoxic effects are not expected to occur.

Teratogenicity: This gas mixture is not expected to cause teratogenic effects in humans due to the small cylinder size and small total amount of all components. Carbon Monoxide, a component of this gas mixture which exists up to 1%, can cause teratogenic effects in humans. Severe exposure to Carbon Monoxide during pregnancy has caused adverse effects and the death of the fetus. In general, maternal symptoms are an indicator of the potential risk to the fetus since Carbon Monoxide is toxic to the mother before it is toxic to the fetus.

Reproductive Toxicity: This gas mixture is not expected to cause adverse reproductive effects in humans.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by over-exposure to this product. Carbon Monoxide, a component of this gas mixture, can aggravate some diseases of the cardiovascular system, such as coronary artery disease and angina pectoris. Because of the presence of Hydrogen Sulfide, eye disorders or skin problems may be aggravated by over-exposure to this product.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate over-exposure. Hyperbaric oxygen is the most efficient antidote to Carbon Monoxide poisoning, the optimum range being 2-2.5 atm. A special mask, or, preferably, a compression chamber to utilize oxygen at these pressures is required. Avoid administering stimulant drugs. Be observant for initial signs of pulmonary edema in the event of severe inhalation over-exposures.

BIOLOGICAL EXPOSURE INDICES (BEIs): Biological Exposure Indices (BEIs) are applicable for this product, as follows:

BIOLOGICAL EXPOSURE INDICES (BEIs) for components of this product are as follows:		
CHEMICAL DETERMINANT	SAMPLING TIME	BEI
CARBON MONOXIDE • Carboxyhemoglobin in blood • Carbon monoxide in end-exhaled air	• End of shift • End of shift	• 3.5% of hemoglobin • 20 ppm

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The gas will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this product.

HYDROGEN SULFIDE: Water Solubility = 1 g/242 mL at 20°C.

CARBON MONOXIDE: Water solubility = 3.3 ml/100 cc at 0 °C, 2.3 ml at 20°C.

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C; 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plant and animal life. Hydrogen Sulfide and Carbon Monoxide, components of this product, can be deadly to exposed animal life, producing symptoms similar to those experienced by humans. This gas mixture may also be harmful to plant life.

12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life. The presence of more than a trace of Carbon Monoxide (a component of this product) is a hazard to fish. The following aquatic toxicity data are available for Hydrogen Sulfide (another component of this gas mixture):

TLm (Asellus sp) = 0.111 mg/L/96 hour

TLm (Cranfongonyx sp) = 1.07 mg/L/96 hour

TLm (Gammarrus) = 0.84 mg/L/96 hour

LC₅₀ (fly inhalation) = 380 mg/m³/960 minutes

LC₅₀ (fly inhalation) = 1500 mg/m³/7 minutes

TLm (Lepomis macrochirus, bluegill sunfish) = 0.0478 mg/L/96 hour

TLm (Lepomis macrochirus, bluegill sunfish) = 0.0448 mg/L/96 hour at 21-22 °C

TLm (Pimephales promelas, fathead minnow) = 0.0071-0.55 mg/L/96 hour

TLm (Salvelinus fontinalis, brook trout) = 0.0216-0.038 mg/L/96 hour at 8-12.5 °C

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (Nitrogen, Hydrogen Sulfide)

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Not applicable.

DOT LABEL(S) REQUIRED: Non-Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Note: DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: This product is subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302	SARA 304	SARA 313
Oxygen	NO	NO	NO
Methane	NO	NO	NO
Carbon Monoxide	NO	NO	NO
Nitrogen	NO	NO	NO
Hydrogen Sulfide	YES	YES	YES

SARA THRESHOLD PLANNING QUANTITY: Hydrogen Sulfide = 500 lbs.

TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.

CERCLA REPORTABLE QUANTITY (RQ): Hydrogen Sulfide = 100 lbs.

OTHER U.S. FEDERAL REGULATIONS:

- Hydrogen Sulfide and Carbon Monoxide are subject to the reporting requirements of CFR 29 1910.1000.

- Hydrogen Sulfide and Methane are subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for each of these gases is 10,000 pounds and so this mixture will not be affected by the regulation.

15. REGULATORY INFORMATION (Continued)

OTHER U.S. FEDERAL REGULATIONS (Continued):

- Depending on specific operations involving the use of this gas mixture, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Hydrogen Sulfide is listed in Appendix A of this regulation. The Threshold Quantity for Hydrogen Sulfide under this regulation is 1500 lbs (and so one cylinder of this product will not be affected by this regulation).
- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82).
- Nitrogen and Oxygen are not listed Regulated Substances, per 40 CFR, Part 68, of the Risk Management for Chemical Releases. Hydrogen Sulfide is listed under this regulation in Table 1 as a Regulated Substance (Toxic Substance), in quantities of 10,000 lbs (4,553 kg) or greater. Carbon Monoxide and Methane are listed under this regulation in Table 3, as Regulated Substances (Flammable), in quantities of 10,000 lbs (4,553 kg) or greater, and so this mixture will not be affected by the regulation.

OTHER CANADIAN REGULATIONS: This gas mixture is categorized as a Controlled Product, Hazard Classes A and D2A, as per the Controlled Product Regulations.

STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Carbon Monoxide, Hydrogen Sulfide, Methane.

California - Permissible Exposure Limits for Chemical Contaminants: Carbon Monoxide, Nitrogen, Hydrogen Sulfide, Methane.

Florida - Substance List: Oxygen, Carbon Monoxide, Hydrogen Sulfide

Illinois - Toxic Substance List: Carbon Monoxide, Methane, Hydrogen Sulfide.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: Oxygen, Carbon Monoxide, Hydrogen Sulfide, Methane.

Minnesota - List of Hazardous Substances: Carbon Monoxide, Hydrogen Sulfide, Methane.

Missouri - Employer Information/Toxic Substance List t: Hydrogen Sulfide, Methane.

New Jersey - Right to Know Hazardous Substance List: Oxygen, Carbon Monoxide, Nitrogen, Methane.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: Hydrogen Sulfide.

Pennsylvania - Hazardous Substance List: Oxygen, Carbon Monoxide, Nitrogen, Hydrogen Sulfide, Methane.

Rhode Island - Hazardous Substance List: Oxygen, Carbon Monoxide, Nitrogen, Hydrogen Sulfide, Methane.

Texas - Hazardous Substance List: Hydrogen Sulfide.

West Virginia - Hazardous Substance List: Hydrogen Sulfide.

Wisconsin - Toxic and Hazardous Substances: Hydrogen Sulfide

CALIFORNIA PROPOSITION 65: Carbon Monoxide (a component of this product) is on the California Proposition 65 lists as a chemical known to the State of California to cause birth defects or other reproductive harm.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. Air Liquide America will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

16. OTHER INFORMATION (Continued)

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 *"Safe Handling of Compressed Gases in Containers"*
AV-1 *"Safe Handling and Storage of Compressed Gases"*
 "Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
 9163 Chesapeake Drive, San Diego, CA 92123-1002
 619/565-0302

Fax on Demand: 1-800/231-1366



This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide America Corporation's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE

Containing One or More of the Following Components in a Nitrogen Balance Gas:
Oxygen 0-23.5%; Isobutylene, 0.0005-0.9%

SYNONYMS: Not Applicable

CHEMICAL FAMILY NAME: Not Applicable

FORMULA: Not Applicable

Document Number: 50054

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
SUPPLIER/MANUFACTURER'S NAME:	AIR LIQUIDE AMERICA CORPORATION
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	1-410-228-6400 General MSDS Information 1-713/868-0440 Fax on Demand: 1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA			OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm	IDLH ppm	
Oxygen	7782-44-7	0 - 23.5%	There are no specific exposure limits for Oxygen.					
Isobutylene	115-11-7	0.0005 - 0.9%	There are no specific exposure limits for Isobutylene.					
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NE = Not Established.

C = Ceiling Limit.

See Section 16 for Definitions of Terms Used.

NOTE : All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This product is a colorless, odorless gas. Releases of this product may produce oxygen-deficient atmospheres (especially in confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated. Isobutylene, a component of this gas mixture, may cause drowsiness and other central nervous system effects in high concentrations; however, due to its low concentration in this gas mixture, this is unlikely to occur.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this product is by inhalation.

INHALATION: Due to the small size of an individual cylinder of this product, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. The chief health hazard associated with this gas mixture is when this product contains less than 19.5% Oxygen and is released in a small, poorly-ventilated area (i.e. an enclosed or confined space). Under this circumstance, an oxygen-deficient environment may occur. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN

OBSERVED EFFECT

12-16% Oxygen:

Breathing and pulse rate increase, muscular coordination slightly disturbed.

10-14% Oxygen:

Emotional upset, abnormal fatigue, disturbed respiration.

6-10% Oxygen:

Nausea, vomiting, collapse, or loss of consciousness.

Below 6%:

Convulsive movements, possible respiratory collapse, and death.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

ACUTE: Due to the small size of the individual cylinder of this product, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. The most significant hazard associated with this gas mixture when it contains less than 19.5% oxygen is the potential for exposure to oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, unconsciousness, and death. The skin of a victim of over-exposure may have a blue color. Additionally, Isobutylene, a component of this gas mixture, may cause drowsiness or central nervous system effects in high concentrations; however, due to its low concentration in this gas mixture, this is unlikely to occur.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to this gas mixture.

TARGET ORGANS: Respiratory system.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH		(BLUE)	1
FLAMMABILITY		(RED)	0
REACTIVITY		(YELLOW)	0
PROTECTIVE EQUIPMENT			B
EYES	RESPIRATORY	HANDS	BODY
See Section 8			
For routine industrial applications			

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS PRODUCT WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn.

No unusual health effects are anticipated after exposure to this product, due to the small cylinder size. If any adverse symptom develops after over-exposure to this product, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary.

4. FIRST-AID MEASURES (Continued)

Victim(s) who experience any adverse effect after over-exposure to this product must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

FLASH POINT, (method): Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

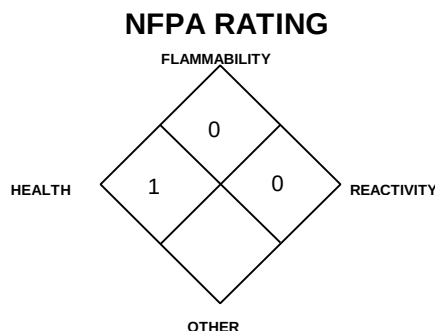
FIRE EXTINGUISHING MATERIALS: Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment.



6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this product presents significantly less risk of an oxygen deficient environment and other safety hazards than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel.

Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for oxygen. Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.

If leaking incidentally from the cylinder, contact your supplier.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue, especially if work is done in a poorly-ventilated area; exposures to fatal concentrations of this product could occur without any significant warning symptoms, due to oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify cylinders containing this gas mixture. If there is a malfunction or another type of operational problem, contact nearest distributor immediately.

STORAGE AND HANDLING PRACTICES: Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C; 70°F). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage.

Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this product in well-ventilated areas. If this product is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of oxygen.

RESPIRATORY PROTECTION: No special respiratory protection is required under normal circumstances of use. Use supplied air respiratory protection if oxygen levels are below 19.5% or unknown during emergency response to a release of this product. If respiratory protection is required for emergency response to this product, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards.

EYE PROTECTION: Safety glasses.

HAND PROTECTION: No special protection is needed under normal circumstances of use.

BODY PROTECTION: No special protection is needed under normal circumstances of use.

9. PHYSICAL and CHEMICAL PROPERTIES

Unless otherwise specified, the following information is for Nitrogen, the main component of this gas mixture.

GAS DENSITY @ 32°F (0 °C) and 1 atm: 0.072 lbs/ ft³ (1.153 kg/m³)

BOILING POINT: -195.8°C (-320.4 °F)

FREEZING/MELTING POINT @ 10 psig -210°C (-345.8°F)

SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906

pH: Not applicable.

SOLUBILITY IN WATER vol/vol @ 32°F (0 °C) and 1 atm: 0.023

MOLECULAR WEIGHT: 28.01

EVAPORATION RATE (nBuAc = 1): Not applicable.

EXPANSION RATIO: Not applicable.

ODOR THRESHOLD: Not applicable.

SPECIFIC VOLUME (ft³/lb): 13.8

VAPOR PRESSURE @ 70°F (21.1°C) psig: Not applicable.

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for this gas mixture.

APPEARANCE AND COLOR: This product is a colorless, odorless gas.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no unusual warning properties associated with a release of this product.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

DECOMPOSITION PRODUCTS: The thermal decomposition products of Isobutylene include carbon oxides. The other components of this gas mixture do not decompose, per se, but can react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Titanium will burn in Nitrogen (the main component of this product). Lithium reacts slowly with Nitrogen at ambient temperatures. A component of this product (Isobutylene) are also incompatible with strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen difluoride, and nitrogen trifluoride).

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are available for the components of this product:

NITROGEN: There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the environment.

ISOBUTYLENE:
LC₅₀ (inhalation, rat) = 620,000 mg/kg/4 hours
LC₅₀ (inhalation, mouse) = 415,000 mg/kg

11. TOXICOLOGICAL INFORMATION (Continued)

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: Not applicable.

SENSITIZATION TO THE PRODUCT: This gas mixture is not known to cause sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this product and its components on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for this gas mixture.

Embryotoxicity: No embryotoxic effects have been described for this gas mixture.

Teratogenicity: No teratogenicity effects have been described for this gas mixture.

Reproductive Toxicity: No reproductive toxicity effects have been described for gas mixture.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by over-exposure to the components of this product.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary; treat symptoms; eliminate exposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The components of this gas mixture occur naturally in the atmosphere. The gas will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this product.

OXYGEN: Water Solubility = 1 volume Oxygen/32 volumes water at 20°C. Log K_{ow} = -0.65

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C. 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (Nitrogen, Oxygen)

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1956

PACKING GROUP: Not applicable.

DOT LABEL(S) REQUIRED: Non-Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

14. TRANSPORTATION INFORMATION (Continued)

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Note: DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: This product is subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302	SARA 304	SARA 313
Oxygen	NO	NO	NO
Nitrogen	NO	NO	NO
Isobutylene	NO	NO	NO

SARA THRESHOLD PLANNING QUANTITY: Not applicable.

TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.

CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

OTHER U.S. FEDERAL REGULATIONS:

- No component of this product is subject to the requirements of CFR 29 1910.1000 (under the 1989 PELs).
- Isobutylene is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 pounds.
- The regulations of the Process Safety Management of Highly Hazardous Chemicals are not applicable (29 CFR 1910.119).
- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR Part 82).
- Nitrogen and Oxygen are not listed as Regulated Substances, per 40 CFR, Part 68, of the Risk Management for Chemical Releases. Isobutylene is listed under this regulation in Table 3 as Regulated Substances (Flammable Substances), in quantities of 10,000 lbs (4,553 kg) or greater.

OTHER CANADIAN REGULATIONS: This gas mixture is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations.

STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: No.

California - Permissible Exposure Limits for Chemical Contaminants: Nitrogen.

Florida - Substance List: Oxygen, Isobutylene.

Illinois - Toxic Substance List: No.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: Oxygen, Isobutylene.

Michigan - Critical Materials Register: No.

Minnesota - List of Hazardous Substances: No.

Missouri - Employer Information/Toxic Substance List: No.

New Jersey - Right to Know Hazardous Substance List: Oxygen, Nitrogen, Isobutylene.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.

Pennsylvania - Hazardous Substance List: Oxygen, Nitrogen, Isobutylene.

Rhode Island - Hazardous Substance List: Oxygen, Nitrogen.

Texas - Hazardous Substance List: No.

West Virginia - Hazardous Substance List: No.

Wisconsin - Toxic and Hazardous Substances: : No.

CALIFORNIA PROPOSITION 65: No component of this product is on the California Proposition 65 lists.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. Air Liquide America will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

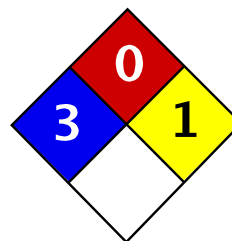
Further information about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 "Safe Handling of Compressed Gases in Containers"
AV-1 "Safe Handling and Storage of Compressed Gases"
"Handbook of Compressed Gases"

PREPARED BY: CHEMICAL SAFETY ASSOCIATES, Inc.
9163 Chesapeake Drive, San Diego, CA 92123-1002
619/565-0302
Fax on Demand: 1-800/231-1366



This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this product. To the best of Air Liquide America Corporation's knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this product is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.



Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer).

CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid].

MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.

The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Non combustible.

Calcium carbide reacts with hydrogen chloride gas with incandescence.

Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine.

Rubidium acetylene carbides burns with slightly warm hydrochloric acid.

Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved.

Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammable gas.

Cesium acetylene carbide burns hydrogen chloride gas.

Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute.

Reacts with most metals to produce flammable Hydrogen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other

violent/vigorous reaction: Acetic anhydride $\text{AgClO} + \text{CCl}_4$ Alcohols + hydrogen cyanide, Aluminum

Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca_3P_2

Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide,

1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO_4 Hexalithium disilicide H_2SO_4 Metal

acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate,

beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl),

Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U_3P_4 , Vinyl acetate.

Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures**Small Spill:**

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid. Poisonous liquid.

Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage**Precautions:**

Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture.

May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection**Engineering Controls:**

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

CEIL: 5 (ppm) from OSHA (PEL) [United States]

CEIL: 7 (mg/m3) from OSHA (PEL) [United States]

CEIL: 5 from NIOSH

CEIL: 7 (mg/m3) from NIOSH

TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)]

TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:

108.58 C @ 760 mm Hg (for 20.22% HCl in water)

83 C @ 760 mm Hg (for 31% HCl in water)

50.5 C (for 37% HCl in water)

Melting Point:

-62.25°C (-80°F) (20.69% HCl in water)

-46.2 C (31.24% HCl in water)

-25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:

1.1- 1.19 (Water = 1)

1.10 (20% and 22% HCl solutions)

1.12 (24% HCl solution)

1.15 (29.57% HCl solution)

1.16 (32% HCl solution)

1.19 (37% and 38% HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:

Highly reactive with metals.

Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316).

Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Reacts with water especially when water is added to the product.

Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C.

Sodium reacts very violently with gaseous hydrogen chloride.

Calcium phosphide and hydrochloric acid undergo very energetic reaction.

It reacts with oxidizers releasing chlorine gas.

Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates.

Reacts with most metals to produce flammable Hydrogen gas.

Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure)

Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid.

Adsorption of Hydrochloric Acid onto silicon dioxide results in exothermic reaction.

Hydrogen chloride causes aldehydes and epoxides to violently polymerize.

Hydrogen chloride or Hydrochloric Acid in contact with the following can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinum, tantalum, silver, and certain alloys are exceptions).

It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys.

No corrosivity data on zinc, steel.

Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:

Acute oral toxicity (LD50): 900 mg/kg [Rabbit].

Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse].

Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid].

May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin,

eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, .
Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:

Lowest Published Lethal Doses (LDL/LCL)

LDL [Man] -Route: Oral; 2857 ug/kg

LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M

LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects (fetotoxicity).

May affect genetic material.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects:

Skin: Corrosive. Causes severe skin irritation and burns.

Eyes: Corrosive. Causes severe eye irritation/conjunctivitis, burns, corneal necrosis.

Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and laryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well as headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure,

occur, particularly if exposure is prolonged. May affect the liver.

Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomiting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophageal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis).

Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel.

Chronic Potential Health Effects:

dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Hydrochloric acid
Illinois toxic substances disclosure to employee act: Hydrochloric acid
Illinois chemical safety act: Hydrochloric acid
New York release reporting list: Hydrochloric acid
Rhode Island RTK hazardous substances: Hydrochloric acid
Pennsylvania RTK: Hydrochloric acid
Minnesota: Hydrochloric acid
Massachusetts RTK: Hydrochloric acid
Massachusetts spill list: Hydrochloric acid
New Jersey: Hydrochloric acid
New Jersey spill list: Hydrochloric acid
Louisiana RTK reporting list: Hydrochloric acid
Louisiana spill reporting: Hydrochloric acid
California Director's List of Hazardous Substances: Hydrochloric acid
TSCA 8(b) inventory: Hydrochloric acid
TSCA 4(a) proposed test rules: Hydrochloric acid
SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid
SARA 313 toxic chemical notification and release reporting: Hydrochloric acid
CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):

R34- Causes burns.
R37- Irritating to respiratory system.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:

Gloves.

Full suit.

Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Face shield.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

-SAX, N.I. Dangerous Properties of Industrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.

-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.

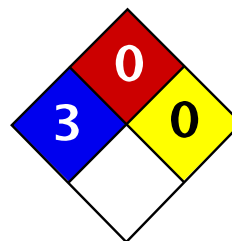
-Guide de la loi et du règlement sur le transport des marchandises dangereuses au Canada. Centre de conformité international Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 05:45 PM

Last Updated: 09/14/2009 10:34 AM

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Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet

Nitric Acid, 10% w/w MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nitric Acid, 10% w/w

Catalog Codes: SLN1330

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Nitric acid, 70%; Water

CI#: Not applicable.

Synonym:

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	93
Nitric acid, fuming	7697-37-2	7

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 67 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Non-sensitizer for skin.

CARCINOGENIC EFFECTS: Not available.

MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.

The substance is toxic to lungs, mucous membranes.

Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:

If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive to explosive in presence of reducing materials, of combustible materials, of organic materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid.

Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as reducing agents, combustible materials, metals, alkalis.

May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:

May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package. Corrosive materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

Nitric acid, fuming

TWA: 2 CEIL: 4 (ppm)

TWA: 5 CEIL: 10 (mg/m3)

Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Acidic.

Boiling Point: The lowest known value is 82.6°C (180.7°F) (Nitric acid, fuming). Weighted average: 98.78°C (209.8°F)

Melting Point: May start to solidify at -41.6°C (-42.9°F) based on data for: Nitric acid, fuming.

Critical Temperature: Not available.

Specific Gravity: Weighted average: 1.02 (Water = 1)

Vapor Pressure:

The highest known value is 45 mm of Hg (@ 20°C) (Nitric acid, fuming). Weighted average: 19.46 mm of Hg (@ 20°C)

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: The highest known value is 0.29 ppm (Nitric acid, fuming)

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:

Extremely reactive or incompatible with alkalis.

Highly reactive with metals.

Reactive with reducing agents, combustible materials.

Slightly reactive to reactive with organic materials, acids.

Corrosivity:

Highly corrosive in presence of steel, of aluminum, of zinc, of copper.

Corrosive in presence of stainless steel(304).

Slightly corrosive to corrosive in presence of stainless steel(316).

Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute toxicity of the vapor (LC50): 957 ppm 4 hour(s) (Rat) (Calculated value for the mixture).

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans: Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 8: Corrosive liquid.

Identification: : Nitric acid, solution (Nitric acid, fuming) : NA2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:

Pennsylvania RTK: Nitric acid, 70%

Massachusetts RTK: Nitric acid, 70%

TSCA 8(b) inventory: Nitric acid, 70%; Water

SARA 302/304/311/312 extremely hazardous substances: Nitric acid, 70%

SARA 313 toxic chemical notification and release reporting: Nitric acid, 70%
CERCLA: Hazardous substances.: Nitric acid, 70%;

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):

CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).

CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

CLASS E: Corrosive liquid.

DSCL (EEC):

R26- Very toxic by inhalation.

R35- Causes severe burns.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves.

Full suit.

Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 11:00 AM

Last Updated: 11/06/2008 12:00 PM

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MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

EMERGENCY OVERVIEW

CAUTION!

**OSHA/NFPA COMBUSTIBLE LIQUID - SLIGHT TO MODERATE IRRITANT
EFFECTS CENTRAL NERVOUS SYSTEM
HARMFUL OR FATAL IF SWALLOWED**

Moderate fire hazard. Avoid breathing vapors or mists. May cause dizziness and drowsiness. May cause moderate eye irritation and skin irritation (rash). Long-term, repeated exposure may cause skin cancer. If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).



NFPA 704 (Section 16)

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800) 424-9300**

COMPANY CONTACT (business hours): Corporate Safety (732) 750-6000

MSDS INTERNET WEBSITE: www.hess.com (See Environment, Health, Safety & Social Responsibility)

SYNONYMS: Ultra Low Sulfur Diesel (ULSD); Low Sulfur Diesel; Motor Vehicle Diesel Fuel; Diesel Fuel #2; Dyed Diesel Fuel; Non-Road, Locomotive and Marine Diesel Fuel; Tax-exempt Diesel Fuel

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and CHEMICAL INFORMATION ON INGREDIENTS

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Diesel Fuel (68476-34-6)	100
Naphthalene (91-20-3)	Typically < 0.01

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher. Diesel fuel may be dyed (red) for tax purposes. May contain a multifunctional additive.

3. HAZARDS IDENTIFICATION

EYES

Contact with liquid or vapor may cause mild irritation.

SKIN

May cause skin irritation with prolonged or repeated contact. Practically non-toxic if absorbed following acute (single) exposure. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.



MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

INHALATION

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY

Similar products produced skin cancer and systemic toxicity in laboratory animals following repeated applications. The significance of these results to human exposures has not been determined - see Section 11 Toxicological Information.

IARC classifies whole diesel fuel exhaust particulates as probably carcinogenic to humans (Group 2A). NIOSH regards whole diesel fuel exhaust particulates as a potential cause of occupational lung cancer based on animal studies and limited evidence in humans.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash).

4. FIRST AID MEASURES

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION

Remove person to fresh air. If person is not breathing provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT:	>	125 °F (> 52 °C) minimum PMCC
AUTOIGNITION POINT:		494 °F (257 °C)
OSHA/NFPA FLAMMABILITY CLASS:		2 (COMBUSTIBLE)
LOWER EXPLOSIVE LIMIT (%):		0.6
UPPER EXPLOSIVE LIMIT (%):		7.5

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO₂, water spray, fire fighting foam, or Halon.



MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES

ACTIVATE FACILITY'S SPILL CONTINGENCY OR EMERGENCY RESPONSE PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE

HANDLING PRECAUTIONS

Handle as a combustible liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Diesel fuel, and in particular low and ultra low sulfur diesel fuel, has the capability of accumulating a static electrical charge of sufficient energy to cause a fire/explosion in the presence of lower flashpoint products such as gasoline. The accumulation of such a static charge occurs as the diesel flows through pipelines, filters, nozzles and various work tasks such as tank/container filling, splash loading, tank cleaning; product sampling; tank gauging; cleaning, mixing, vacuum truck operations, switch loading, and product agitation. There is a greater potential for static charge accumulation in cold temperature, low humidity conditions.

Documents such as 29 CFR OSHA 1910.106 "Flammable and Combustible Liquids, NFPA 77 Recommended Practice on Static Electricity, API 2003 "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents and ASTM D4865 "Standard Guide for Generation and Dissipation of Static



MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

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Electricity in Petroleum Fuel Systems" address special precautions and design requirements involving loading rates, grounding, bonding, filter installation, conductivity additives and especially the hazards associated with "switch loading." ["Switch Loading" is when a higher flash point product (such as diesel) is loaded into tanks previously containing a low flash point product (such as gasoline) and the electrical charge generated during loading of the diesel results in a static ignition of the vapor from the previous cargo (gasoline).]

Note: When conductivity additives are used or are necessary the product should achieve 25 picosiemens/meter or greater at the handling temperature.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION

EXPOSURE LIMITS

Components (CAS No.)	Source	<u>Exposure Limits</u>		Note
		TWA/STEL		
Diesel Fuel: (68476-34-6)	OSHA	5 mg/m, as mineral oil mist		
	ACGIH	100 mg/m ³ (as totally hydrocarbon vapor) TWA		A3, skin
Naphthalene (91-20-3)	OSHA	10 ppm TWA		
	ACGIH	10 ppm TWA / 15 ppm STEL		A4, Skin

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile, neoprene, or PVC are recommended. Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.



MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

RESPIRATORY PROTECTION

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES

APPEARANCE

Clear, straw-yellow liquid. Dyed fuel oil will be red or reddish-colored.

ODOR

Mild, petroleum distillate odor

BASIC PHYSICAL PROPERTIES

BOILING RANGE: 320 to 690 oF (160 to 366 °C)
VAPOR PRESSURE: 0.009 psia @ 70 °F (21 °C)
VAPOR DENSITY (air = 1): > 1.0
SPECIFIC GRAVITY (H₂O = 1): 0.83 to 0.88 @ 60 °F (16 °C)
PERCENT VOLATILES: 100 %
EVAPORATION RATE: Slow; varies with conditions
SOLUBILITY (H₂O): Negligible

10. STABILITY and REACTIVITY

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID and INCOMPATIBLE MATERIALS

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers; Viton ®; Fluorel ®

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

11. TOXICOLOGICAL PROPERTIES

ACUTE TOXICITY

Acute dermal LD50 (rabbits): > 5 ml/kg Acute oral LD50 (rats): 9 ml/kg
Primary dermal irritation: extremely irritating (rabbits) Draize eye irritation: non-irritating (rabbits)
Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenic: OSHA: NO IARC: NO NTP: NO ACGIH: A3

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

MUTAGENICITY (genetic effects)

This material has been positive in a mutagenicity study.



MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

12. ECOLOGICAL INFORMATION

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable, under Federal and State regulations.

13. DISPOSAL CONSIDERATIONS

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:	Diesel Fuel	Placard (International Only):
HAZARD CLASS and PACKING GROUP:	3, PG III	
DOT IDENTIFICATION NUMBER:	NA 1993 (Domestic)	
UN	1202 (International)	
DOT SHIPPING LABEL:	None	
Use shipping		Combustible Placard if in bulk domestically



15. REGULATORY INFORMATION

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the state and/or local level. Consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

<u>ACUTE HEALTH</u>	<u>CHRONIC HEALTH</u>	<u>FIRE</u>	<u>SUDDEN RELEASE OF PRESSURE</u>	<u>REACTIVE</u>
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the *de minimis* levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

CALIFORNIA PROPOSITION 65 LIST OF CHEMICALS

This product contains the following chemicals that are included on the Proposition 65 "List of Chemicals" required by the California Safe Drinking Water and Toxic Enforcement Act of 1986:

<u>INGREDIENT NAME (CAS NUMBER)</u>	<u>Date Listed</u>
Diesel Engine Exhaust (no CAS Number listed)	10/01/1990

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 3 (Combustible Liquid) and Class D, Division 2, Subdivision B (Toxic by other means)



MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

16. OTHER INFORMATION

NFPA® HAZARD RATING

HEALTH:	0
FIRE:	2
REACTIVITY:	0

Refer to NFPA 704 "Identification of the Fire Hazards of Materials" for further information

HMIS® HAZARD RATING

HEALTH:	1 *	* Chronic
FIRE:	2	
PHYSICAL:	0	

SUPERSEDES MSDS DATED: 02/28/2001

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

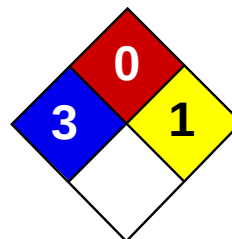
ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NTP	National Toxicology Program
AIHA	American Industrial Hygiene Association	OPA	Oil Pollution Act of 1990
ANSI	American National Standards Institute (212) 642-4900	OSHA	U.S. Occupational Safety & Health Administration
API	American Petroleum Institute (202) 682-8000	PEL	Permissible Exposure Limit (OSHA)
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act	RCRA	Resource Conservation and Recovery Act
DOT	U.S. Department of Transportation [General info: (800) 467-4922]	REL	Recommended Exposure Limit (NIOSH)
EPA	U.S. Environmental Protection Agency	SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
HMIS	Hazardous Materials Information System	SCBA	Self-Contained Breathing Apparatus
IARC	International Agency For Research On Cancer	SPCC	Spill Prevention, Control, and Countermeasures
MSHA	Mine Safety and Health Administration	STEL	Short-Term Exposure Limit (generally 15 minutes)
NFPA	National Fire Protection Association (617)770-3000	TLV	Threshold Limit Value (ACGIH)
NIOSH	National Institute of Occupational Safety and Health	TSCA	Toxic Substances Control Act
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)	TWA	Time Weighted Average (8 hr.)
		WEEL	Workplace Environmental Exposure Level (AIHA)
		WHMIS	Canadian Workplace Hazardous Materials Information System

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Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.



Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:

1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammable gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrogen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl₄ Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca₃P₂ Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO₄ Hexalithium disilicide H₂SO₄ Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U₃P₄, Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m³) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m³) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m³) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:

108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:

-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:

1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:

Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothermic reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the following can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinum, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:

Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:

Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects (fetotoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjunctivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and laryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well as headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomiting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophageal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):

CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):

R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:

Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Industrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangereuses au Canada. Centre de conformité international Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 05:45 PM

Last Updated: 11/01/2010 12:00 PM

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Appendix H

Pilot Scale Treatment Studies H &S Guidelines

Appendix H - Pilot Scale Treatment Studies for Soil

Several bench scale tests have been conducted to assess the effectiveness of treating soil from the Garfield Avenue Site. Large scale testing of “pilot” testing is now proposed. The pilot scale testing will be conducted on-site using a much larger volume of soil compared to the bench testing. The pilot scale testing has the following general objectives:

- Determine the treatment effectiveness on a larger scale under realistic conditions;
- Determine on what soil types/material the process is most effective. Evaluating the effectiveness on COPR nodules is a key goal of the pilot study;
- Obtain process data to be used in full-scale design;
- Obtain data to be used in estimating costs for full-scale design; and
- Obtain additional data to help define what constitutes successful treatment.

The following pilot scale tests for soil treatment are proposed:

- Ex-Situ treatment of backfill using FerroBlack-H. The primary treatment reagents are ferrous sulfide (“FeS”).
- In-Situ treatment of soil using the process developed by ARCADIS. This process involves chemical weathering of the COPR minerals to mitigate alkalinity over the long-term, access hexavalent chromium incorporated in the mineral matrix, and disaggregate nodules of COPR material to support more effective treatment. This is coupled with chemical and biological reduction of the incorporated hexavalent chromium to permanently stabilize it, rendering the material safe as measured by acceptable methods. Treatment reagents are primarily sulfuric acid (“H₂SO₄”), ferrous sulfate (“FeSO₄”), a fermentable organic substrate and inoculum to stimulate anaerobic microbial activity.

The processes are described in more detail in the Technical Execution Plans for each study. The treated soil from each scenario will be maintained in approximately 600 cubic yard cells on-site for post-treatment testing.

2.0 Overall Site Safety Inspection

Activity at the site will consist of four separate areas for differing pilot studies, areas of excavation, soil stockpile areas, groundwater storage areas, parking, and field trailer areas. Given the variety of activities being conducted, a daily inspection of all areas to avoid potential cross-contamination and assure HASP requirements are met will be necessary.

Daily Inspections will be performed to ensure:

Pilot Study Treatment Areas

- The area is clearly marked and all chemicals and equipment are within the designated area;
- Any chemicals not associated with and not designated to be in this area are not present;
- Chemical containers are clearly and correctly marked;
- Tanks and double containment structures are in good shape and there is no evidence of leaks;

- Chemical containers that require ventilation are adequately vented;
- No un-cleaned or partially filled containers are present in the work areas; containers must be completely emptied and cleaned immediately after use;
- If work is underway, it is being conducted in accordance with the activity specific Job Safety Analysis (“JSA”) or Task Hazard Analysis (“THA”);
- If work is underway, one person has been designated as Site Safety Officer (“SSO”) for that work and is overseeing the work;
- All personnel in the area are aware of the JSA/THA requirements, are wearing the appropriate personal protective equipment (“PPE”), and are following JSA/THA requirements;
- Air monitoring is taking place as directed; and
- The area is neatly organized; no trash and/or no trip/fall hazards are present.

Excavation Areas

- Areas are clearly marked;
- Open excavations, if any, are marked with caution tape or barricaded;
- Safe trench/excavation procedures are being followed;
- No unauthorized personnel are in the work area;
- Authorized personnel are using proper signals around equipment;
- Appropriate PPE is being worn;
- Air monitoring is taking place as directed;
- All personnel in the area are familiar with the JSA/THA and following JSA/THA procedures;
- Equipment is working in the area following proper procedures; and
- Appropriate oversight by safety designated staff is being conducted.

3.0 Backfill Amendment Pilot Study FerroBlack-H Treatment

The backfill amendment pilot study will be conducted in a 30-foot by 30-foot cell. A layout for the calcium polysulfide (“CaSx”) treatment is shown in the Backfill Amendment Technical Execution Plan. The pilot study testing will include the following steps:

- Selection of an appropriate test location: The cell will be fully excavated to meadow mat and backfilled with an amended fill material.
- Pre-treatment testing of soils: This will include analytical testing of chromium (totals analysis and Synthetic Precipitation Leaching Procedure (“SPLP”)), percent COPR by field screening, soil grain size by laboratory analysis, volatile organic compounds (“VOCs”) and semi- volatile organic compounds (“SVOCs”), Target Analyte List (“TAL”) metals, pH, and baseline physical properties testing.
- Blending of reagents: Using the pretreatment data on hexavalent chromium, the mass of treatment reagents to be applied will be determined. The stoichiometric blend will be 3X for FeS. Soil will be blended using an excavator bucket to loosen soils, blending.

- Testing to confirm adequate blending: Samples will be collected to confirm even distribution of the FerroBlack-H.
- Initial testing to assess effectiveness and physical properties.
- Post Treatment Monitoring.

The use of FeS for treatment of hexavalent chromium in soil and groundwater is a fairly widely accepted process. Full-scale in-situ projects with this general chemistry have been conducted at several sites.

3.1 Scope of Work

Mobilization will occur after the IRM #1 work is completed. An area north of the IRM #1 will be designated for the Backfill Amendment treatment process. As a result of the IRM #1 work, the site will already be equipped with a construction trailer, soil erosion measures, decontamination pads, stockpile areas, etc. The IRM #1 work will result in the removal of building slabs and other large debris from the area. The test location will not include Green-Gray Mud. A cell 30 feet wide, 30 feet long and 18 feet deep (to depth of meadow mat) will be constructed. After development of a site specific HASP for the pilot study, the following activities will be conducted:

- Conduct a kick off meeting among PPG, AECOM, and the construction contractor regarding the site controls. Reagent blending operations will be conducted by a construction contractor under the supervision of AECOM.
- Conduct a kick off meeting with site personnel to ensure that site health and safety hazards are understood and emergency procedures are reviewed.
- Construct a chemical storage area for Ferro-Black-H. Ferro-Black will be delivered in a tanker truck and stored on-site in one 5,000-gallon plastic tank. The tank will be installed within secondary containment. The tank will be outfitted with agitators to prevent the material from settling.
- Mobilize heavy equipment to the site. Heavy equipment is expected to include an excavator with a standard bucket attachment for mixing.
- It should be possible to gravity feed the treatment solutions into the mixing cell. Hoses and a metering system will be set-up.
- A temporary soil stockpile area (lined and covered) will be constructed within the pilot test cell area.

3.2 Process Health and Safety Concerns

The health and safety concerns associated with the FerroBlack-H treatment process are as follows:

- Reaction/ incompatibilities of reagents used in the treatment process;
- Proper handling of reagents used in the treatment process;
- Working around construction equipment including excavator and front-end loader;
- Temporary electrical supply; and
- Workers' exposure to impacted soil COPR, hexavalent chromium and off gases.

3.3 Chemical Reagents

Redox® FerroBlack-H is black liquid that is a ferrous sulfide solution with a pH between 9.5 and 12.3. FerroBlack-H can irritate the eyes, and mucous membranes. Skin contact will result in irritation and possible corrosion of the skin. Ingestion will irritate/burn mouth, throat and gastrointestinal tract. There is no occupational exposure level for FerroBlack-H and/or ferrous sulfide. FerroBlack-H is incompatible with strong acids, metal oxides, and strong bases decomposing into hydrogen sulfide.

FerroBlack-H must be stored in a well ventilated area away from combustible materials, sources of heat or flame and out of direct sunlight at moderate temperature (<80° F). FerroBlack-H will be stored on site in a 5,000-gallon double walled plastic tank. The tank containment must be protected from physical damage. The tank of FerroBlack-H must be properly labeled as to its content and hazards using the manufacturers' labels or a 704M label specific for the material is considered to be an acceptable label (H/0, F/0, R/2). All containers of FerroBlack-H must be labeled in accordance with the Occupational Safety and Health Administration's ("OSHA's") Hazard Communication Standard. The Material Safety Data Sheet ("MSDS") for ferrous sulfide must be readily available on site. The fitting used for the transfer of FerroBlack-H must be unique and not compatible with other fittings, (i.e. water).

3.4 Engineering/Work Practice Controls

Engineering controls will consist of the following:

- Proper storage and protection of chemical reagents;
- Secondary containment for liquid chemical reagents;
- Use of material compatible with the chemical reagents;
- Covering of soil stock piles with poly sheeting;
- Use of dust control agents (water) to prevent dusting;
- Use of water mist to prevent dusting at soil blending area;
- Designation of a exclusion zone ("EZ"), contamination reduction zone ("CRZ") and support zone; and
- Installation of a safety drench shower/eyewash meeting ANSI standards in the area where chemicals are handled/stored.

Work practice controls will consist of the following:

- Twenty-four hour security coverage of the site;
- Fenced in site;
- Implementation of a sign-in/sign-out procedure;
- Limit the number of workers in the EZ;
- Daily inspection of process equipment and reagent storage tanks;
- Limit the number of vehicles on site to reduce the chance of collisions, and establish hand signals for workers;
- Limit the dump height of impacted soils to prevent the generation of dust;
- Slow equipment movement down to prevent the generation of dust;
- Daily inspection of construction equipment;
- Maintaining an upwind position;

- No eating, drinking, or applying cosmetics while in the EZ; and
- Implementation of decontamination procedures for personnel and equipment that enter the EZ.

3.5 Personal Protective Equipment

To protect workers from accidental splash or inhalation of gases, mists or vapors, chemical resistant garments and respiratory protection will be used when handling or transferring chemicals. The use of PPE is also necessary to protect workers from contaminants of concern, COPR and hexavalent chromium during soil excavation.

Modified Level D protection is recommended for activities where respirator protection is not required and maybe limited to handling of reagents when splash is anticipated. Level D modified protection will consist of the following in addition to Level D protection:

- Chemical-resistant overalls (Tychem QC- chemical splash) or neoprene apron
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent
- Over boots (rubber)
- Safety glasses
- Full face splash shield worn over safety glasses

Level D protection is recommended for activities where respirator and dermal protection is not required. Level D modified protection will consist of the following:

- Hardhat
- High visibility vest
- Steel toe protective foot wear
- Safety glasses
- Shirt with sleeves
- Long pants

3.6 Air Monitoring

3.6.1 Dust/Hexavalent Chromium

The TSI DustTrak and DataRAM Model DR 1000 Aerosol Monitors (or equivalent) measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, during intrusive work. TSI DustTrak Aerosol Monitors will be to measure the upwind and downwind concentrations of particulates at the perimeter of the EZ, while personal aerosol monitors (such as the DataRAM DR 1000 or equivalent) will be used to monitor worker exposure within the EZ.

A personal exposure level was calculated and measured in milligrams per cubic meter (mg/m^3) on an 8-hour Time Weighted Average (TWA_8) based on contaminants of concern (hexavalent chromium) which has the lowest occupational exposure ($0.005 \text{ mg}/\text{m}^3 \text{ TWA}_8$) of the potential dust producing substances such as Portland cement and ferrous sulfide. It is recognized that respirable dust particles are generally not visible to the naked eye, but a total airborne dust clouds is often visible at concentrations of $2 \text{ mg}/\text{m}^3$. Since visible dust is not acceptable, a dust action of $0.167 \text{ mg}/\text{m}^3$ will be used as the dust action level for upgrading to Level C.

3.6.2 Hydrogen Sulfide

The soil treatment may generate hydrogen sulfide under acidic conditions. Hydrogen sulfide will be measured using a single gas monitor such as the BW Tech Gas Alert or equivalent specifically for hydrogen sulfide (H₂S). Measurement for hydrogen sulfide will be made on an intermittent basis inside and outside the EZ and outside the during the treatability study.

If any hand-held hydrogen sulfide instantaneous levels exceed 5 parts per million (“ppm”) for a sustained 15 minute period, workers should relocate to an area where the airborne concentration of hydrogen sulfide is less than 5 ppm. A full face air purifying respirator (APF- 50) equipped with combination organic vapor/acid gas cartridge with an N-100 filter is recommended and approved for escape only in an atmosphere containing hydrogen sulfide.

3.6.3 Calibration

The Aerosol Monitors will be field checked daily using zero calibration air. At the beginning of each workday (prior to site intrusive activities each day) a calibration zero check will be performed on each unit at the measurement locations. A zero (or particulate-free) test sample, using the appropriate particulate filter supplied by the manufacturer for this purpose, will be placed over the sample inlet. The data output for the monitor will be observed and the response recorded in a field logbook.

Prior to each measurement session, an on-site dynamic calibration of the hydrogen sulfide monitor will be performed against a known hydrogen sulfide calibration gas. The daily calibration will also include a dynamic zero air check of the instrument. The data output for the monitor will be observed and the response recorded in a field logbook.

3.6.4 Personal Air Sampling

Personal exposure assessment may be conducted for hexavalent chromium/total dust if the dust action level is exceeded during the task or if the task is determined to be “high-risk” for personal exposure. Personal air samples will be collected in accordance with OSHA and/or National Institute for Occupational Safety and Health (“NIOSH”) methodology and analyzed by an American Industrial Hygiene Association (“AIHA”) accredited laboratory. The results of the sampling will be communicated to project personnel. The number of workers selected to wear the personal sampling pumps will be determined in advance of the field activity by AECOM’s RSHEM. Personal hydrogen sulfide monitor will be performed on at risk employees by using a clip on disposable hydrogen sulfide detector with a low alarm range of 5 ppm.

3.6.5 Analytical Methods

- Hexavalent Chromium- 29 CFR 1910.1026(d)-Analytical Method OSHA ID-215
- Dust-NIOSH Analytical Method- 0500

3.6.6 Task-Specific Job Safety Analysis

Specific JSA’s/THAs will be prepared for the following:

- Chemical handling/blending
- Soil handling
- In-situ soil blending
- Equipment operation
- Soil/groundwater sampling

4.0 ARCADIS In Situ Soil Treatment Process

The in situ treatment process being proposed by ARCADIS is a patent pending multi-step process intended to systematically address the primary restrictions that generally inhibit COPR remediation.

The initial step involves the careful addition of a mineral acid (sulfuric acid). This is meant to decrease the pH from approximately 12 to an approximate pH of 9 by accelerating weathering of the primary minerals that are the source of the alkalinity and are also responsible for the cementation and bulking often observed with COPR. This liberates hexavalent chromium that was sequestered in these minerals, making it available for treatment, and begins the process of long-term stabilization of pH. In addition to the acid, this step also involves the addition of ferrous iron (in the form of ferrous sulfate) to support immediate reduction of hexavalent chromium on the surfaces of the solids and in pore water as well as providing an accessible source of renewable reductive poise. This chemical reduction component continues the process of displacing hexavalent chromium, weathering parent minerals, and stabilizing pH.

The second step involves the delivery of a fermentable source of organic carbon in conjunction with an inoculum that will help accelerate the stimulation/propagation of anaerobic microbial activity (i.e., sludge from an anaerobic digester). This creates a strongly anaerobic environment and a very efficient source of electrons for hexavalent chromium reduction. As part of this, the iron delivered in the first step can go through multiple cycles of reduction and oxidation, helping to accelerate treatment of the hexavalent chromium. This iron can be supplemented with the addition of more iron in this step, which coupled with acidity generated by microbial fermentation continues the process of displacing hexavalent chromium, weathering parent minerals, and stabilizing pH.

4.1 Scope of Work

For this field test, in-situ soil mixing will be used to deliver amendments associated with each of the process phases. Conceptually, this will be accomplished with pairing of a dual-axis soil mixer (a.k.a. Lang LTC290) and a long-stick hydraulic bucket excavator. The Lang tool utilizes a mixing drum with two counter-rotating parts mounted at the tip of a vertical rotating shaft. Amendments are prepared as a liquid or slurry in a separate mixing station, and are pumped to the tip of the shaft in the middle of the mixing drum. The soil is thus treated in-situ in a 5-foot diameter vertical column. The whole treatment area can be covered in a series of overlapping columns or other patterns. An excavator would provide a back up for areas where debris in the subsurface makes it difficult for the Lang tool to operate. This would involve the use of bucket mixing for selective removal of debris and loosening of the soil, such that workability is improved and the Lang tool can be re-applied. Where debris is too dense, completion of the mixing could also proceed via bucket mixing alone. Bucket mixing alone can also be used for the biogeochemical and geotechnical stabilization treatments. In addition to the Lang tool and an excavator, other support equipment that may also be mobilized to the site includes a front-end loader, dump truck, and tender for the Lang tool.

In conjunction with the mobilization of equipment, there are several site preparation tasks that will be completed prior to initiating the soil treatment activities, as follows:

- Setup of the treatment cell: The cell will be created by installation of a 25 foot long x 20 foot wide x 15 foot deep sheetpile wall, with the top of the sheeting terminated at a depth of approximately 5 feet (just above the groundwater interface). The sheetpile wall will physically contain the treatment zone and will provide a hydraulic barrier between treated and untreated material below the water table. Within the cell, the top 3 feet of soil will be removed and the sides worked back at a 1:1 slope. This will provide freeboard to accommodate expansion of the soils being stabilized (due to bulking). A 2 foot wide x 2 foot deep pea-gravel filled trench will be built around the perimeter of the sheeting to collect and drain excess fluids during the mixing process. This will also assist in post-mixing consolidation of the treated material and will demarcate a buffer around the sheeting for the mixing process (at least 2 feet clearance from the sheetpile wall will be maintained during mixing). Based on this layout, the effective treatment volume will be approximately 160 cubic yards.

- Set-up of the construction support area: This will involve creation of several level areas covered with crushed stone to provide for equipment staging, materials staging, waste management, and personnel support as follows:
 - o The equipment staging area will be separate from the materials staging area and will be used to stage equipment between mixing efforts. Equipment will ultimately be decontaminated in this staging area prior to leaving the site.
 - o The materials staging area will be used for general materials laydown and staging of all treatment reagents other than acid. It is anticipated that this will include the following:
 - Molasses will be used as the fermentable source of organic carbon in the treatment process. Based on the planned dosing, molasses could be delivered by tanker or handled in a series of 275-gallon plastic totes with a pump suitable for moving high-viscosity fluids.
 - Granular ferrous sulfate will be used in the form of ferrous sulfate heptahydrate. This can be delivered in super sacks that must be kept dry until used. While it is anticipated that storage timeframes will be minimized by coordinating delivery with use, the iron will be covered as needed with a weatherproof tarp that is sufficiently anchored to prevent it from coming loose.
 - A specific source for the biological inoculant remains to be identified, but will likely involve a limited amount of sludge from an anaerobic digester. This can be staged in lined containers (drums or roll-off).
 - o The waste management area will consist of a separate area set aside from the materials staging area. General wastes from the site activities will be containerized in the waste management area and stored for disposal.
 - o The personnel support area will include a safety shower/decontamination area, and a clean zone for breaks. All personnel will enter and exit the work zone through this support area. An attempt will be made to stage this support area upwind of the work area and acid storage area based on prevailing wind directions.
- Setup of the acid storage and conveyance area: The titration of soils in the treatment area will be done with up to a 50% solution of sulfuric acid, the handling of which requires the utmost care and attention to safety. As envisioned, configuration of this area has been designed to minimize both the handling and the proximity of site workers to the acid solution. This will involve the following:
 - o Staging of the acid will only be needed for a short time given that the titration step is expected to be completed within one week of initiation (discussed further below). Regardless, the local fire department and emergency services will be alerted so they can be prepared in the event of an incident.
 - o A chemically compatible temporary containment structure that complies with applicable guidelines will be erected for the acid storage. Based on the planned dosing, it is anticipated that a number of tanker deliveries will be required. It is envisioned that each tanker will be dropped in the containment, and connected to the conveyance system. When the first tanker is empty, it will be disconnected, removed from the containment, and replaced with the next tanker.
 - o Due to their composition, the site soils will provide sufficient alkalinity to neutralize incidental spills of acid, something that the configuration of the storage and conveyance system should prevent. However, a stockpile of acid neutralizing material (crushed limestone) will be maintained at the site for use in the event of a large release inside the containment (the acidic solution in the containment can be drained through the neutralizing material in a controlled manner).

- o From the secondary containment, chemically compatible dual-walled piping supported by steel pipe stands will be used to convey the acid by gravity flow to the work area. This line will be equipped with a control valve at the containment bulkhead and at the discharge end. It will also be equipped with a chemically compatible flow totalizer, siphon break (to allow the line to drain down when the control valve is closed), and will have a tie-in to a clean water tank to flush the line after each use. Procedures for the actual loading of acid into the work area are discussed in Section 8.3.4 of the Feasibility Study work plan.

The estimated amounts of the various reagents that will be required to complete the field test include: up to 10,000 gallons of 50% sulfuric acid solution, 15 tons of ferrous sulfate, 15 tons of molasses, and 250 pounds of activated sludge. These estimates will be refined based on the results of the pre-testing data collection. Once the site preparation tasks are complete and all equipment is on site, the initial process pass will be initiated. This is discussed in the next section.

4.2 Process Health and Safety Concerns

The health and safety concerns associated with the ARCADIS, soil treatment process are as follows:

- Reaction/ incompatibilities of reagents {acids and base} used in the treatment process;
- Proper handling of reagents used in the treatment process;
- Temporary electrical supply;
- In-situ blending with Lang tool and excavator bucket;
- Workers' exposure to impacted soil COPR, hexavalent chromium;
- Off gases from treatment process (Carbon Dioxide, Carbon Monoxide, and Sulfur Dioxide); and
- Excavation which includes placing treated material in the treatment cell.

4.3 Chemical Reagents

Sulfuric acid is a clear oily liquid corrosive liquid with no odor. Sulfuric acid is a highly corrosive substance with a pH of 0.3. Sulfuric acid can cause server eye and skin burns. Ingestion of sulfuric acid may cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. When inhaled sulfuric acid mist may cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Sulfuric acid is very corrosive action to the mucous membranes.

Prolonged or repeated inhalation of sulfuric acid may cause kidney and lung damage. Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis. Sulfuric acid may cause fetal effects and may cause cancer in humans. The OSHA Permissible Exposure Limit ("PEL") for sulfuric acid is 1 mg/m³ ppm as aTWA₈.

Sulfuric acid is incompatible with bases, strong dehydrating agents, organic materials, finely powdered metals, moisture, carbides, chlorates, cyanides (e.g. potassium cyanide, sodium cyanide), nitrates, alkali halides, zinc, iodides, permanganates, hydrogen peroxides, phosphorus, nitrites, iron, mercuric nitride, benzene, potassium chlorates, steel, cesium, and acetylene carbide. When combined with water, sulfuric acid will cause a violent reaction, releasing heat and flammable hydrogen gas. Conditions to avoid when using or storing sulfuric acid are incompatible materials, ignition sources, metals, excess heat, combustible materials, organic materials, reducing agents, exposure to moist air or water, oxidizers, amines, bases.

Containers of sulfuric acid must be properly labeled as to their content and hazards using the manufacturers' labels. Secondary containers must also be labeled as to their content and hazards using either the original manufacturer's label or an 704M label specific for the material is considered to be an acceptable label (H/4, F/0, R/2). All containers of sulfuric acid must be labeled in accordance with OSHA's Hazard Communication Standard. The MSDS for sulfuric acid must be readily available on site.

Sulfuric acid is not compatible with calcium polysulfide (CaS_x alone or CaS_x in the COPREX mix). Sulfuric acid is not compatible with sodium hydrosulfide ("NaSH"). Sulfuric acid will not be handled, stored, or applied in areas where CaS_x or NaSH may be present.

Ferrous sulfate is characterized by its blue green crystal. Ferrous sulfate causes irritation to the respiratory tract, skin and eyes. Severe or chronic ferrous sulfate poisonings may damage blood vessels. Chronic exposure may cause liver effects. Prolonged exposure of the eyes may cause discoloration. The ACGIH recommends a Threshold Limit Value ("TLV") for ferrous sulfate (soluble iron) of 1 mg/m³ as aTWA₈. Ferrous sulfate is incompatible with alkalis, soluble carbonates and oxidizing material.

While in storage, ferrous sulfate must be protected from moisture and high humidity and protected from physical damage and isolated from incompatible substances. Maintain a constant temperature not to exceed 75° F. Fluctuating temperatures causes product oxidation. Do not use this product if coated with brownish-yellow basic ferrous sulfide. Containers of ferrous sulfate must be properly labeled as to their content and hazards using the manufacturers' labels. Secondary containers must also be labeled as to their content and hazards using either the original manufacturer's label or an NFPA 704M label specific for the material is considered to be an acceptable label (H/1, F/0, R/0). All containers of ferrous sulfate must be labeled in accordance with OSHA's Hazard Communication Standard. The material safety data sheet for ferrous sulfate must be readily available on site.

4.4 Engineering/Work Practice Controls

Engineering controls will consist of the following:

- Proper storage and protection of chemical reagents;
- Secondary containment for liquid chemical reagents;
- Use of material compatible with the chemical reagents;
- Covering of soil stock piles with poly sheeting;
- Use of dust control agents to prevent dusting;
- Use of water mist to prevent dusting at blending site;
- Designation of an EZ, CRZ and support zone; and
- Installation of a safety drench shower/eyewash meeting ANSI standards in the area where chemicals are handled/stored.

Work practice controls will consist of the following:

- Twenty-four hour security coverage of the site;
- Fenced in site;
- Implementation of a sign-in/sign out procedure;
- Limit the number of workers in the EZ;
- Daily inspection of process equipment and reagent storage tanks;

- Limit the number of vehicles on site to reduce the chance of collisions, and establish hand signals for workers;
- Limit the dump height of impacted soils to prevent the generation of dust;
- Slow equipment movement down to prevent the generation of dust;
- Daily inspection of construction equipment;
- Maintaining an upwind position;
- No eating, drinking, or applying cosmetics while in the EZ; and
- Implementation of decontamination procedures for personnel and equipment that enter the EZ.

4.5 Personal Protective Equipment

To protect workers from accidental splash or inhalation of gases, mists or vapors, chemical resistant garments and respiratory protection will be used when handling or transferring chemicals. The use of PPE is also necessary to protect workers from contaminants of concern, COPR and hexavalent chromium during soil handling and preparation.

Based on the hazardous properties of the chemical reagents and contaminants of concern Level C PPE is recommended for work inside the EZ. Level C protection will consist of the following:

- Hardhat ;
- High visibility vest;
- Steel toe protective foot wear;
- Hearing protection;
- Full face air purifying respirator (APF- 50) equipped with combination organic vapor/acid gas cartridge with an N-100 filter;
- Chemical-resistant overalls (Tychem QC- chemical splash);
- Inner gloves: Best Safety N-DEX or equivalent;
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent; and
- Over boots (rubber).

Respirator cartridges must be changed after each day's use, immediately if breakthrough is perceived, or when breathing becomes difficult. Chemical resistant coveralls and outer gloves must be properly disposed of after each use. If chemical resistant glove or coverall become ripped or show signs of swelling or failure, the person should immediately leave the area, remove the protective equipment and immediately notify the SSO of the potential exposure. It is the responsibility of each employee to inspect their PPE for defects prior to donning. Defective PPE must be replaced.

The SSO, with concurrence from the PM and RSHEM, may down grade the level of protection based on air monitoring results, observation of work practices or hazardous assessment. Down grading of PPE may occur if the use PPE poses a safety hazard (i.e. heat stress, entanglement).

Modified Level D protection is recommend for activities where respirator protection is not required and maybe limited to handling of reagents when splash is anticipated. Modified Level D modified protection will consist of the following:

- Chemical-resistant overalls (Tychem QC- chemical splash) or neoprene apron
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent
- Over boots (rubber)
- Safety glasses
- Full face splash shield worn over safety glasses

Level D protection is recommended for activities where respirator and dermal protection is not required. Level D modified protection will consist of the following:

- Hardhat
- High visibility vest
- Steel toe protective foot wear
- Safety glasses
- Shirt with sleeves
- Long pants

4.6 Air Monitoring

4.6.1 Dust/Hexavalent Chromium

The TSI DustTrak and DataRAM Model DR 1000 Aerosol Monitors (or equivalent) measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, during intrusive work. TSI DustTrak Aerosol Monitors will be to measure the upwind and downwind concentrations of particulates at the perimeter of the EZ, while personal aerosol monitors (such as the DataRAM DR 1000 or equivalent) will be used to monitor worker exposure within the EZ.

A personal exposure level was calculated base on contaminants of concern hexavalent chromium which has the lowest occupational exposure ($0.005 \text{ mg/m}^3 \text{ TWA}_8$) of the potential dust producing substances such as Portland cement and ferrous sulfate. It is recognized that respirable dust particles are generally not visible to the naked eye, but a total airborne dust clouds is often visible at concentrations of 2 mg/m^3 . Since visible dust is not acceptable a dust action of 0.167 mg/m^3 will be used as the dust action level for upgrading to Level C. Regardless of the measured airborne concentration of dust in the workers breathing zone the initial level of protection will be Level C as described in Section 3.5.

4.6.2 Carbon Dioxide

During the naturalization process carbon dioxide gas may be emitted. Carbon dioxide gas is heavier then air, settling in low laying areas. Carbon dioxide is a simple asphyxiant that can displace oxygen. Carbon dioxide is the most powerful cerebral vasodilator known. Inhaling large concentrations causes rapid circulatory insufficiency leading to coma and death. Asphyxiation is likely to occur before the effects of carbon dioxide overexposure. Chronic, harmful effects are not known from repeated inhalation of low concentrations. Low concentrations of carbon dioxide cause increased respiration and headache. The OSHA PEL for carbon dioxide is 5000 ppm as a TWA_8 .

A carbon dioxide monitor such as the MultiRAE R or equivalent will be used to measure the airborne concentration of carbon dioxide in the breathing zone of workers in the EZ. In addition an oxygen monitor will be used to measure the percent of oxygen in the EZ. If the oxygen level is below 19.5%, this is considered an oxygen deficient atmosphere and workers should immediately level the work area.

When the instantaneous levels of carbon dioxide is at or exceed 5000 ppm, workers should relocate to an area were the airborne concentration of carbon dioxide is less than 5000 ppm. The initial level of protection Level C respirator protection as described in **Section 4.5** must not be used in an atmosphere containing carbon dioxide.

When the instantaneous levels of oxygen is at or below 19.5% workers should relocate to an area were the airborne concentration of oxygen is greater than 19.5%. The initial level of protection Level C respirator protection as described in **Section 4.5** must not be used in an atmosphere containing less than 19.5% oxygen.

4.6.3 Carbon Monoxide

Carbon monoxide gas may also be generated during the naturalization process. Carbon monoxide is a colorless, odorless gas. The most common symptoms of CO poisoning are headache, dizziness, weakness, nausea, vomiting, chest pain, and confusion. High levels of CO inhalation can cause loss of consciousness and death. The ACGIH recommends a TLV for carbon monoxide is 25 ppm as aTWA₈.

A multi-gas meter such as the VRAE or equivalent will be used to measure the airborne concentrations of carbon monoxide and oxygen in the breathing zone of workers in the EZ. Multi-gas meters such as the VRAE can simultaneously measure oxygen, hydrogen sulfide and carbon monoxide.

When the instantaneous levels of carbon monoxide is at or above 25 ppm, workers should relocate to an area where the airborne concentration of carbon monoxide is less than 25 ppm. The initial level of protection Level C respirator protection as described in **Section 4.5** must not be used in an atmosphere containing carbon monoxide.

4.6.4 Sulfur Dioxide

Sulfur dioxide gas may also be generated during the naturalization process. Sulfur dioxide is a colorless gas with a pungent odor. The most common symptoms of sulfur dioxide are burning the nose and throat, and breathing difficulties with lung function changes over time. High levels of sulfur dioxide inhalation can cause loss of life. OSHA has established a PEL of 5 ppm as aTWA₈.

A multi-gas meter such as the VRAE or equivalent will be used to measure the airborne concentrations of sulfur dioxide in the breathing zone of workers in the EZ. Multi-gas meters such as the VRAE can simultaneously measure oxygen, hydrogen sulfide and carbon monoxide.

When the instantaneous levels of sulfur dioxide is at or above 0.25 ppm, workers should relocate to an area where the airborne concentration of carbon monoxide is less than 0.25 ppm.

4.6.5 Sulfuric Acid

Sulfuric acid gas may be liberated during the process. It is an odorless gas, which when inhaled, may cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Sulfuric acid is very corrosive action to the mucous membranes.

Prolonged or repeated inhalation of sulfuric acid may cause kidney and lung damage. Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis. Sulfuric acid may cause fetal effects and may cause cancer in humans. The OSHA PEL for sulfuric acid is 1 mg/m³ ppm as aTWA₈.

The Porta Sens II Gas Detector is capable of monitoring acid gases. When the instantaneous levels of acid gases is at or above 0.5 ppm, workers should relocate to an area where the airborne concentration of acid gases is less than 0.5 ppm.

4.6.6 Calibration

The Aerosol Monitors will be field checked daily using zero calibration air. At the beginning of each workday (prior to site intrusive activities each day) a calibration zero check will be performed on each unit at the measurement locations. A zero (or particulate-free) test sample, using the appropriate particulate filter

supplied by the manufacturer for this purpose, will be placed over the sample inlet. The data output for the monitor will be observed and the response recorded in a field logbook.

Prior to each measurement session, an on-site dynamic calibration of the carbon monoxide monitor and oxygen monitor will be performed according to the manufactures' directions. The data output for the monitor will be observed and the response recorded in a field logbook.

Prior to daily use the multi-gas meter or equivalent for carbon monoxide, sulfur dioxide, etc. will be bump tested in as a means of verifying calibration by using a known concentration of test gas (i.e. carbon monoxide). In addition the instrument will be calibrated in accordance with manufacturers' recommendations. The data output for the monitor will be observed and the response recorded in a field logbook.

4.6.7 Personal Air Sampling

Personal exposure assessment may be conducted for hexavalent chromium/total dust if the dust action level is exceeded during the task or if the task is determined to be "high-risk" for personal exposure. Personal air samples will be collect in accordance with OSHA and/or NIOSH methodology and analyzed by an AIHA accredited laboratory. The results of the sampling will be communicated to project personnel. The number of workers selected to wear the personal sampling pumps will be determined in advance of the field activity by AECOM's RSHEM. The RSHEM will also determine the need for personal monitoring of other gases including hydrogen sulfide, sulfuric acid, and sulfur dioxide using commercially available direct read instruments, Draeger Tubes or NIOSH Sampling Methods as appropriate.

4.6.8 Analytical Methods

- Hexavalent Chromium- 29 CFR 1910.1026(d)-Analytical Method OSHA ID-215
- Dust-NIOSH Analytical Method- 0500

4.7 Task-Specific Job Safety Analysis

Specific JSA's/THAs will be prepared for the following:

- Chemical handling/blending
- Soil handling
- Equipment operation
- Soil/groundwater sampling

5.0 Pilot Scale Treatment Studies for Groundwater and Saturated Soils

5.1 Introduction

Two types of pilot studies will be conduct to treat groundwater and saturated soils. Approximate locations for the studies are depicted in Figure 8-1 of the Feasibility Study Work Plan. In one test, the pilot study will use primary calcium polysulfide ("CaS_x and may include addition of FeS. The second approach will utilize a degradable organic carbon source to stimulate native sulfate- and iron-reducing microorganisms in situ, whose metabolic byproducts include ferrous iron (Fe(II)) and sulfides (H₂S, HS⁻) that react abiotically and reduce hexavalent chromium to trivalent chromium solids. The proposed locations and well infrastructure for these two studies are presented in Figures 9-1 and 9-7 of the Feasibility Study Work plan. Each of these processes is discussed in further detail below.

5.2 Process Description

Following excavation in the western portion of IRM#1, pilot studies of In-Situ Chemical Reduction/Geochemical Fixation (IRC) will be conducted in both the shallow zone and the intermediate zone. Note that the deep zone in this area is also impacted. Monitoring in the deep zone will be conducted to determine the combination of soil removal (IRM#1) and groundwater treatment in the shallow and deep zones results in an improvement in deep groundwater. For the shallow and deep zones, a primarily abiotic process and a primarily biologically mediated process will be tested. This approach will allow comparison of the two approaches and allow a comprehensive assessment of groundwater treatment methods for the Feasibility Study.

In general, the abiotic process works by adding a chemical reductant, such as CaSx, to react with hexavalent chromium to reduce hexavalent chromium to trivalent chromium. The chromium becomes insoluble and unavailable for dissolution into the groundwater. Thus, the concentration of total chromium dissolved in groundwater becomes significantly lower. The reduction process does not remove the chromium from the system but converts it to a less mobile form. The initial effectiveness and long-term effectiveness of the process depends on several variables. Changes in the geochemistry of the aquifer brought on by the reagents can, in some cases, lead to higher dissolved phase concentrations of some metals. The general objectives of the pilot studies are to determine short-term and long-term effectiveness at reducing chromium and to evaluate other impacts on groundwater quality.

The starting point for the abiotic pilot studies at Site will be the use of sulfur compounds, such as CaSx. These same reagents were used successfully in the bench top studies of soils discussed in Section 8 of the Work Plan. In those bench top studies, CaSx was shown to effectively reduce hexavalent chromium, immobilize trivalent chromium, and not to mobilize other metals. To further improve effectiveness, another additive has been selected for testing. After CaSx injection and initial testing, FeS will likely be added.

Depending on results from injection of CaSx additional treatment using FeS may be conducted. FeS has a low solubility in water and would be a persistent reductant. Addition of FeS may not be necessary if there is sufficient iron naturally occurring in the aquifer materials and sulfate reducing conditions prevail after CaSx addition alone. Tests will be conducted to determine the need for FeS addition.

While use of CaSx is expected to be effective, use of a primarily biological treatment may have advantages. One advantage would be avoiding an increase in the level of sulfate in the groundwater. Cost may be a second advantage. One of the more commonly used and successful biological treatments for hexavalent chromium is use of carbohydrate solutions. Sucrose and other sugars in the carbohydrate solutions are degraded by heterotrophic microorganism naturally occurring in the aquifer (or introduced). Consumption of the sugars leads to depletion of dissolved oxygen and to reducing conditions. Hexavalent chromium is then reduced to trivalent chromium which forms low solubility hydroxides.

5.3 Overall Sequence and Treatment Area Layout

The approximate areas for the two groundwater pilot studies are shown in Figure 8-1 of the Work Plan. Design and implementation will proceed sequentially as initial data is used to refine the next steps. The general sequence of work is as follows:

- Excavate soils in western portion of IRM #1;
- Collect post excavation soil samples, analyze for hexavalent chromium, review results;
- Select locations for monitoring wells based on soil results and historic groundwater data;
- Install monitoring wells and sample for parameters necessary for final determination of injection locations and for determining initial reagent blends;

- Install injection and extraction wells;
- Collect soil samples in intermediate zone during well installation to help refine reagent formulations (for example, determine if FeS is needed and establish baseline biological conditions);
- Begin extraction and injection processes, monitor processes using tracer and injection/extraction data, adjust processes as necessary;
- Achieve minimal pore volume goals;
- Test monitoring wells, injection wells, and extraction wells;
- Conduct additional injection of initial reagent formulation or modified reagent formulations as needed;
- Complete injection process;
- Resample saturated soils; and
- Conduct long-term monitoring.

The proposed layout for both groundwater pilot studies are similar same. Both treatment areas are approximately 80 by 110 feet in size. The treatment areas are surrounded by monitoring wells. The monitoring wells will be used to assess any interaction between the treatment zones and impacts from up-gradient areas. For the CaSx treatment, two centrally located extraction wells will be surrounded by 10 injection wells. Spacing for the extraction wells is approximately 40 feet. Spacing for the injection wells is approximately 20 feet.

For the biological treatment, no extraction wells will be used. The treatment solution will be supplied to centrally located injection wells. The injection well will be surrounded by monitoring wells.

Groundwater will be extracted from the treatment zone, blended with the treatment reagents, filtered and then injected into the treatment zone. The extracted groundwater will first be pumped into a storage tank. The water will then be blended with the treatment chemicals using a metering pump and in-line mixer. Solids will be removed in a settling tank. Water containing the treatment solution will be filtered prior to injection. A combination of field test kits and laboratory analysis will be used to confirm that the desired concentration of treatment chemical is achieved. Flexible hose will be used to connect the injection wells to the treatment solution storage tank. Flow meters will be installed for each injection well so that the performance of each well can be monitored. Solution is expected to be injected under a slight pressure (less than 40 pounds per square inch) provided by an injection pump. Each injection well will be outfitted with a float control valve or other means to more evenly distribute the flow among the injection wells. If the flow rate to an injection well decreases, the well will be redeveloped.

At this time it is anticipated that the treatment reagents will be injected in a sequential manner. First, the primary reductant (CaSx) will be injected. After review of the initial CaSx injection data, a decision regarding injection of FeS will be made. If the FeS is not being generated in-situ and the injection of FeS is expected to be beneficial, then FeS will be injected. The estimated concentration of FeS solution for injection is 100 to 500 milligrams per liter ("mg/l"). For FeS tests, beneficial results (maintenance of reducing conditions) should be observed before 0.5 pore volumes are added. Therefore, the injection volume for FeS will not exceed 0.5 pore volumes.

Submersible pumps with variable speed drives designed to maintain a constant drawdown will be installed in the extraction wells. An initial batch of approximately 20,000 gallons of water will be extracted and pumped to the storage tank. Flow rates from each extraction well will be recorded and drawdown in nearby

monitoring and injection wells recorded. This initial batch of water will be processed and stored in the treatment solution storage tank. After results from the first batch of treatment solution are obtained, injection will begin. Later, groundwater will be extracted, processed, and injected in a continuous process.

The exact injection procedure will be determined in the field based on preliminary results. Injections will likely start with a few wells and then ramp-up as the process proceeds. Push-pull tests may be conducted to help determine the exact injection process. Push-pull tests consist of injecting treatment solution at one injection well and allowing the solution to react for a period of time (typically overnight). Then the injection volume plus several (approximately 10) times more the injection volume is extracted. The extracted water is periodically tested (redox potential and hexavalent chromium) to determine effectiveness of treatment. Once the injection process is fully defined, simultaneous extraction from all extraction wells and injection in all injection wells should be possible as the process is refined. Testing during injection will include:

- Flow rates from each extraction wells (daily);
- Drawdown in extraction wells (daily);
- Flow rates and pressure in injection wells (daily);
- Groundwater elevations in monitoring wells (twice per week);
- For the CaSx injection, field testing of monitoring wells and extraction wells for presence of treatment chemicals (SO_4^{-2} , S, Ca and Na), pH and redox potential (once per week);
- For biological treatment testing will include field parameters (pH, dissolved oxygen, temperature and oxidation potential). If a tracer is used, analysis for the tracer will also be conducted; and
- Laboratory analysis for chromium (hexavalent and total, filtered and unfiltered) and other constituents (sulfate, Ca and Na) in monitoring wells will be conducted. The frequency of laboratory testing will begin as weekly and then extend to monthly as the injection process proceeds.

5.4 Treatment Solution Mixing and Injection – CaSx Treatment

The primary reductant chemicals under consideration are calcium polysulfide and/or sodium polysulfide. Products being considered for injection include:

- Calcium Polysulfide (“CaSx”) as a 29% liquid solution delivered in tankers, BSP Cascade is a supplier.
- Ferrous Sulfide (“FeS”) as a 10% liquid suspension delivered in tankers, Redox Solutions is a supplier.

5.5 Process Health and Safety Concerns

The health and safety concerns associated with the CaSx treatment process are as follows:

- Reaction/ incompatibilities of reagents {Ferric sulfide and CaSx solution} used in the treatment process;
- Proper handling of reagents used in the treatment process;
- Working around construction equipment including drill rigs;
- Temporary electrical supply; and
- Workers’ exposure to impacted soil/groundwater COPR, hexavalent chromium and off gases during drilling.

5.6 Chemical Reagents

CaSx will be delivered to the site as a 29% solution in water. CaSx is a deep reddish liquid with a strong rotten egg odor. CaSx is a highly alkaline substance with a pH between 11.0 and 12.5. CaSx can irritate the eyes and cause severe corneal damage. Skin contact will result in irritation and possible corrosion of the skin. Ingestion will irritate/burn mouth, throat and gastrointestinal tract. There is no occupational exposure level for CaSx and its ingredients, since CaSx is capable for releasing hydrogen sulfide the manufacturer use the occupational level for hydrogen sulfide. The OSHA PEL for hydrogen sulfide is 10 ppm as a TWA₈. Hydrogen sulfide gas is also flammable with a Lower Flammability Limit ("LFL") of 4.0% and upper flammability limit of 44%. CaSx is incompatible with strong oxidizers such as nitrates, nitrites or chlorates can cause explosive mixtures if heated to dryness. Acids, acidic materials or dilution with water will cause the release of hydrogen sulfide, a highly toxic gas.

While in storage CaSx must be stored in a well ventilated area away from combustible materials, sources of heat or flame and out of direct sunlight at moderate temperature (<90° F). CaSx will be stored on site in a 5,000-gallon double wall plastic tank. The tank containment must be protected from physical damage. The tank of CaSx must be properly labeled as to its content and hazards using the manufacturers' labels or an NFPA 704M label specific for the material is considered to be an acceptable label (H/2, F/0, R/1). All containers of CaSx must be labeled in accordance with OSHA's Hazard Communication Standard. The MSDS for CaSx must be readily available on site. Fitting for the transfer of the transfer of CaSx must be unique and not compatible with other fittings (i.e. water).

Ferrous sulfide is black liquid solution (10% FeS in water suspension) with a pH between 8.0 and 12 units. Ferrous sulfide can irritate the eyes, and mucous membranes. Skin contact will result in irritation and possible corrosion of the skin. Ingestion will irritate/burn mouth, throat and gastrointestinal tract. There is no occupational exposure level for ferrous sulfide. Ferrous sulfide is incompatible with strong acids, metal oxides, and strong bases decomposing into hydrogen sulfide.

Ferrous sulfide must be stored in a well ventilated area away from combustible materials, sources of heat or flame and out of direct sunlight at moderate temperature (<90° F). Ferrous sulfide will be stored on site in a 5,000-gallon double wall plastic tank. The tank containment must be protected from physical damage. The tank of ferrous sulfide must be properly labeled as to its content and hazards using the manufacturers' labels or an NFPA 704M label specific for the material is considered to be an acceptable label (H/1, F/0, R/0). All containers of ferrous sulfide must be labeled in accordance with OSHA's Hazard Communication Standard. The MSDS for ferrous sulfide must be readily available on site. The fitting for the transfer of the transfer of ferrous sulfide must be unique and not compatible with other fittings (i.e. water, CaSx).

5.7 Engineering/Work Practice Controls

Engineering controls will consist of the following:

- Proper storage and protection of chemical reagents;
- Secondary containment for liquid chemical reagents;
- Use of material compatible with the chemical reagents;
- Use of dust control agents to prevent dusting;
- Designation of an EZ, CRZ and support zone; and
- Installation of a safety drench shower/eyewash meeting ANSI standards in the area where chemicals are handled/stored.

Work practice controls will consist of the following:

- Twenty-four hour security coverage of the site;

- Fenced in site;
- Implementation of a sign-in/sign-out procedure;
- Limit the number of workers in the EZ;
- Daily inspection of process equipment and reagent storage tanks;
- Limit the number of vehicles on site to reduce the chance of collisions, and establish hand signals for workers;
- Use of direct push or sonic drilling methods to prevent the generation of dust;
- Slow equipment movement down to prevent the generation of dust;
- Daily inspection of construction equipment;
- Maintaining an upwind position;
- No eating, drinking, or applying cosmetics while in the EZ; and
- Implementation of decontamination procedures for personnel and equipment that enter the EZ.

5.8 Personal Protective Equipment

To protect workers from accidental splash or inhalation of gases, mists or vapors, chemical resistant garments and respiratory protection will be used when handling or transferring chemicals. The use of PPE is also necessary to protect workers from contaminants of concern, COPR and hexavalent chromium during well construction and sampling.

Based on the hazardous properties of the chemical reagents and contaminants of concern Level C PPE is recommended for the initial blending operation where the concentrated CaSx and FeS solutions are being used. Level C protection will consist of the following:

- Hardhat
- High visibility vest
- Steel toe protective foot wear
- Hearing protection
- Full face powered air purifying respirator (APF- 1000) equipped with combination organic vapor/acid gas cartridge with a P-100 filter. This cartridge is recommended for escape only in an atmosphere containing hydrogen sulfide.
- Chemical-resistant overalls (Tychem QC- chemical splash)
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent
- Over boots (rubber)

Respirator cartridges must be changed after each day's use, immediately if breakthrough is perceived, or when breathing becomes difficult. Chemical resistant coveralls and outer gloves must be properly disposed of after each use. If chemical resistant glove or coverall become ripped or show signs of swelling or failure, the person should immediately leave the area, remove the protective equipment and immediately notify the SSO of the potential exposure. It is the responsibility of each employee to inspect their PPE for defects prior to donning. Defective PPE must be replaced.

The SSO, with concurrence from the PM and RSHEM, may down grade the level of protection based on air monitoring results, observation of work practices or hazardous assessment. Handling of the dilute solutions after blending will likely be a Level D operation. Down grading of PPE may occur if the use PPE poses a safety hazard (i.e. heat stress, entanglement).

Modified Level D protection is recommended for activities where respirator protection is not required and maybe limited to handling of reagents when splash is anticipated. Level D modified protection will consist of the following:

- Chemical-resistant overalls (Tychem QC- chemical splash) or neoprene apron
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent
- Over boots (rubber)
- Safety glasses
- Full face splash shield worn over safety glasses

Level D protection is recommended for activities where respirator and dermal protection is not required. Level D modified protection will consist of the following:

- Hardhat
- High visibility vest
- Steel toe protective foot wear
- Safety glasses
- Shirt with sleeves
- Long pants

5.9 Air Monitoring

5.9.1 Dust/Hexavalent Chromium during Drilling

The TSI DustTrak and DataRAM Model DR 1000 Aerosol Monitors (or equivalent) measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, during intrusive work. TSI DustTrak Aerosol Monitors will be to measure the upwind and downwind concentrations of particulates at the perimeter of the EZ, while personal aerosol monitors (such as the DataRAM DR 1000 or equivalent) will be used to monitor worker exposure within the EZ.

A personal exposure level was calculated base on contaminants of concern hexavalent chromium which has the lowest occupational exposure ($0.005 \text{ mg/m}^3 \text{ TWA}_8$) of the potential dust producing substances such as Portland cement and ferrous sulfide. It is recognized that respirable dust particles are generally not visible to the naked eye, but a total airborne dust clouds is often visible at concentrations of 2 mg/m^3 . Since visible dust is not acceptable a dust action of 0.167 mg/m^3 will be used as the dust action level for upgrading to Level C. Regardless of the measured airborne concentration of dust in the workers breathing zone the initial level of protection will be Level C as described in **Section 5.8**.

5.9.2 Hydrogen Sulfide

The soil treatment may generate hydrogen sulfide under acidic conditions. Hydrogen sulfide will be measured using a single gas monitor such as the BW Tech Gas Alert or equivalent specifically for hydrogen sulfide. Measurement for hydrogen sulfide will be made on an intermittent basis inside and outside the EZ and outside the during the treatability study.

If any hand-held hydrogen sulfide instantaneous levels exceed 5 ppm for a sustained 15 minute period, workers should relocate to an area were the airborne concentration of hydrogen sulfide is less than 5 ppm. Regardless of the measured airborne concentration of hydrogen sulfide in the workers breathing zone the initial level of protection will be Level C as described in **Section 5.8**. As noted in **Section 5.8**, the respirator cartridge is recommended and approved for escape only in an atmosphere containing hydrogen sulfide.

5.9.3 Volatile Organic Vapors

During well installation, the air in work areas will be monitored periodically for the potential presence of volatile organic vapors. A portable PID with a 10.6 eV lamp will be utilized to periodically monitor the levels of volatile organic compound in the ambient air. Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions and whether there is a need to change levels of worker protection.

If the PID indicates sustained (15 minute) breathing zone vapor concentrations in excess of 5 ppm above background Level C respiratory protection should be donned. Regardless of the measured airborne concentration of VOC in the workers breathing zone the initial level of protection will be Level C as described above.

5.9.4 Calibration

The Aerosol Monitors will be field checked daily using zero calibration air. At the beginning of each workday (prior to site intrusive activities each day) a calibration zero check will be performed on each unit at the measurement locations. A zero (or particulate-free) test sample, using the appropriate particulate filter supplied by the manufacturer for this purpose, will be placed over the sample inlet. The data output for the monitor will be observed and the response recorded in a field logbook.

Prior to each measurement session, an on-site dynamic calibration of the hydrogen sulfide monitor will be performed against a known hydrogen sulfide calibration gas. The daily calibration will also include a dynamic zero air check of the instrument. The data output for the monitor will be observed and the response recorded in a field logbook.

At the beginning of each workday (prior to site intrusive activities each day) the PID will be bump tested in as a means of verifying calibration by using a known concentration of test gas (isobutylene). In addition the PID will be zeroed using a zero gas or filter unit as specified by the instruments manufacturer. The data output for the monitor will be observed and the response recorded in a field logbook.

5.9.5 Personal Air Sampling

Personal exposure assessment will be conducted for organic vapors/benzene and hexavalent chromium/total dust if the dust action level is exceeded during the task or if the task is determined to be "high-risk" for personal exposure. Personal air samples will be collect in accordance with OSHA and/or NIOSH methodology and analyzed by an AIHA accredited laboratory. The results of the sampling will be communicated to project personnel. The number of workers selected to wear the personal sampling pumps will be determined in advance of the field activity by AECOM's RSHEM.

5.9.6 Analytical Methods

- Hexavalent Chromium- 29 CFR 1910.1026(d)-Analytical Method OSHA ID-215
- Dust-NIOSH Analytical Method- 0500
- Benzene- 29 CFR 1910.1028 (e) - Analytical Method 12 or equivalent.

5.9.7 Task-Specific Job Safety Analysis

Specific JSA's/THAs will be prepared for the following:

- Chemical handling/blending
- Drilling/well construction
- Injection and Extraction Equipment operation
- Soil/groundwater sampling

6.0 Treatment Solution Mixing and Injection – Biological Treatment

The second remedial technology proposed for shallow and intermediate zone pilot testing is anaerobic bioprecipitation and hexavalent chromium fixation. This process incorporates the periodic delivery of a degradable organic carbon source to stimulate the native microorganisms and promote the development of an in situ reaction zone (“IRZ”). The goal of this process is to overcome the aquifer’s supply of aerobic electron acceptors (primarily oxygen and nitrate) and to stimulate iron and sulfate reducing conditions. In this environment, microorganisms can support the reduction of hexavalent chromium by a variety of mechanisms. While these processes include enzymatic extracellular reduction and intracellular reduction (Zhu et al, 2008), the primary mechanisms are via the reduction of naturally-occurring iron and sulfate (by microbial respiration) to create ferrous iron (Fe(II)) and sulfides (H_2S , HS^-) that react abiotically with hexavalent chromium. These reactions reduce hexavalent chromium to trivalent chromium and result in the formation of trivalent chromium-hydroxide solids.

This remedial process is designed to reductively precipitate and permanently fix/immobilize the chromium in the aquifer, thereby removing chromium from the groundwater.

The goal of the proposed IRZ application is to demonstrate proof of concept for the anaerobic bioprecipitation approach. The initial demonstration of biologically-mediated chromium reduction will be accomplished by conducting an initial injection of a carbohydrate solution to enhance reducing conditions in the subsurface and promote development of the IRZ. Monitoring activities during and following the injection will be used to evaluate the overall changes in dissolved metals concentrations and the biogeochemistry within the injection area over time. Additional injection events will be conducted, as necessary, based on results observed during the operational monitoring period.

As organic carbon is the driver for the entire treatment process, the single most critical factor in the successful application of anaerobic IRZ technology is adequate delivery and distribution of the carbon source in the subsurface to achieve contact with the impacted soil and groundwater targeted for treatment. This requires an adequate understanding of the hydrogeologic environment, plume configuration, and the specific responses to fluid injection as a function of geology. Thus, the overall objectives of this approach are as follow:

- Collect site-specific data from hydraulic injection/tracer testing to support the engineering design of the full-scale injection program;
- Establish a geochemical environment conducive to hexavalent chromium bioprecipitation (i.e. iron-to sulfate-reducing);
- Demonstrate hexavalent chromium mass reduction by evaluating dissolved metal concentrations and water quality data within the treatment areas; and
- Determine of the optimal injection frequency and substrate loading for full-scale operations.

As proposed, the carbon delivery approach does not include groundwater re-circulation to promote subsurface distribution, but relies instead on batch injection to achieve sufficient subsurface distribution during the initial injection event. As multiple lithologies are being targeted in this pilot test (shallow backfill materials within the IRM#1 excavation area and the underlying intermediate sand, silt and gravel lithologies), the batch injection method will be used to evaluate aquifer hydraulics in these intervals and to determine whether subsurface heterogeneities could potentially limit distribution during full-scale application. Enhanced hydraulic distribution mechanisms (i.e. recirculation) can be easily coupled with this remedial strategy, but are not necessary to demonstrate overall efficacy during the pilot treatment phase.

A carbon substrate (molasses) will be mixed in two 500-gallon high-density polyethylene (“HDPE”) storage tanks. While one tank is being injected, the second tank will be filled with the subsequent batch such that

the injections can be executed continuously. Conveyance tubing will be used to deliver the carbon solution through a manifold network to each of the injection well heads. During the injection event, injection flow rates and wellhead pressures will be recorded using digital turbine flow-meters and pressure gauges within the manifold.

During the initial organic carbon injection, two different solutions will be mixed to provide greater data resolution following the injection event. One solution will include molasses and inert Rhodamine WT dye, and the other solution will include molasses alone. As both Total Organic Carbon ("TOC") and dye analyses will be collected following the injection, the concentration profiles of these two constituents will be used to refine the groundwater flow direction and velocity, and to assess the rate of organic carbon utilization.

6.1 Process Health and Safety Concerns

The health and safety concerns associated with the biological treatment process are as follows:

- Working around construction equipment including drill rigs;
- Temporary electrical supply; and
- Workers' exposure to impacted soil/groundwater (Chromite Ore Processing Residue), hexavalent chromium and off gases.

6.2 Process Chemical

The carbon source, molasses poses no unique physical or health hazards to site personnel. The carbon source requires no special precautions.

Rhodamine WT dye is a red liquid with no odor. Rhodamine WT dye, component is trimellitic acid (2.6%) and water. There is no occupational exposure level for Rhodamine WT dye and its components. Rhodamine WT dye is irritating to the eyes and skin. Inhalation of Rhodamine WT dye mist may cause irritation to the respiratory tract. The dye can stain clothing and skin. The product should be stored in its original water-proof container, away from direct sunlight and heat.

Engineering/Work Practice Controls

Engineering controls will consist of the following:

- Proper storage process chemicals;
- Use of material compatible with the chemical reagents;
- Use of dust control agents to prevent dusting;
- Designation of an EZ, CRZ and support zone; and
- Installation of a safety drench shower/eyewash meeting ANSI standards in the area where chemicals are handled/stored.

Work practice controls will consist of the following:

- Twenty-four hour security coverage of the site;
- Fenced in site;
- Implementation of a sign-in/sign-out procedure;
- Limit the number of workers in the EZ;
- Daily inspection of process equipment and reagent storage tanks;

- Limit the number of vehicles on site;
- Use of direct push or sonic drilling methods to prevent the generation of dust;
- Slow equipment movement down to prevent the generation of dust;
- Daily inspection of construction equipment;
- Maintaining an upwind position;
- No eating, drinking, or applying cosmetics while in the EZ; and
- Implementation of decontamination procedures for personnel and equipment that enter the EZ.

6.3 Personal Protective Equipment

The personnel protective equipment recommended for the biological treatment including installation of groundwater wells is modified Level D.

Modified Level D protection is recommend for activities where respirator protection is not required and maybe limited to handling of reagents when splash is anticipated. Level D modified protection will consist of the following:

- Chemical-resistant overalls (Tychem QC- chemical splash) or neoprene apron
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent
- Over boots (rubber)
- Safety glasses
- Full face splash shield worn over safety glasses.

Level D protection is recommended for activities where respirator and dermal protection is not required. Level D modified protection will consist of the following:

- Hardhat
- High visibility vest
- Steel toe protective foot wear
- Safety glasses
- Shirt with sleeves
- Long pants

The contingency to Level D and modified Level D will be Level C protection. Level C will be based on the airborne concentration of contaminants of concern, COPR and hexavalent chromium during well construction and sampling.

Based on the airborne concentrations of the contaminants of concern Level C PPE is recommended for work inside the EZ. Level C protection will consist of the following:

- Hardhat
- High visibility vest
- Steel toe protective foot wear
- Hearing protection
- Full face powered air purifying respirator (APF- 1000) equipped with combination organic vapor/acid gas cartridge with a P-100 filter. This cartridge is recommended for escape only in an atmosphere containing hydrogen sulfide.

- Chemical-resistant overalls (Tychem QC- chemical splash)
- Inner gloves: Best Safety N-DEX or equivalent
- Outer gloves: Ansell-Edmont SOL-VEX (Nitrile) or equivalent
- Over boots (rubber)

Respirator cartridges must be changed after each day's use, immediately if breakthrough is perceived, or when breathing becomes difficult. Chemical resistant coveralls and outer gloves must be properly disposed of after each use. If chemical resistant glove or coverall become ripped or show signs of swelling or failure, the person should immediately leave the area, remove the protective equipment and immediately notify the SSO of the potential exposure. It is the responsibility of each employee to inspect their PPE for defects prior to donning. Defective PPE must be replaced.

The SSO, with concurrence from the PM and RSHEM, may down grade the level of protection based on air monitoring results, observation of work practices or hazardous assessment. Down grading of PPE may occur if the use PPE poses a safety hazard (i.e. heat stress, entanglement).

6.4 Air Monitoring

6.4.1 Dust/Hexavalent Chromium

The TSI DustTrak and DataRAM Model DR 1000 Aerosol Monitors (or equivalent) measures concentrations of airborne dust, smoke, mists, haze and fumes with real-time readout. The instrument can be used for exposure sampling of ambient air, during intrusive work. TSI DustTrak Aerosol Monitors will be to measure the upwind and downwind concentrations of particulates at the perimeter of the EZ, while personal aerosol monitors (such as the DataRAM DR 1000 or equivalent) will be used to monitor worker exposure within the EZ.

A personal exposure level was calculated base on contaminants of concern hexavalent chromium which has the lowest occupational exposure ($0.005 \text{ mg/m}^3 \text{ TWA}_8$) of the potential dust producing substances such as Portland cement and ferrous sulfide.

It is recognized that respirable dust particles are generally not visible to the naked eye, but a total airborne dust clouds is often visible at concentrations of 2 mg/m^3 . Since visible dust is not acceptable a dust action of 0.167 mg/m^3 will be used as the dust action level for upgrading to Level C. Regardless of the measured airborne concentration of dust in the workers breathing zone the initial level of protection will be Level C.

6.4.2 Volatile Organic Vapors

During well installation, the air in work areas will be monitored periodically for the potential presence of volatile organic vapors. A portable PID with a 10.6 eV lamp will be utilized to periodically monitor the levels of volatile organic compound in the ambient air. Measurements will be monitored from the breathing zone (4 to 5 feet above ground level) at worker locations to determine working conditions and whether there is a need to change levels of worker protection.

3.0 If the PID indicates sustained (15 minute) breathing zone vapor concentrations in excess of 5 ppm above background Level C respiratory protection as described above should be donned. Regardless of the measured airborne concentration of VOC in the workers breathing zone the initial level of protection will be Level C as described in **Section 6.3**.

6.4.3 Calibration

The Aerosol Monitors will be field checked daily using zero calibration air. At the beginning of each workday (prior to site intrusive activities each day) a calibration zero check will be performed on each unit at the measurement locations. A zero (or particulate-free) test sample, using the appropriate particulate filter supplied by the manufacturer for this purpose, will be placed over the sample inlet. The data output for the monitor will be observed and the response recorded in a field logbook.

At the beginning of each workday (prior to site intrusive activities each day) the PID will be bump tested in as a means of verifying calibration by using a known concentration of test gas (isobutylene). In addition the PID will be zeroed using a zero gas or filter unit as specified by the instruments manufacturer. The data output for the monitor will be observed and the response recorded in a field logbook.

6.4.4 Personal Air Sampling

Personal exposure assessment may be conducted for organic vapors/benzene and hexavalent chromium/total dust if the dust action level is exceeded during the task or if the task is determined to be "high-risk" for personal exposure. Personal air samples will be collect in accordance with OSHA and/or NIOSH methodology and analyzed by an AIHA accredited laboratory. The results of the sampling will be communicated to project personnel. The number of workers selected to wear the personal sampling pumps will be determined in advance of the field activity by AECOM's RSHEM.

6.4.5 Analytical Methods

Analytical methods will include the following:

- Hexavalent Chromium- 29 CFR 1910.1026(d)-Analytical Method OSHA ID-215
- Dust-NIOSH Analytical Method- 0500
- Benzene- 29 CFR 1910.1028 (e) - Analytical Method 12 or equivalent.

6.4.6 Task-Specific Job Safety Analysis

Specific THA's will be prepared for the following:

- Chemical handling/blending
- Drilling/well construction
- Equipment operation
- Soil/groundwater sampling

Appendix I

AECOM-PPG NJ Chrome Program Organization

HAZWOPER Health and Safety Plan

PPG New Jersey Chromium Program

Site 156 Metro Towers

270-280 Luis Munoz Marin Boulevard

Jersey City, New Jersey 104063



Prepared for
PPG
One PPG Place
Pittsburgh, PA

Prepared by
AECOM
30 Knightsbridge Road
Suite 520
Piscataway, NJ 08735

Expiration Date :July 31, 2018

Preparer
Eric Acs
Geologist

Aug 1, 2017

Stacy Wells
Regional SH&E Manager

Aug 29, 2017

Project Manager
William Spronz
Project Manager

Aug 31, 2017

HASP SUMMARY

Note: This Summary is intended to provide key information only and cannot be substituted for reading, understanding, and complying with the full HASP. This summary may be continually updated as tasks and personnel change. Use Continuation Sheets if necessary.

Project Name: Metro Towers		Project Number: 60493065	
Summary Revision Date: 8/01/2017		Client Name: PPG	
Report ALL SH&E Incidents, no matter how minor, to the Incident Hotline: 800-348-5046 Injury, Property Damage, Vehicle, Security, Regulatory Inspection, Environmental Impact, and any potentially work related injury, discomfort/ pain, or damage.			
Identify the nearest Occupational Clinic and Hospital to the site that accepts AECOM Workers Compensation Insurance (see Attachment A for instructions). If the nearest such clinic or hospital is an unreasonable distance from the site, identify nearer hospitals or clinics. Attach maps and directions to the clinics and hospitals in Attachment A .			
Occupational Clinic:	Concentra Medical Center	Nearest Hospital:	Jersey City Medical Center
Address:	574 Summit Ave, 4 th floor Jersey City, NJ 07306	Address:	335 Grand Street, Jersey City, NJ 07304-3254
Phone Number:	201-656-7678	Phone Number:	201-915-2000
Key Personnel			
Project Manager (PM):	William Spronz	Cell Phone:	908 377-7226
Site Supervisor (SS)	Eric Acs	Cell Phone	732 343-0374
Safety Officer (SSO):	Eric Acs	Cell Phone	732-343-0374
AECOM SH&E Mgr.	Stacy Wells	Cell Phone:	917-324-2554
Client PM:	Rich Feinberg	Cell Phone:	732-233-4552
List ALL Short-Service Employees, including subcontractors (<6 Months with Company in Current Area/Job Description):			
List ALL Subcontractors and their Site Safety Officers: Entact, LLC, Maser Surveying, WTS, TPI Environmental			

PM must positively verify subcontractors are approved in Subpart for the work described. If there were any limitations/ conditions of approval, describe them and how they are being met.

☒ I have verified that all subcontractors are approved in Subpart, and that all conditions of approval are met.

PM Name _____ PM Signature _____ Date _____

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ATTACHMENTS

Attachment A: Hospital/Clinic Maps and Incident Reporting and Response Flow Chart

Attachment B: AECOM SH&E Procedures

Attachment C: Safety Data Sheets

Attachment D: Site Orientation

Attachment E: Project/Task-Specific Pre-Job Hazard Assessments Forms

1.0 INTRODUCTION

This written HASP is designed to identify, evaluate, and control safety and health hazards, and to outline emergency response actions for AECOM-managed activities. This HASP must be kept on site during work activities and made available to all workers including subcontractors and other site occupants for informational purposes. AECOM subcontractors are expected to independently characterize, assess, and control site hazards created by their specific scope of work.

This section of the HASP summarizes important AECOM SH&E Procedures that apply to all Design and Consulting Services (DCS) Americas jobs. See **Attachment B** for complete copies of applicable field SH&E Procedures. This template has been designed primarily for use in the United States; see procedure attachment S3AM-320-ATT2 for Canadian Specific Requirements on AECOM's ecosystem.

1.1 APPLICABLE REFERENCES

This Health and Safety Plan (HASP) conforms to the regulatory requirements and guidelines established in the following documents:

- Title 29, Part 1910 of the Code of Federal Regulations (29 CFR 1910), Occupational Safety and Health Standards (with special attention to Section 120, Hazardous Waste Operations and Emergency Response).
- Title 8 of the California Code of Regulations (8 CCR), with special attention to Section 5192 Hazardous Waste Operations and Emergency Response, and Section 3202, Injury Illness Prevention Program.
- 29 CFR 1926, Safety and Health Regulations for Construction.
- 8 CCR, with special attention to Sub Chapter 4, Sections 1500 - 1938 Construction Safety Orders.
- National Institute for Occupational Safety and Health/Occupational Safety and Hazards Administration/U.S. Coast Guard/U.S. Environmental Protection Agency, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication No. 85-115, 1985.
- The requirements in this HASP also conform to AECOM's Safety for Life Program requirements as specified in the AECOM Safety, Health and Environment (SH&E) Manual.
- Site 156 – Metro Towers Soil RA and RAR Development, and Planning; July 2017. PPG New Jersey Chromium Program, -Jersey City, NJ.
- Program Health and Safety Plan - PPG Hudson County Chromium Sites Jersey City, New Jersey; (May 2012 (Last Revised 8/2017, Rev.4)

Project Assumptions

- Site management will assist in locating subsurface utilities, vessels, and structures located on the property and outside the scope of the utility locator service.
- No confined spaces will be entered on this project.
- No excavations will be entered.
- Work will be performed during daylight hours.

2.0 SITE INFORMATION AND SCOPE OF WORK

2.1 SITE DESCRIPTION

Site 156 is located on Luis Munoz Marin Boulevard within a residential and commercial area of Jersey City, New Jersey. The Site is bound to the north by Christopher Columbus Drive; to the south by Montgomery Street; to the east by Warren Street; and to the west by Luis Munoz Marin Boulevard. The Site occupies tax parcels Block 13101 Lots 1 and 2. Site 156 encompasses the Metropolis Towers property (previously Gregory Park Apartments) which occupies approximately 8.6 acres (see Figure 1). The property consists of two 20-story multi-unit residential buildings (Buildings 1 and 2). Most of the area surrounding the buildings is paved and is used as parking for property residents. A small percentage of the property consists of green space. The buildings were constructed between 1961 and 1967 with aid from Federal grants issued by the Housing and Urban Redevelopment Authority (HUD). The buildings are constructed of reinforced concrete and are supported by driven piles (CEC, 2012).

2.2 SITE BACKGROUND/HISTORY

Historically, a two-story building known as the Central Building was located between Buildings 1 and 2. An in-ground swimming pool was located on the second floor of the Central Building. The building was demolished in 2006, but pilings and grade beams from the building were still present at the Site prior to excavation (CEC, 2012).

A 1906 Sanborn map indicates that between the late 1800's and 1950, Site 156 was historically occupied by several industries including, National Iron Works, a filling station, a painting contractor, a chemical warehouse, auto truck parking, a motor freight station, a machine shop, and a furniture manufacturer. Aerial photographs from 1951 depict various commercial, light industrial, and row-style housing buildings at Site 156 (CEC, 2012).

In 1990, the NJDEP notified PPG that Mr. Claude Perretti issued a statement noting that approximately 9,000 cubic yards of CCPW was used as backfill at the Site in 1961. The exact location of where the material was placed was not known. Several soil removal activities have taken place at the Site since 1961. In 1976 or 1977 a total of 5,200 to 6,800 cubic yards of soil was excavated from the north and south parking lots of Building 1. There is no indication that this excavation was conducted for remedial purposes. An unknown volume of soil was excavated from the northeast corner of Building 1 in response to a leak from an above ground heating oil tank in 1986-1987 and again in 1987 as part of the Port Authority Trans Hudson (PATH) ventilation duct remodeling (CEC, 2012). that have previously occurred on site, as well as current operations and any emergency response actions.

2.3 CLIENT OPERATIONS AT SITE

Soil remedial action (RA) activities at the Site were initiated in March 2013 and continued through May 2014 pursuant to the approved Remedial Action Work Plan (RAWP) prepared by Civil and Environmental Consultants, Inc. (CEC), dated November 2012. Pursuant to the RAWP, Cr+6 and Chromate Chemical Production Waste (CCPW) -related metals contamination in soil at the Site was remediated by means of excavation and off-site disposal. Delineation was not achieved along the southern boundary of the target area. Rather than continuing with delineation, PPG has opted for a remedial approach to begin excavation and determine the southern boundary via post-excavation sampling.

2.4 SCOPE OF WORK

Excavation Oversight

AECOM will provide oversight during excavation activities. The current excavation limit is expected to be in Grids L2-L5 and K2-K5. Pending the results of confirmation samples, the excavation may expand to the south. It is assumed that the excavation will not expand beyond the property boundary. Additional soil will be excavated along the sidewalls for sloping to effect a stable excavation. It is anticipated that the excavation

will incorporate an area of approximately 3,000 square feet ranging from 6 to 18 feet below ground surface with additional area to accommodate sidewall sloping for stability. Pre-excavation waste classification samples were collected during the April 2017 delineation activities to determine disposal requirements. The field work is expected to take approximately four weeks to complete. AECOM will provide the following services in preparation for and during excavation:

AECOM will provide the following services;;

- Coordinate with the contractors, property owners, attend meetings and conference calls, as needed;
- Contract and oversee land surveyor as defined in Task 17;
- Conduct personal air monitoring;
- Perform direct visual monitoring of excavation by Contractor;
- Collect samples for analysis and field data in accordance with the NJDEP approved RAWP dated November 2012 and NJDEP requirements documented in Technical Guidance for Site Investigation of Soil, Remedial Investigation of Soil, and Remedial Action Verification Sampling for Soil dated March 2015, Version 1.2. Samples will be analyzed on a 1-day turnaround time (TAT);
- Assist in identification of CCPW, COPR, GGM, if encountered, and hazardous/non-hazardous soils;
- Monitor excavated soil movement assuming direct loading;
- Oversee dewatering and groundwater disposal activities conducted by PPG contractor;
- Inspect soil disposal trucks prior to their leaving the Site;
- Evaluate soils for compliance with disposal facility requirements (moisture content); It is anticipated that soils will require amendments to reduce water content before transport; and manage soil disposal manifests and track disposal quantities. Soil has been pre-classified for disposal via waste classification samples collected during the April 2017 RI. It is anticipated manifests will be signed by AECOM field personnel that will be appropriately trained to fill this role.

Boiler Room Air Monitoring

Project Background

The purpose of this task is to conduct air monitoring services during remediation of Building #2 boiler room and ensuring dust generated by contractors are not migrating outside of the established containment area where it may be detrimental to the public's health. AECOM will provide dust (PM₁₀) and VOC monitoring oversight during Budget Maintenance (contractors) activities in the boiler room. Contractors will be working in three areas (phases) sequentially in the following process (but not limited to):

1. Setting up containment area
2. Performing scarification activities
3. Application of caulk, primer and Retro-Coat
4. Allow drying time in between application
5. Disassemble containment area

Health and Safety

- Site Safety Officer – Eric Acs
- Attend daily tailgate meetings
- Review “HAZWOPER Health and Safety Plan – PPG New Jersey Chromium Program Site 156 Metro Towers” HASP (8/2017).
- Review Pre-Job Hazard Assessment
- Prepare Task Hazard Analysis daily. Hazards include: slips, trips and falls, heat stress, fugitive dust, proper lifting techniques, potential for loud noise, low overhead pipes, and local traffic in parking lot.
- PPE: Hardhat, high-visibility vest, respirator (when required), Tyvek (when required), safety glasses, hearing protection and steel-toed boots
- Air Monitoring Action Level
 - o All tasks with the potential to generate dust associated with silica (concrete)
 - o 0.05 mg/m³ above background
 - o Implement dust control measures

Air Monitoring Equipment

- Dataram 4000 (2 units) will be setup at entrances to the boiler room adjacent to the lobby and the outdoor entrance of the boiler room.
- PID (1 units) for VOC measurement. Considered utilizing PID to address potential residential concerns of nuisance odors.
- TSI Dustrak (handheld) unit for particulate measurement along the exterior of containment area where Budget Maintenance will be performing dust generating activities. Handheld unit will be used in conjunction with visual observation of potential emissions from breaches along the containment areas.

AECOM Responsibilities

- Ensure air intakes and ducts in the work area are closed/blocked to prevent odor/particulate from migrating outside of the work area.
- Calibrate dust monitoring equipment (DR 4000) each morning and set up units at minimum ½ hour before and after dust generating activities. Rational for this approach is to have background readings outside of work-related activities.
- Visit each DR 4000 at least once every hour to check on real-time readings, check unit functionality and recalibration if needed.
- Note visual observation of current air monitoring conditions (e.g. no visual emissions observed in lobby).
- Conduct qualitative (visual observations) and quantitative (handheld readings) outside of containment area for emissions. If breaches in containment are observed, utilize stop work authority until the issue is resolved.
- Budget Maintenance proposes to install poly enclosures around the boilers and clean them after work is completed in case residual dust enters the boilers. Ensure boilers are dust free prior to boilers being turned on.
- Download data from the dust monitoring units at the end of each work day (connecting DR 4000 with a computer) and saved pdfs to location described below.

Field Documentation

- All field information, including activities, locations, measurements etc, must be recorded in a PPG dedicated field logbook.

- All field documentations (scanned notes, photos, etc) shall be scanned and saved to the following location
 - o [\\uspsw2pfpsw001\Data\Data_USPSW2VFP001\Environment\Piscataway\Project\PPG-NJCProgram\6-ProjectInput\6.1-FieldData\6.1-Site156\Boiler Room RA](\\uspsw2pfpsw001\Data\Data_USPSW2VFP001\Environment\Piscataway\Project\PPG-NJCProgram\6-ProjectInput\6.1-FieldData\6.1-Site156\Boiler Room RA)
 - o Additional folders may be created within this filepath for any other project-related scans

Contact Information

- Project-related questions or concerns (bold and underline indicates preferred contact numbers)
 - o Tarique Islam: O 732-564-3622 **M 973-462-2761**
 - o Eric Acs: O 732-564-3901 **M 732-343-0374**
 - o Steve Surman: **O 732-564-3639** M 732-241-2319
 - o Bill Spronz: **O 732-564-3917** M 908-377-7226
- For emergencies and incident reporting, refer to the "Incident Contact Phone Tree" located on page 6 of the HASP.

SCOPE OF WORK RISK ASSESSMENT

- ☐ Low Risk (examples: non-intrusive work, occasional exposure and/or low risk hazards)
- ☐ Medium Risk (examples: intrusive work, heavy equipment use, frequent exposure and/or moderate hazards)
- ☒ High Risk (examples: complicated scope, large/ multiple work crews, and/or constant exposure to hazards).

The following tasks/ hazards automatically trigger high risk ranking. Check all which apply. Include hazard mitigation procedures later in the appropriate Physical, Chemical, or Environmental section of the HASP.

☐ Asbestos removal/ contact	☐ Ordinance, Munitions, Explosives use
☐ ATV use	☐ Pile Driving
☐ Bridge/dam Inspections/ Snooper Truck use	☐ Radiation or Radioactive Instrument use
☐ Confined Space	☐ Remote location or lone worker
☐ Cranes and Rigging use	☐ Respirator use (does not include dust mask)
☐ Demolition	☐ Scaffolding use
☐ Diving- scientific or commercial	☒ Use or exposure to toxic chemicals
☐ High speed traffic exposure	☒ Trenching/ Excavation
☐ Hot Work	☐ Tunnel/ Underground work
☐ Conditions Immediately Dangerous to Life or Health (IDLH)	☐ UXO/ MMR
	☐ Work at Heights > 4ft.

☐ Laboratory Operations	☐ Work at angle >30 deg.
☐ LOTO or Live Energy Source work	☐ Work On/Over Water
☐ On-rail/ Near Rail work	

3.0 AECOM SAFETY HEALTH AND ENVIRONMENT PROGRAM

3.1 AECOM POLICY

Safety, Health and Environment Policy Statement



Purpose
This policy establishes the framework to attain best-in-class Safety, Health and Environmental (SH&E) performance for AECOM's employees in the global marketplace.

Commitment
AECOM is committed to exceptional levels of performance in protecting its people and the environment. As stated in our Core Values, keeping our people safe is our most important measure of success. We strive to be the beacon of safety excellence in the industries and global communities in which we work.

To advance our SH&E program, we are committed to:

- Zero work-related injuries to AECOM employees and protection of the environment as a result of our activities.
- Providing a highly effective SH&E management system that drives continual review and improvement.
- Meeting client requirements and properly incorporating all safety, health and environmental rules and regulations at the local, state, provincial and national levels.
- Developing an exceptional safety culture where our people embrace ownership for the safety of themselves and others.
- Substantial improvements toward our goals of pollution prevention, resource conservation and environmental sustainability.
- Setting and meeting aggressive SH&E performance goals and Core Value Metrics to promote continuous improvement.
- Working with employees and business partners in order to continuously improve SH&E performance.
- Recognizing and celebrating those who contribute to excellent SH&E performance.
- Striving to make AECOM the provider of choice for the safe execution of design, build, finance, operate and maintenance work globally.

The commitment to this policy by the leadership, management and employees of AECOM provides the foundation for a safe workplace, operational excellence and long-term business success.

Expectations
Safety is a core value and a key to our success. We demand continuous improvement in our journey toward a zero incident culture, where everyone is committed to safety, health and environmental excellence.

To that end, we demand:

- Our leaders, managers, supervisors and employees demonstrate their commitment in their actions and decisions to assure that every person goes home safe every day.
- Our employees embrace safety as a core value both on and off the job.
- Each employee is committed to his/her own safety and that of his/her fellow employees.
- We will incorporate Life-Preserving Principles into our work planning and execution.
- We proactively and aggressively identify, manage and eliminate hazards in the workplace.
- We train and prepare our people to have the knowledge, skills, competency and equipment required to work safely.
- We stop our employees from working if the work cannot be executed safely or if conditions or behaviors on the work activity are unsafe.
- All employees immediately report safety, health and/or environmental incidents, near-misses, unsafe conditions, and at-risk behaviors to their supervisor; and that we diligently work to correct the problem.

Our SH&E expectations will be accomplished by the demonstrated leadership of management, compliance with regulatory requirements and participation of AECOM personnel.

Communication
This Policy will be reviewed annually to ensure it meets the needs of the company, and will be made available to all persons under the control of the company.

Sincerely:



04 March 2016

Date

Michael S. Burke
Chairman and Chief Executive Officer

3.2 SAFETY FOR LIFE



"Safety for Life" is a comprehensive integrated AECOM Safety Management System that drives our nearly 100,000 employees toward AECOM's commitment to achieving zero work-related injuries and/or illnesses; preventing damage to property and the environment; and maintaining an environmentally friendly and sustainable workplace. Our Safety for Life program is supported by nine Life Preserving Principles that apply to all AECOM activities.

3.3 LIFE PRESERVING PRINCIPLES

Demonstrated Management Commitment

Our Executive, senior and project managers will lead the SH&E improvement process and continuously demonstrate support and commitment.

Employee Participation

Our employees will be encouraged and empowered to become actively engaged in our safety processes through their active participation in safety committees, training, audits, observations and inspections. Employees will be encouraged to participate in health initiatives and adopt a healthy lifestyle.

Budgeting and Staffing for Safety

Our safety staff will be competent, fully trained and qualified to provide technical resources to our internal and external clients. A budget to support safety activities will be included in project proposals.

Pre-Planning

Our design, engineering, project and construction management staff will deploy effective risk mitigation efforts to design, plan and build safety into every project. Pre-Project and Pre-Task planning will be an effective tool in protecting our employees and the environment.

Contractor Management

Our project staff will work closely with our sub-consultants, subcontractors, contractors and Joint Venture Partners to provide a safe work environment for employees and members of the public. Our goal of SH&E performance excellence will be equally shared by all project participants.

Recognition and Rewards

Our employees will be recognized for their efforts in working safely and their support of our safety efforts.

Safety Orientation and Training

Our employees will be provided with effective safety training in order to identify and mitigate hazards in the workplace to prevent injuries to themselves and others who may be affected by their actions.

Incident Investigation

Our managers and safety professionals will investigate all recordable incidents and serious near misses to identify contributing factors and root causes in order to prevent a reoccurrence. Lessons learned shall be identified, communicated and implemented.

Fit for Duty

Our employees are responsible to report to work each day fit for duty and not to pose a health and safety hazard to themselves or others.

3.4 DRIVING AND VEHICLE SAFETY

The proper operation of vehicles is critical to protecting the safety of AECOM employees and subcontractors. Drivers face numerous hazards while operating vehicles. Some of the hazards include collision with another vehicle, collision with a fixed object, vehicle break down or failure, or falling asleep or becoming otherwise incapacitated while driving. All employees will adhere to Driving procedure [S3AM-005-PR](#), which includes the following key practices:

- **Authorized Drivers** - Managers must authorize drivers following evaluation of driver criteria to drive and maintain an AECOM-owned, leased or rented vehicle, a client or customer-owned vehicle, or a personal vehicle operated in the course of conducting AECOM business.
- **Electronic Devices Prohibited** - AECOM prohibits use of all portable electronic devices while operating a motor vehicle/ equipment which includes being stopped at a traffic light or stop sign. This includes cell phones, two-way radios and other items whether hand-held or hands-free. Electronic devices include, but are not limited to, all mobile phones, pagers, iPods, MP3s, GPS, DVD players, tablets laptops and other portable electronic devices that can cause driver distraction. Hands-free device use is not allowed.
 - GPS units and devices used for navigation may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their

eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities and shall not be changed by the driver while driving.

- **Vehicle Inspections** - The driver shall conduct pre-trip vehicle inspections prior to each trip. A vehicle inspection checklist, [S3AM-005 FM2](#), can be used to guide and document the inspection process. Vehicle inspection is to include a 360-degree walk around and visual inspection under the vehicle for leaks and obstructions prior to moving the vehicle.
- **Training** - All drivers shall complete defensive driver training. Additional training (i.e., hands-on defensive driver training) may apply for medium and high-risk drivers; see Driving procedure [S3AM-005-PR](#) and SHE Training procedure [S3AM-003-PR](#) for more details.
- **Journey Management Plan** - Drivers who undertake trips in excess of 250 miles (400 kilometers) one way, drive in remote or hazardous areas, or when otherwise deemed necessary, shall develop and document a Journey Management Plan using [S3AM-005-FM1](#) or equivalent.
- **Secure Loads** - Cargo is only to be carried within the passenger compartment of a vehicle when segregated and restrained to prevent objects from becoming distractions, obstructions or projectiles to occupants should emergency vehicle maneuvers be required (e.g., harsh braking or crash). All goods transported on flatbed trucks or in pickup beds must be securely fastened to prevent them from becoming hazards. All applicable laws and regulations regarding securing of loads must be met. It is prudent to check the load after a few miles to ensure that load has not shifted or loosened prior to completing the remainder of the trip.
- **Backing Up** - Reversing the vehicle is to be avoided if at all possible. If backing up is necessary, use the following guidelines:
 - Pre-plan all vehicle movements.
 - If the pull-through method of parking is not possible, drivers will scan parking spot/area for hazards and back in; thereby, facilitating departure where the first move is forward.
 - A light tap of the horn should be used to alert others of your intention to back up.
 - Avoid tight spaces.
 - Vehicles over 10,000 pounds gross vehicular weight are required to have a competent spotter in place when backing. A competent spotter is one that has received spotter training.
 - All vehicles shall have a competent spotter in place when backing in an active work zone. Parking and public access areas are recommended but not required to have a spotter.

3.5 FITNESS FOR DUTY

One of AECOM's nine Life-Preserving Principles is Fitness for Duty (see Fitness for Duty procedure [S3AM-008-PR](#)). Fitness for Duty means that individuals are in a state (physical, mental, and emotional) that enables them to perform assignments competently and in a manner that does not threaten the health and safety of themselves or others. On certain projects or for specific tasks, fit for duty certifications may be requested of medical providers by SH&E Managers or Human Resources (HR). Employees should report to work fit for duty and unimpaired by substances or fatigue. Supervisors must observe their employees and work with the employee, SH&E staff, and HR to address deficiencies. AECOM will not tolerate retaliation against any employee for filing a complaint or concern regarding their fitness for duty or participating in any way in an investigation.

3.5.1 Medical Surveillance

AECOM's [S3AM-128-PR, Medical Screening and Surveillance](#), details the requirements to participate in a medical monitoring program. Medical Surveillance provides a streamlined process to determine if employees meet the physical requirements to perform assigned duties as defined by applicable regulations. It is also designed to provide a means to collect data relevant to exposure to chemical and physical agents for the protection of the workers and to confirm the effectiveness of health and safety programs.

3.5.2 Fatigue

One aspect of fit for duty is fatigue management. AECOM has developed procedures that limit work periods or requires additional rest under certain circumstances, including during long-distance travel or when working at high altitudes. These procedures also set limits on extended work periods of 14 hours per day or 60 hours per week. A fatigue management plan is required if longer working hours are necessary (see Fatigue Management Procedure [S3AM-009-PR](#)).

3.5.3 Substance Abuse

Drug and alcohol abuse pose a serious threat to the health and safety of employees, clients, and the general public as well as the security of our job sites, equipment and facilities. AECOM is committed to the elimination of illegal drug use and alcohol abuse in its workplace and regards any misuse of drugs or alcohol by employees to be unacceptable. AECOM Substance Abuse Prevention Procedure ([S3AM-019-PR](#)) prohibits the use, possession, presence in the body, manufacture, concealment, transportation, promotion or sale of the following items or substances on company premises. Company premises refer to all property, offices, facilities, land, buildings, structures, fixtures, installations, aircraft, automobiles, vessels, trucks and all other vehicles and equipment - whether owned, leased, or used.

- Illegal drugs (or their metabolites), designer and synthetic drugs, mood or mind altering substances, and drug use related paraphernalia unless authorized for administering currently prescribed medication;
- Controlled substances that are not used in accordance with physician instructions or non-prescribed controlled substances; and
- Alcoholic beverages while at work or while on any customer- or AECOM-controlled property.

This policy does not prohibit lawful use and possession of current medication prescribed in the employees name or over-the-counter medications. Employees must consult with their health care provider about any prescribed medication's effect on their ability to perform work safely and disclose any restrictions to their supervisor.

Although some states may pass laws legalizing medical or recreational marijuana use, the use, sale, distribution and possession of marijuana are violations of federal law and AECOM policy, and will subject an employee to disciplinary action up to and including termination in accordance with controlling law.

3.6 HAND SAFETY

The hands are exposed to hazards more than any body part. SH&E Hand Safety Procedure [S3AM-317-PR](#) describes requirements and best practices including these notable practices:

- **All personnel shall have gloves in their immediate possession 100%** of the time when in a shop or on a work site. Gloves that address the hazard shall be worn when employees work with or near any materials or equipment that present the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc. Use the Gloves Needs Assessment ([S3AM-317-FM1](#)) to help determine the appropriate glove for the hazard(s).

- **Fixed open-blade knives are prohibited** from use during the course of AECOM work. Examples of fixed open-blade knives include pocket knives, multi-tools, hunting knives, and standard utility knives. For more information about cutting tools, see [S3AM-317-ATT1](#) Safe Alternative Tools.

3.7 HAZARD COMMUNICATION

Hazardous materials that may be encountered on-site as existing environmental or physical/health contaminants are addressed in this HASP. Their properties, hazards, and associated required controls will be communicated to all affected staff and subcontractors in accordance with the requirements of AECOM Procedure [S3AM-115-PR1](#) Hazardous Materials Communication including these key elements:

- All personnel shall be briefed on the hazards of any chemical product they use and shall be aware of and have access to the Safety Data Sheets (SDS).
- All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto this AECOM-controlled work site must first provide a copy of the item's SDS to the Site Supervisor or Site Safety Officer for review and filing. The Site Supervisor or Site Safety Officer will maintain copies of all SDS on site and in **Attachment C**. SDS may not be available for locally obtained products, in which case an alternate form of product hazard documentation will be acceptable.

3.8 HAZARDOUS MATERIAL HANDLING AND WASTE MANAGEMENT

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable Federal, State, Provincial, Territorial and/or local regulations and SH&E Procedure [S3AM-116-PR](#) Hazardous Materials Shipping. A site-specific Entity Letter may be required for the site/client; if so, only persons named on the entity letter are allowed to sign waste shipping papers "**on behalf of [client name]**". Any individual signing shipping papers must have valid Department of Transportation and Resource Conservation and Recovery Act training for waste shipment. Consult the [HZM/HZW & TDG page](#) on ecosystem or the SH&E Manager for further guidance on AECOM and regulatory procedures and training requirements.

3.9 HOUSEKEEPING AND PERSONAL HYGIENE

Basic housekeeping requirements for offices and work sites, as well as personal hygiene and sanitation standards can be found in [S3AM-013-PR](#) Housekeeping. Inspections should be performed at the regular interval specified below. The housekeeping inspection form [S3AM-013-FM1](#) is available for use.

Complete the table below regarding site-specific Housekeeping and Personal Hygiene requirements:

Housekeeping: Inspection Frequency: Twice a day	Inspector: Site Safety Officer
Eating, Drinking, Smoking: Permitted only in designated area(s) located outside of the work area.	
Handwashing: Water, soap and paper towels or equivalent supplies are located near the portable toilets. Site staff will wash hands and face after completing work activities and prior to breaks or meals.	
Toilets are located onsite (Portable Toilets)	
NOTE: A minimum of one toilet must be provided for every 20 personnel on site. For mobile crews where work	

activities and locations permit transportation to nearby toilet facilities on-site facilities are not required.
Water is located in the work trucks (bottled water) A water supply meeting the following requirements will be utilized: <i>Potable Water</i> - An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Disposable drinking cups for single use and a waste receptacle will be provided as needed. Water containers will be refilled daily and disinfected regularly. Potable water containers will be properly identified in order to distinguish them from non-potable water sources. <i>Non-Potable Water</i> - Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating "Non-Potable Water, Not Intended for Drinking Water Consumption"
Illumination ; Work will not be conducted at night

3.10 LONE WORKER

AECOM discourages employees from working alone (i.e. where AECOM personnel are out of visual and audio range of others) when performing field tasks (see SH&E Procedure [S3AM-314-PR, Working Alone](#)). If lone work is to be performed, a communications/check-in plan must be developed and implemented using the table below.

Lone Worker	Work will not be conducted alone or with one worker
Justification	Not Applicable
Check-In Requirement	Not Applicable
Check-In Contact	Not Applicable
Hazard Summary	Not Applicable
Response Plan	Not Applicable

3.11 SAFETY OBSERVATIONS

Safety observations are observations made by employees or subcontractors of a condition or behavior which could contribute to an incident, prior to the incident occurring. Observations can also identify positive behaviors or interventions which contribute to the prevention of incidents. Large, long-term projects may benefit from the use of LifeGuard to track and trend observations on a site level. All other projects should log their observations using IndustrySafe. Both reporting systems can be accessed on any safety page of ecosystem. Or the QR codes below can be used while off the AECOM network from a smartphone/ device.



3.12 SHORT SERVICE EMPLOYEE

A Short Service Employee is an employee with fewer than 6 months experience working on field projects or an employee who has not completed the required training or received required certifications (see the Short Service Employee procedure, [S3AM-002-PR](#)). The Project Manager will identify all Short Service Employees working on the project, and each Short Service Employee will be assigned to an experienced team member so all activities may be monitored. Short Service Employees shall be easily identified in the field environment, such as through wearing a specific colored hardhat, a manufacturer-approved orange stripe applied to their hardhat, or be clearly identified by some other system. Any new employee shall wear the designated Short Service Employee identifier until the Project Manager determines the employee has the knowledge, skills, and ability related to the specific hazard on the project.

3.13 STOP WORK AUTHORITY

AECOM empowers and expects all employees to exercise their Stop Work Authority (see Stop Work Authority Procedure [S3AM-002-PR](#)) if an incident appears imminent, or when hazardous behaviors or conditions are observed. A stop work request can be informal if the situation can be easily corrected, or may require shutting down operations if revised procedures are necessary to mitigate the hazard. If an AECOM employee observes an imminently hazardous situation on a site controlled by others (i.e., a client-managed contractor), the employee can always stop work for themselves by removing themselves from the situation. Employees also may attempt to stop work to avoid allowing the contractor to come to harm by immediately notifying the contractor foreman or site engineer, or if necessary, the client or party managing the contractor.

No employee should object to the issuance of a stop-work request, nor can any disciplinary action be levied against the employee. All employees must agree that the situation has been mitigated before resuming work. No employee will be disciplined for refusing to work if they feel it is unsafe.



4.0 ROLES AND RESPONSIBILITIES

Roles and responsibilities for the project team are defined in SH&E Procedure [S3AM-209-PR](#), Safe Work Standards and Rules. The Project Manager (PM) is ultimately responsible for the development of this HASP and establishing a budget to implement the controls and training required. The Project Manager is also responsible for ensuring that the plan is implemented, that appropriate documentation is generated, and that records are maintained. The SH&E Manager is responsible for reviewing and approving this HASP, and assisting with other SH&E matters upon request. A Site Safety Officer may be appointed to oversee implementation of the HASP in the field. All project team members are responsible for reviewing and abiding by this HASP, performing daily (or more frequent) task hazard assessments, stopping work when necessary to correct unsafe behaviors or conditions, and reporting incidents promptly to the PM and AECOM Incident Reporting Hotline (Incident Hotline 800-348-5046).

4.1.1 Project Manager

The Project Manager has overall management authority and responsibility for all site operations, including safety. The Project Manager will provide the site supervisor with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations. Some of the Project Manager's specific responsibilities include:

- Verifying that personnel, to whom this HASP applies, including AECOM subcontractors, have received a copy of it, with ample opportunity to review the document and to ask questions.
- Providing the concurring SH&E Manager with updated information regarding conditions at the site and the scope of site work if changes occur that will affect the accuracy of this HASP.
- Providing adequate authority and resources to the Site Supervisor or Site Safety Officer to allow for the successful implementation of all necessary SH&E Procedures.
- Maintaining regular communications with the Site Supervisor or Site Safety Officer and, when necessary, the AECOM Client SH&E Program Manager.
- Coordinating the activities of AECOM subcontractors and ensuring that they are aware of the pertinent health and safety requirements for these projects, when applicable.
- Conducting Safety System Auditing by way of Management Site Visits and/or Project Manager Self Assessments on a regular basis.
- Approving amendments to the HASP (in conjunction with the Site Supervisor or Site Safety Officer).
- Coordinating activities with the client as needed to ensure the safe implementation of this HASP.

4.1.2 Site Supervisor

The Site Supervisor has the overall responsibility and authority to direct work operations at the job site according to the provided work plans and HASP. The Project Manager may act as the Site Supervisor while on site. The Site Supervisor's responsibilities include:

- Discussing deviations or drift from the work plan with the Site Safety Officer and Project Manager.
- Discussing safety issues with the Project Manager, Site Safety Officer, and field personnel.
- Assisting the Site Safety Officer with the development and implementation of corrective actions for site safety deficiencies.

- Assisting the Site Safety Officer with the implementation of this HASP and ensuring compliance.
- Assisting the Site Safety Officer with inspections of the site for compliance with this HASP and applicable SH&E Procedures.
- Reviewing Job Safety Analyses (JSAs) and Task Hazard Assessments (THAs) with the work crew.
- Reporting incidents and ensuring incidents and observations are logged into Lifeguard or IndustrySafe.
- Verifying that all operations are in compliance with the requirements of this HASP, and halting any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the Site Safety Officer, the SH&E Manager, and the Project Manager.

4.1.3 Site Safety Officer

The Site Safety Officer supports the Site Supervisor in providing a safe work environment. Not all sites will have a designated Site Safety Officer; the decision should be made by the Project Manager and SH&E Manager taking into consideration the complexity and risks of the scope of work. The Site Supervisor may act as the Site Safety Officer on sites without one. The Site Safety Officer's responsibilities include:

- Updating the site-specific HASP to reflect changes in site conditions or the scope of work. HASP updates must be reviewed and approved by the SH&E Manager.
- Inspecting the site for compliance with this HASP and the SH&E Procedures using the appropriate field audit inspection checklist found in IndustrySafe.
- Coordinating with Site Supervisor to review JSAs and THAs with the work crew.
- Assisting as needed to report incidents and verify that incidents and observations are logged into Lifeguard or IndustrySafe.
- Working with the Site Supervisor and Project Manager to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contacting the SH&E Manager for technical advice regarding safety issues.
- Determining emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Checking that all site personnel and visitors have received the proper training, orientation and medical clearance prior to entering the site.
- Establishing controlled work areas (as designated in this HASP or other safety documentation).
- Facilitating or co-leading daily tailgate meetings and maintaining attendance logs and records.
- Discussing potential SH&E hazards with the Site Supervisor, the SH&E Manager and the Project Manager.
- Selecting an alternate Site Safety Officer by name and informing him/her of their duties, in the event that the Site Safety Officer must leave or is absent from the site.

- Verifying that all operations are in compliance with the requirements of this HASP.
- Issuing a “Stop Work Order” under the conditions set forth in this HASP.
- Temporarily suspending individuals from field activities for infractions against the HASP pending consideration by the SH&E Manager and the Project Manager.

4.1.4 Employees

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the SH&E Procedures specified in the HASP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to SH&E management for continuous improvement relating to omissions and modifications in the HASP or other safety policies and procedures.
- Notifying the Site Supervisor or Site Safety Officer of unsafe conditions and acts.
- Stopping work if there is doubt about how to safely perform a task or if unsafe acts or conditions are observed (including subcontractors or team contractors).
- Speaking up and refusing to work on any site or operation where the SH&E procedures specified in this HASP or other safety policies are not being followed.
- Contacting the Site Supervisor or Site Safety Officer or the SH&E Manager at any time to discuss potential concerns.

4.1.5 Subcontractors

The requirements for subcontractor selection and subcontractor safety responsibilities are outlined in AECOM Procedure *S3AM-213-PR Subcontractor Management*. Each AECOM subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE) and all required training.

AECOM considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services as well as all other requirements applicable to their work. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to AECOM for review prior to the start of on-site activities.

Hazards not listed in this HASP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed to the AECOM Project Manager or the Site Supervisor prior to beginning work operations. The Site Supervisor or authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

4.1.6 Visitors

Authorized visitors (e.g., client representatives, regulators, AECOM management staff, etc.) requiring entry to any work location on the site will be briefed by the Project Manager, Site Supervisor, or Site Safety Officer on the

hazards present at that location. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer's health and safety policies. In addition, this HASP specifies the minimum acceptable qualifications, training and PPE that are required for entry to any controlled work area; visitors must comply with these requirements at all times.

If the site visitor requires entry to any exclusion zone (EZ), but does not comply with the above requirements, all work activities within the EZ must be suspended.

Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

5.0 TRAINING AND DOCUMENTATION

The following sections describe the standard practices or programs that AECOM will establish to prepare employees to perform work safely and consistent with AECOM policy and Procedures.

5.1 HASP/SITE ORIENTATION

The Project Manager shall conduct a project/site-specific HASP orientation prior to the start of field operations, with support as needed by the SH&E Manager, Site Safety Officer, or Site Supervisor. This meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site. Minimum items to be covered are listed in **Attachment D**. Participants will then sign the HASP Personnel Acknowledgement register at the end of the HASP.

5.2 DAILY TAILGATE MEETINGS AND THA REVIEW

The Site Supervisor, Site Safety Officer or designee shall facilitate a tailgate meeting to discuss the specific requirements of this HASP, review the applicable JSAs and/or complete THAs prior to the commencement of daily project activities. Attendance at the daily tailgate meeting is mandatory for all employees and subcontractors at the site contracted to AECOM. Simultaneous operations are encouraged to attend each other's tailgate meetings or at the very least the supervisors shall discuss the coordination of activities and associated hazards of each other's tasks. The supervisor will then convey the information to the work crew. The Tailgate Meeting must be documented by the Site Supervisor or Site Safety Officer on a Daily Tailgate Meeting form, a blank copy of which is included in **Attachment E**.

5.3 WORKER TRAINING AND QUALIFICATIONS

All personnel at this site must be qualified and experienced in the tasks they are assigned. SH&E Training Procedure [S3AM-003-PR](#) establishes the general training requirements for AECOM employees. In addition, [S3AM-117-PR](#), Hazardous Waste Operations, explains the HAZWOPER training and [S3AM-128-PR, Medical Screening and Surveillance](#), details the medical surveillance requirements.

Check all required training on the table below. Verify training records of employees and subcontractors.

Site Specific Training Requirements	
Training	Applies to
☒ HASP Orientation	All Employees and Subcontractors
☒ HAZWOPER 40 –HR	On HAZWOPER sites, in EZ, exposed to hazardous contamination
☒ HAZWOPER Supervisor	Employees managing others in HAZWOPER activities
☐ Fit Test/ Respiratory Protection	Employees needing to wear respirators
☒ Hazardous Materials Shipping	Employee responsible for shipping HZM/HZW/DG and/or signing manifests
☒ Annual Medical Surveillance/ Clearance	Employees working in an exclusion zone and the regulatory required exposure limit <u>is</u> exceeded for 30 or more days a year

☐ Biennial Medical Surveillance/ Clearance	Working in an exclusion zone more than 30 days a year and the regulatory required exposure limit is not exceeded
☐ OSHA 10 Hr Construction	Employees working near heavy equipment
☐ OSHA 30 Hr Construction	Supervisor/SSO overseeing work with heavy equipment
☐ Local requirements:	
☐ Client requirements:	

5.3.1 Competent Person

A competent person is an employee who, through education, training and experience, has knowledge of applicable regulatory requirements, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

AECOM's Competent Person Designation Procedure, [S3AM-202-PR](#), explains the roles, responsibilities and procedures of naming a competent person. Complete the table below and include a [S3AM-202-FM1](#) Competent Person Designation Form for each AECOM competent person (subcontractors to use an equivalent process).

These activities require a competent person. Mark all that apply and list the name of the person.

	Activity	Name of Person
☐	Asbestos	
☐	Assured Equipment Grounding Conductor	
☐	Blasting & Explosives	
☐	Concrete & Masonry Construction	
☐	Confined Spaces	
☐	Control of Hazardous Energy (Lockout-Tagout)	
☐	Crane Assembly / Disassembly	
☐	Cranes & Derricks	
☐	Demolition	
☐	Electrical Wiring Design & Protections	
☐	Elevated Work Platforms & Aerial Lifts	
☐	Fall Protection	

☐	Hearing Protection	
☐	Heavy Equipment	
☐	Ionizing Radiation	
☐	Lead	
☐	Material Hoists & Personnel Hoists	
☐	Respiratory Protection	
☐	Rigging Equipment	
☐	Scaffolds	
☐	Stairways & Ladders	
☐	Steel Erection	
☒	Trench & Excavations	Contractor Foreman
☐	Underground Construction	
☐	Welding & Cutting	

6.0 HAZARD ASSESSMENT AND CONTROL

AECOM has adopted an approach to hazard assessment and control that incorporates both qualitative and quantitative methods to identify hazards and the degree to which they may impact employees and AECOM operations. See [S3AM-209-PR](#), Risk Assessment and Management, for details regarding AECOM's process. This approach involves the following:

6.1 SH&E PROCEDURES

All AECOM SH&E procedures, in their controlled copy version, are available on the [internal SH&E Policy and Procedures ecosystem page](#). Programmatic procedures referenced in this document (for example SH&E Training) do not need to be printed for inclusion in this HASP. Only procedures that are needed for field activity reference and application MUST be printed in full and included in this HASP. The applicable field procedures checklist is in the Physical Hazards section below and procedures are included in **Attachment B**.

6.2 PRE-JOB HAZARD ASSESSMENT/ JOB SAFETY ANALYSIS

A pre-job hazard assessment or JSA is to be developed for each discrete task planned as part of the project. This assessment lays out the steps of the job, potential hazards, and mitigation measures. Form [S3AM-209-FM4](#) or a client required equivalent may be used. A blank copy is included in **Attachment E**.

6.3 TASK HAZARD ASSESSMENT

The THA is a handwritten field form which is based on "Stop and Think" as the first thing you do before starting work activities often paired with the daily tailgate meeting or work permit issuance. Not all risks can be anticipated in this HASP or the pre-job hazard assessment process; therefore, the THA is used to assess, mitigate, and document the site-specific conditions and changes to the hazard profile prior to and throughout the work task. Proper implementation of the THA program protects worker health and safety. A blank THA form is included in **Attachment E**. The THA must be signed by all employees each day and initialed whenever a changed condition provokes a change in hazard controls.

6.3.1 Hazard Categories

JSAs and THAs should include consideration of the following hazard categories when identifying hazards and task specific controls:

- Energy Sources (line of fire, electricity, pressure, compression/ tension)
- Fall (slip/trip, fall to same level, fall from height)
- Contact with (struck against, struck by, contact with sharp/ abrasives)
- Caught (in, under, between, by)
- Strain/ Overexertion (lifting, repetition, push/pull, bending, twisting)
- Exposure (temperature, radiation, noise, chemicals, radiation, hazardous atmosphere)

6.4 4-SIGHT

When preparing hazard assessments and throughout the day workers should use 4-Sight. This is a mental process through which workers ask themselves (and each other) four questions designed to effectively assess hazards. Using these questions during each task, especially those without formal JSA or THA, will help workers identify hazards and condition changes so that they can control them or stop work to seek assistance.

- 1) What am I about to do?
- 2) What could go wrong?
- 3) What could be done to make it safer?
- 4) What have I done to communicate the hazards?



7.0 PHYSICAL HAZARD ASSESSMENT

7.1 PHYSICAL HAZARDS

A physical hazard is a hazard that threatens the physical safety of an individual; contact with the hazard typically results in an injury. The following table summarizes the physical hazards or activities containing physical hazards present at the site and the associated procedures that address protection and prevention of harm.

All checked procedures **MUST** be included in **Attachment B** for implementation and reference.

Check all applicable hazards/ activities and add site specific description of the hazard.

	Hazard/ Activity (note: text in this column links to procedure)	Site Specific Description	Applicable Procedure
☐	Abrasive Blasting	[where, what phase of work, frequency, etc]	S3AM-335-PR
☐	Aerial Work Platforms		S3AM-323-PR
☐	All-Terrain Vehicles		S3AM-319-PR
☐	Blasting and Explosives		S3AM-336-PR
☐	Bloodborne Pathogens		S3AM-111-PR
☐	Cofferdams		S3AM-344-PR
☐	Cold Stress		S3AM-112-PR
☐	Compressed Air Systems and Testing		S3AM-337-PR
☐	Compressed Gases		S3AM-114-PR
☐	Concrete Work		S3AM-338-PR
☐	Confined Spaces		S3AM-301-PR
☐	Corrosive Reactive Materials		S3AM-125-PR
☐	Cranes and Lifting Devices		S3AM-310-PR
☐	Demolition		S3AM-339-PR
☐	Diving (scientific and commercial)		S3AM-334-PR
☐	Drilling, Boring & Direct Push Probing		S3AM-321-PR
☐	Electrical Safety		S3AM-302-PR
☒	Excavation		S3AM-303-PR
☐	Fall Protection		S3AM-304-PR
☐	Flammable and Combustible Liquids		S3AM-126-PR
☐	Gauge Source Radiation		S3AM-122-PR
☐	Hand and Power Tools		S3AM-305-PR
☒	Hazardous Waste Operations		S3AM-117-PR
☒	Heat Stress		S3AM-113-PR
☒	Heavy Equipment		S3AM-309-PR
☐	High Altitude		S3AM-124-PR
☐	Highway and Road Work		S3AM-306-PR
☐	Hoists Elevators and Conveyors		S3AM-343-PR

☐	Hot Work		S3AM-332-PR
☐	Ladders		S3AM-312-PR
☐	Lockout Tagout		S3AM-325-PR
☐	Machine Guarding Safe Work Practice		S3AM-326-PR
☐	Marine Safety and Vessel Operations		S3AM-333-PR
☐	Material Storage		S3AM-316-PR
☐	Mine Site Activities		S3AM-341-PR
☐	Mining Operations		S3AM-345-PR
☐	Non Ionizing Radiation		S3AM-121-PR
☐	Overhead Lines		S3AM-322-PR
☐	Powder-Actuated Tools		S3AM-327-PR
☐	Powered Industrial Trucks		S3AM-324-PR
☐	Radiation		S3AM-120-PR
☐	Railroad Safety		S3AM-329-PR
☐	Respiratory Protection		S3AM-123-PR
☐	Scaffolding		S3AM-311-PR
☐	Steel Erection		S3AM-340-PR
☐	Temp. Floors, Stairs, Railings, Toe-boards		S3AM-342-PR
☐	Underground Utilities		S3AM-331-PR
☐	Underground Work		S3AM-330-PR
☐	Wildlife, Plants and Insects		S3AM-313-PR
☐	Working Alone		S3AM-314-PR
☐	Working On and Near Water		S3AM-315-PR

8.0 CHEMICAL HAZARD ASSESSMENT

AECOM will perform tasks that can expose personnel to a variety of hazards due to the operational activities, physical conditions of the work locations, and potential presence of environmental contaminants. This section presents a variety of potential chemical hazards, exposure pathways, and related mitigation actions. See [S3AM-110-PR](#), Toxic and Hazardous Substances, for information on planning, training, monitoring, and details on several specific chemicals (Benzene, Cadmium, Chromium, Hydrogen Sulfide, Lead, and Silica).

8.1 POTENTIAL CHEMICAL HAZARDS

[Complete table, delete chemicals that do not apply to the site]

Summary of Hazardous Properties of Contaminant Exposure Hazards

PEL: Permissible Exposure Limits

TLV: Threshold Limit Values

METALS

	Chemical Name	Maximum Concentration found on site	Media	Primary Routes of Exposure	PEL	TLV	IP electron volts (eV)
☒	Antimony	3.9 mg/kg	Soil	Dermal	0.5 mg/m ³	0.5 mg/m ³	n/a
☒	Chromium (Total)	1330 mg/kg	Soil	Dermal	0.5 mg/m ³	0.5 mg/m ³	n/a
☒	Chromium VI	131 mg/kg	Soil	Dermal	0.005 mg/m ³	0.005 mg/m ³	n/a
☒	Nickel	32.3 mg/kg	Soil	Dermal	1 mg/m ³	0.5 mg/m ³	n/a
☒	Thallium	40.3 mg/kg	Soil.	Dermal	0.01 mg/m ³	0.01 mg/m ³	n/a
☒	Vanadium	48.2 mg/kg	Soil	Dermal	0.05 mg/m ³	0.05 mg/m ³	n/a
☐	Dust		Air	Inhalation	15 mg/m ³	10 mg/m ³	n/a

8.2 POTENTIAL EXPOSURE PATHWAYS

Occupational exposure to chemical hazards associated with the work activities could potentially occur by two primary routes (inhalation and skin contact) and one indirect route (incidental ingestion).

8.2.1 Inhalation

The primary risks associated with AECOM's scope of work pertain to potential exposure to airborne contaminants and explosion hazards. Constituents that potentially pose an occupational concern to employees by the inhalation route are carbon monoxide, hydrogen sulfide, methane, and volatile organic compounds. Air monitoring will be performed within the employee breathing zone to assess the need to implement appropriate control measures or stop work. In addition, air monitoring will be performed at the source to assess potential explosion hazards.

8.2.2 Skin Contact

Personnel handling residual product or waste and associated equipment may be exposed to chemical hazards by skin contact or adsorption. However, exposure is expected to be limited since workers will be required to wear appropriate PPE (i.e. appropriate work gloves, body clothing, and/or face shield).

8.2.3 Ingestion

Personnel handling residual product or waste and associated equipment, including project hazardous materials, may be exposed by incidental ingestion. Typically, this exposure occurs if proper PPE was not used or personal hygiene was not practiced. Personal protection against exposure via ingestion can be accomplished by performance of proper decontamination procedures when exiting contaminated work areas as well as using the correct PPE.

8.3 DECONTAMINATION

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities. Decontamination steps are outlined in Hazardous Waste Operations procedure [S3AM-117-PR](#). Some key elements are as follows:

- All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to exiting to clean areas of the site.
- Avoid reactions between the solutions and contaminated materials. Review the applicable SDS.
- All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.
- Use caution while working around decontamination stations, including the decontamination pad, which may be a slip or trip hazard.
- Use disposable equipment when possible and practical.
- All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors.
- All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ).

Decontamination Procedures & Equipment	
Procedure	Equipment Needed
Wash face and hands, Use disposable PPE when necessary	Wash Station with soap and water
Waste Handling for Decontamination	
Waste Streams/Products	Disposal Procedures

Wash Water	Disposed of with Dewatering Waste and trucked offsite

8.4 AIR MONITORING

Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be in accordance with Exposure Monitoring Procedure [S3AM-127-PR](#) and specified in the work permit and/or JSAs for the tasks. Key elements of the procedure include:

- Calibration of monitoring equipment and/or daily bump tests to verify calibrations and confirm alarm function.
- Personal monitoring and result evaluation must be directed by a Certified Industrial Hygienist or Certified Safety Professional.

8.4.1 Real- Time Exposure Measurement/ Equipment

Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Monitoring shall be conducted as specified in the work permit and JSAs as work is performed. All instrumentation need to be rated intrinsically safe to prevent fire or explosion.

Check which real-time monitoring equipment will be used and update the model type if needed:

	Instrument	Manufacturer/Model	Substances Detected
☐	Photo Ionization Detector (PID)	RAE Systems mini-RAE Photovac Microtip HNu Model Hnu (min. 10.6 eV bulb)	• Petroleum hydrocarbons • Organic Solvents
☐	Multi or 4 Gas Detectors	RAE Systems Multi-RAE	• Lower Explosive Limit • Oxygen • Carbon Monoxide • Hydrogen Sulfide
☐	Combustible Gas Indicator (CGI) May be combined with individual or multi-gas detectors.		• Explosivity
☒	Particulate Monitor	MIE Model PDM-3 mini-RAM Dust Trac 2	• Aerosols, mist, dust, and fumes
☐	Personal Monitoring/ Badges		

8.4.2 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone.

If ambient levels are measured which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigation actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of Site Supervisor or Site Safety Officer or the Safety Manager.

Reasons to upgrade:

- Known or suspected presence of dermal hazards;
- Occurrence or likely occurrence of gas, vapor, or dust emission; or
- Change in work task that will increase the exposure or potential exposure to hazardous materials.

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally suspected;
- Change in site conditions that decrease the potential hazard; or
- Change in work task that will reduce exposure to hazardous materials.

8.4.3 Monitoring Procedures

The monitoring procedures shown below are general guidelines for sampling activities. A reading in excess of action level outlined below will require additional ventilation for 30 minutes, followed by re-monitoring.

Monitoring Procedures and Action Levels

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
Volatile Organic Compounds (VOCs) and	Breathing zone, continuously during tasks where exposure to	< 5 ppm	Continue monitoring, may continue work in required PPE

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
volatile hydrocarbons (total by PID)	VOCs and volatile hydrocarbons is possible	5- 25 ppm (sustained for 5 minutes)	STOP WORK and notify PM. Investigate the cause of elevated VOC measurements and identify measures to reduce concentrations (cover impacted soils, ventilation, etc.). Work activities shall only continue once levels have decreased to or below 5 units above background. If levels continue above 5 units, only individuals who are medically qualified to wear respiratory protection are permitted to continue work activities with Project Manager approval. Don Level C PPE (organic vapor respirator cartridges), continue monitoring, and initiate continuous air monitoring for benzene.
		> 25 ppm (sustained for 5 minutes)	Cease work, exit, and contact the Site Safety Officer, Site Supervisor and Project Manager.
Benzene (by PID with benzene-specific separation tube)	Breathing zone, continuously where indicated by VOC readings	> 0.25 ppm	Cease work, exit the area, and contact the Site Safety Officer, Site Supervisor and Project Manager.
Hydrogen Sulfide (multi-gas detector or individual H ₂ S meter)	Breathing zone, continuously during tasks where exposure to hydrogen sulfide is possible	< 5 ppm	Continue work activities. Contact the Site Safety Officer to investigate the potential for contributing factors.
		> 5 ppm	Cease work, exit the area or confined space, and contact the Site Safety Officer, Site Supervisor and Project Manager..
Combustible Gas (multi-gas meter or individual combustible gas indicator, CGI)	Breathing zone or in the immediate work area continuously during tasks where explosive atmospheres are possible	> 5% of LEL	Cease work, exit, and contact the Site Safety Officer, Site Supervisor and Project Manager..
Oxygen (O₂) (multi-gas detector or individual O ₂ meter)	Breathing zone, continuously during tasks where oxygen enriched or deficient atmospheres are possible	< 19.5 % O ₂	Cease work (deficient atmosphere), exit the area or confined space, and contact the Site Safety Officer, Site Supervisor and Project Manager..
		> 23.5 % O ₂	Cease work (enriched atmosphere), exit the area or confined space, and contact the Site Safety Officer, Site Supervisor and Project Manager..
Carbon Monoxide (CO) (multi-gas detector or individual CO meter)	Breathing zone, continuously during tasks where exposure to CO is possible	< 10 ppm	Continue work in Level D and continue monitoring
		> 10 ppm	Cease work, exit the area or confined space, and contact the Site Safety Officer, Site Supervisor and Project Manager..

Parameter	Zone Location and Monitoring Interval	Response Level	Response Activity
Dust not otherwise classified (total by aerosol monitor)	Breathing zone every 30 minutes during field activities where exposure to excessive dusts are possible	< 5 mg/m ³	Continue work in Level D and continue monitoring
		> 5mg/m ³	Upgrade to Level C (P100 respirator cartridges), implement dust suppression measures; contact the Site Safety Officer & Site Supervisor.
		> 10 mg/m ³	Cease activities, implement more effective dust suppression measures; contact the Site Safety Officer & Site Supervisor.
Dust not otherwise classified (total by aerosol monitor)	Edge of Exclusion Zone, every 30 minutes during excavation activities	< 5 mg/m ³	Continue work in required PPE, monitor air, and implement engineering controls
		> 5 mg/m ³	Cease activities and contact the Site Safety Officer & Site Supervisor.

9.0 ENVIRONMENTAL IMPACT PREVENTION

AECOM strives to avoid or control environmental impacts from our operations through planning and implementation of best practices as well as preparing responses to react to environmental incidents. Environmental Compliance procedure [S3AM-204-PR](#) provides details on permitting and planning requirements.

	Potential Environmental Impact	Description of hazard and permit or control being implemented
☒	Air Emissions	Dust may be generated during excavation activities. The use of water trucks will be implemented if dust levels exceed the threshold levels
☒	Hazardous Waste Management	Hazardous waste will be generated during the excavation. If possible, the soil waste will be directly loaded into trucks off site. If stockpiling is necessary, stockpiles will be covered at the end of the day to minimize exposure.
☒	Storm Water Pollution	Storm water will be containerized and trucked off site
☐	Wetlands	
☐	Critical Habitat	
☐	Other:	

9.1 INCIDENTAL SPILL PREVENTION AND CONTAINMENT

Spill prevention and containment planning must be conducted and appropriate control measures established, consistent with regulatory requirements. Personnel are not expected to perform a response action related to an uncontrolled release of a hazardous substance. However, in the event of an incidental release of a hazardous material, a response will be performed to absorb, neutralize or otherwise control the release within the immediate work area. Procedures contained in the SDS of the hazardous material will be implemented to perform the response. The Emergency Response section of this HASP contains information on spill reporting, pre- and post-spill evaluation, and response

9.1.1 Spill Prevention and Containment Practices

Work activities may involve the use of hazardous materials (i.e. fuels, solvents) or work involving drums or other containers. When these activities exist the procedures outlined below will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers and labelled.
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.
- Drums/containers will be secured and handled in a manner which minimizes spillage and reduces the risk of musculoskeletal injuries.
- Equipment will be inspected daily for signs of leaks, wear, or strain on parts that, if ruptured or broken, would result in a spill.

- Refueling should occur in designated areas where incidental spills can be prevented from reaching permeable ground surfaces.
- Whenever possible, position parked or stationary equipment over secondary containment and/ or absorbent materials to prevent spills from reaching permeable ground surfaces.
- A spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e. speedy dri, absorbent pads, etc.) will be available on the project site and positioned for quick and easy access.

10.0 PERSONAL PROTECTIVE EQUIPMENT

PPE is considered the last line of defense in hazard control. PPE is meant to protect workers when all other methods (elimination, engineering, and administrative) have been exhausted. All employees must be trained in the proper use and maintenance of PPE. See Procedure [S3AM-208-PR](#), Personal Protective Equipment.

A PPE assessment (see [S3AM-208-FM1](#)) can be performed to help determine PPE requirements. PPE upgrades for individual tasks or steps of a task are to be identified in JSAs or THAs.

Minimum Required PPE (per AECOM PPE and HAZWOPER Procedures):

- Hard hat
- Safety glasses w/ side shields (may be clear or shaded)
- Safety toe work boots
- Long pants and shirts with sleeves (short or long- cover shoulders no tank or muscle shirt styles)

Complete the table below for site-specific PPE

Additional PPE Needed On Site (to encompass all task specific additions and upgrades)

Face/ Eyes	Head/ Ears
☐ Spoggles (Safety Glasses with foam liner for dust protection) ☐ Welding mask/goggles ☐ Chemical goggles ☐ Face shield (splash) ☐ Face shield (impact)	☐ Helmet with chin strap ☐ Wide brimmed hat ☐ Earplugs ☐ Over-ear hearing protection
Hands	Legs/ Feet
☐ Nitrile ☐ Leather ☐ Cut, abrasion and puncture resistant ☐ Impact-resistant ☐ Other Chemical Resistant: _____	☐ High ankle boots ☐ Snake guards ☐ Rubber boots/waders ☐ Metatarsal Guards ☐ Electrically-resistant boots
Body	Equipment
☒ Sunscreen ☐ Insect repellent (DEET) ☐ Permethrin applied to clothing ☐ Long-sleeved shirt	☐ Air/noise monitoring equipment (specify): ☒ Traffic/Work zone control equipment (specify): Work Zone defined by portable fencing

☒ High-visibility vest ☐ High-visibility pants ☐ Disposable coveralls ☐ Flame retardant clothing ☐ Fall protection ☐ Personal floatation device ☐ Other: _____	☐ Communication beyond cell phones (specify): ☐ Fire controls (specify):

11.0 SITE CONTROL

The purpose of site control is to protect the public from inadvertently coming into contact with site hazards and to protect AECOM employees being impacted by hazards. This section details the equipment and actions needed to promote optimal site control.

11.1 SITE WORK ZONES

Site layout and site control need to be coordinated achieve a productive work environment and efficient work process while minimizing exposure of employees and the public to hazards associated with the work. Consider the following items when planning the site layout and controls:

- "Line of Fire" hazards- overhead utilities, falling/ tipping equipment, release of energy/ pressure, flying debris,
- Noise, dust, odor suppression
- Contamination containment and decontamination area layout
- Traffic control for site vehicles/ equipment (public traffic control requires Traffic control Plan)
- Restricted access for areas requiring special training, skills, or certifications
- Restriction of work near railroads
- Presence or creation of excavations
- Loading/unloading areas
- Portable restrooms
- Dumpsters and bins
- Equipment lay down
- Heavy equipment parking
- Overnight safety and security needs

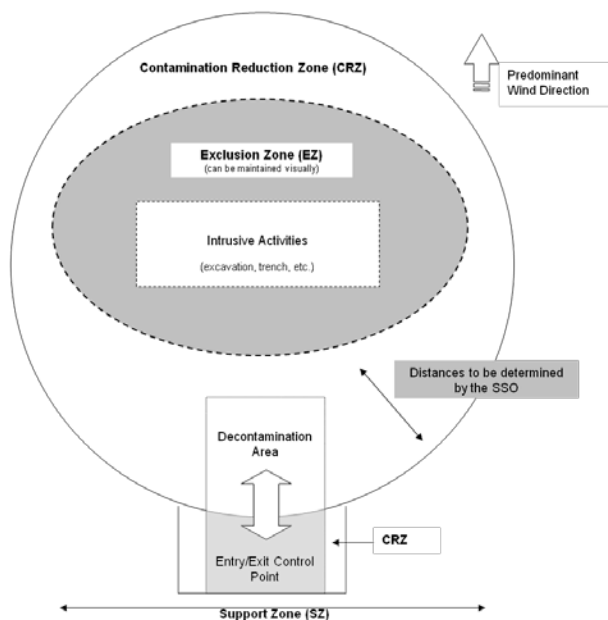
Check the description of the site controls **already** in place:

☒	Work area is within a facility/ property with secure and restricted access provided by client or third party
☐	Work area is enclosed within facility/ property but access is not restricted via locks, guards, or gates
☐	Work area is on a property that is open and access by the public is likely
☐	Work area is on a property that is open but access by the public is unlikely
☐	Work area is in a roadway or right of way of a roadway (Traffic Control Plan required S3AM-306-PR)
☐	Work area is on or near railroad (including right of way, active lines, and crossings)
☐	Other (describe):

Check and describe the site controls that need to be added to protect the public and the AECOM work team.

	Control Item	Description of type and application
☒	Fence	Portable fence will be around the work area with one monitored opening
☐	Locks	
☐	Barricades	
☒	Cones	Cone will be use to block off area outside the exclusion zone where trucks may be staged
☐	Tape	
☐	Hole Covers	
☐	Other:	

11.2 SITE CONTROL MAP/ DIAGRAM



11.3 SIMULTANEOUS AND NEIGHBORING OPERATIONS

Simultaneous and neighboring operations present a need for added coordination and communication to address hazards that are presented by multiple operations.

Complete the tables below or mark "N/A"

Activity/ Company	Hazard	Controls/ mitigations & Communication methods
Simultaneous Operation (within the site)		
Not Applicable		
Neighboring Operation (outside/ bordering the site)		
Not Applicable		

11.4 SITE SECURITY

All projects should be reviewed for the potential for personal security issues (e.g., assault, robbery, threat, etc.). Check all of the following that apply:

- ☐ Project site located in a higher crime area or has a history of security incidents
- ☐ Working outside of regular cellular telephone service
- ☐ Idle property with potential for trespasser(s) to shelter in buildings/structures and assault personnel
- ☐ Working at night

Detail the security measures to address the above risks: Not Applicable

12.0 EMERGENCY RESPONSE

AECOM requires that all projects plan for reasonably foreseeable emergencies (see Emergency Response Planning Procedure [S3AM-010-PR](#)). Prior to the start of site operations, all personnel shall review the table below for site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures. An Incident Response Flow Chart is included in **Attachment A**.

12.1 INCIDENT/ EMERGENCY CONTACT INFORMATION

AECOM Contacts			
Name	Title	Telephone Number	Mobile Phone
William Spronz	Project Manager	732 564-3917	908 377-7226
Eric Acs	Site Supervisor	732 564-3901	732 343-0374
Eric Acs	Site Safety Officer	732 564-3901	732 343-0374
Peter Gregory	Region SH&E Manager	973 883-8683	201 602-3511
Stacy Wells	Area SH&E Manager	212 377 8583	917 324-2554
Incident Reporting	DCS Incident Reporting & Help Line	800-348-5046	
AECOM Nurse direct	Use only after incident reporting line	877-878-9525	
Client Contacts			
Rich Feinberg	Client Project Manager		732 233-4552
Organization/Agency			
Police Department (local)			911
Fire Department (local)			911
Ambulance Service (EMT will determine appropriate hospital for treatment)			911
Hospital: (Site personnel to use for emergency care) Jersey City Medical Center			(201) 915-2000
Occupational Clinic: (Site personnel to use for non-emergency care) Concentra Medical Center/ Urgent Care			(201) 656-7678
Poison Control Center			(800) 222-1222
Pollution Emergency			(800) 424-8802
INFOTRAC (AECOM's account number 74984)			800-535-5053

AECOM Hazardous Material Shipping Help Line	800-381-0664
Public Utilities	
Electric and Gas- PSEG	(800) 880-7734
Call Before You Dig	811

12.2 MUSTER LOCATION

Gate entrance to the site

12.3 COMMUNICATION PROCEDURES

Air horn or truck horn blast indicates all personnel rally at the Muster Zone

12.4 CPR/ FIRST AID TRAINED PERSONNEL

Eric Acs

12.5 INCIDENT REPORTING

Incidents involving or affecting an AECOM employee or subcontractor will be reported in a prompt manner verbally to the site supervisor and project manager.

1. If the incident is a significant or life-threatening emergency, the employee or supervisor shall immediately dial 911 or the appropriate emergency contact phone number for your site.
2. The employee or supervisor shall contact the Incident Hotline (800-348-5046).
3. The employee or supervisor must notify their operational leaders and the Area SH&E Manager.
4. The supervisor, or delegate, must make initial notification in [IndustrySafe](#) within 4 hours for significant incidents, or 24 hours for less significant events event.
5. Client and account management notifications may also apply. The Project Manager will make any necessary notifications.

Any injury, even if no treatment is required, and any incident for which assistance by SH&E Management is needed must be immediately communicated to the Incident Hotline at 1-800-348-5046.

All incidents are also to be reported to IndustrySafe within the timeframes listed below:

Incident Type	IndustrySafe Reporting Time Frame
Significant Incident, including any injury	→ 4 Hours
All Other Incidents	→ 24 Hours

Significant Incident:

- Fatality;
- Amputation;
- Hospitalization for treatment for more than 24 hours (admission);
- Any single event resulting in more than one employee requiring medical treatment or more than one employee being away from work more than 3 days;
- Any SH&E-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than \$10,000 or alleging criminal activity;
- Any spill or release of a hazardous material that is reportable to a regulatory agency;
- Any Notices of Violation resulting from not operating within a regulatory agency permit/license or consent;
- Any incident resulting in property damage expected to exceed \$10,000 United States (US) dollars;
- Any security-related incident that could have caused significant harm to an AECOM employee; and/or
- Any Near Miss event that may have resulted in any of the above consequences but because of "luck" did not result in harm to persons, property or the environment.

All Other Incidents:

- Any injury or illness to an AECOM employee or subcontractor, even if it does not require medical attention, including work-related injuries/illnesses that have become significantly aggravated by the work environment;
- An injury to a member of the public, or clients, occurring on an AECOM-controlled work site;
- Re-occurring conditions such as back pain or cumulative trauma disorders (e.g., carpal tunnel syndrome);
- Fire, explosion, or flash that is not an intended result of a planned event (e.g., remediation process, laboratory Procedure);
- Any incident involving company-owned, rented, or leased vehicles (including personal vehicles used for company business); and/or
- Any failure to comply with the requirements of a regulatory permit issued to AECOM.
- Scan the QR code below to access IndustrySafe reporting system from your smartphone/ device.



12.6 MEDICAL EMERGENCIES

In the event of a life-threatening or critical emergency, AECOM employees should dial 911 and follow the recommended instructions. However, in less serious situations, an injured employee or a co-worker should

contact the Incident Hotline at 800-348-5046 to ensure that the employee receives the best care at the best time (i.e., within the first hour following an injury or potential injury). By contacting the Incident Hotline, the worker can be connected with AECOM's nurses for first aid advice. If recommended by the nurse, the supervisor or a co-worker should drive the injured employee to the project-designated clinic or hospital. A map to the designated hospital and clinic is attached as **Attachment A** and the locations and addresses are included in the table above as well as in the HASP Summary on Page i.

12.7 VEHICLE INCIDENTS

All vehicles should be rented through Carson Wagonlit Travel (accessible via Ecosystem) to ensure that AECOM insurance is included in the rental rate. All other insurances should be declined. AECOM's rental vehicle insurance policy for National/Enterprise or Avis can be found on the DCS Americas [United States](#) or [Canada](#) travel pages. **Drivers MUST print and carry the applicable insurance policy for the rental.**

In the event of a vehicle incident (including collisions as well as mechanical difficulties such as breakdowns and flat tires) the following responses are recommended:

- For breakdowns and flat tires, contact an emergency provider
- For rental vehicles, contact the rental company
- To the extent possible, AECOM personnel should not change flat tires or perform similar repairs
- If a collision has occurred, assess the situation and move all occupants (except the injured) out of further harm's way. If safe to do so, remove the car from the traveled way. Call 911 if necessary, and report the incident to the Incident Hotline at 800-348-5046 as soon as practical. If appropriate, wait for police to arrive before moving vehicles. Provide insurance information to other drivers if necessary or requested and collect the same. If possible, obtain names and phone numbers of witnesses. Take photographs of the scene if possible. **DO NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE, OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW.**

12.8 SPILL OR RELEASE

AECOM employees are not expected to take action or to participate in rescues or responses to chemical releases (including of petroleum products) beyond the initial discovery of the release and immediate mitigation actions such as closing a valve, placing absorbents, and notifying the client and or public emergency response system (911), unless there is a contractual provision for this response and specially trained employees.

12.8.1 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the incident reporting procedure. In determining whether a spill or release must be reported to a regulatory agency, the Site Supervisor or qualified worker will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, applicable regulatory permit, and/or client-specific reporting procedures. **If reporting to a US state or Federal regulatory agency is required, AECOM has 15 minutes from the time of the spill/release to officially report it.**

Chemical-specific Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Reportable Quantities for the known chemicals onsite are shown in the table below.

CERCLA Reportable Quantities

Hazardous Substance	Regulatory Synonyms	Final RQ (lbs)
1,1,1-Trichloroethane	TCA	1,000
Arsenic	N/A	1

Benzene	N/A	10
Cadmium	N/A	10
Carbon Tetrachloride	N/A	10
Chromium	N/A	5,000
Ethyl Benzene	N/A	1,000
Lead	N/A	10
Mercury	N/A	1
Methyl Ethyl Ketone	MEK	5,000
Nickel	N/A	100
Pentachlorophenol	PCP	10
Selenium	N/A	100
Tetrachloroethylene	Perchloroethylene, PCE	100
Toluene	N/A	1,000
Trichloroethylene	Trichloroethene, TCE	100
Xylene	N/A	100

CERCLA RQ's can be found at: <http://www.epa.gov/oem/docs/er/302table01.pdf>

The spill containment program addresses the following site-specific information:

- Potential hazardous substance spills and available controls;
- Initial notification and response;
- Spill evaluation and response; and
- Post-spill evaluation.

12.8.2 Spill Evaluation and Response

The SSO is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area is isolated and demarcated to the extent possible. When an incidental release occurs, clean-up personnel receive instructions in a pre-clean-up meeting as to spill conditions, PPE, response activities, decontamination, and waste handling.

The procedures of the Emergency Response section of this HASP are immediately implemented when the spill is determined to require emergency precautions and action. If necessary to protect those outside the clean-up area, notification of the appropriate authorities is made. Table 10-2 lists the spill conditions that trigger notification of Federal, state, and local agencies.

The following are general measures that response/clean-up personnel take when responding to a spill:

- To minimize the potential for a hazardous spill, hazardous substances, control/absorbent media, drums and containers, and other contaminated materials are properly stored and labeled;
- When a spill occurs, only those persons involved in overseeing or performing spill containment operations will be allowed within the designated hazard areas. If necessary, the area will be roped or otherwise blocked off. Unauthorized personnel are kept clear of the spill area;
- Appropriate PPE is donned before entering the spill area;
- Appropriate spill control measures are applied during spill response;

- Whenever possible without endangerment of personnel, the spill is stopped at the source or as close to the source as possible;
- Ignition points are removed if fire or explosion hazards exist;
- Surrounding reactive materials are removed;
- Drains or drainage in the spill area are blocked or surrounded by berms to exclude the spilled waste and any materials applied to it;
- Provisions are made to contain and recover a neutralizing solution, if used;
- Small spills or leaks from a drum, tank, or pipe will require evacuation of at least Enter Distance feet in all directions to allow clean-up and to prevent employee exposure. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents (see Table 10-1 above for site-specific sorbent media) are placed directly on the spill to prevent further spreading and aid in recovery;
- Spill area is sprayed with appropriate foam where the possibility of volatile emissions exists;
- If the spill results in the formation of a toxic vapor cloud, from vaporization, reaction with surrounding materials, or the outbreak of fire, further evacuation may be required;
- To dispose of spill waste, all contaminated sorbents, liquid waste, or other spill clean-up will be placed in small quantities Enter QTY pounds) in approved drums for proper storage or disposal as hazardous waste; and

12.8.3 Post Spill Evaluation

As part of the incident investigation and reporting documentation, a written spill response report shall be prepared at the conclusion of clean-up operations. The report will include, at a minimum, the following information:

- Date of spill incident;
- Cause of incident;
- Spill response actions;
- Any outside agencies involved, including their incident reports; and
- Lessons learned or suggested improvements.

The spill area is inspected to ensure the area has been satisfactorily cleaned. The use of surface and air sampling is utilized in this determination as necessary. The root cause of the spill is examined and corrective steps taken to ensure the engineering and control measures in place have performed as required. If alternative precautions or measures are needed, they are made available and implemented.

All durable equipment placed into use during clean-up activities is decontaminated for future utilization. All spill response equipment and supplies are re-stocked as required.

12.9 FIRE

AECOM employees are not expected to attempt to put out fires. Stop work; notify all AECOM personnel, move upwind and contact 911 and/or emergency response at the site. If employees have been properly trained in the operation of a fire extinguisher, they may attempt to put out a small fire, provided that the following conditions are met:

- The fire must be small (i.e., smaller than a trash can) and in its early stages
- The employee must have an escape route
- The employee must be trained and know they have the right type of extinguisher
- The employee must be safe from toxic gases

- There must be no hazardous conditions that could quickly accelerate the fire (i.e., presence of chemicals, especially dry grass, etc.)
- Above all, if in doubt, the employee must not attempt to fight the fire

Attachment A

Hospital and Clinic Directions/ Maps

Incident Reporting and Response
Flow Chart

Hospital- Address, written directions, and mapped route from site

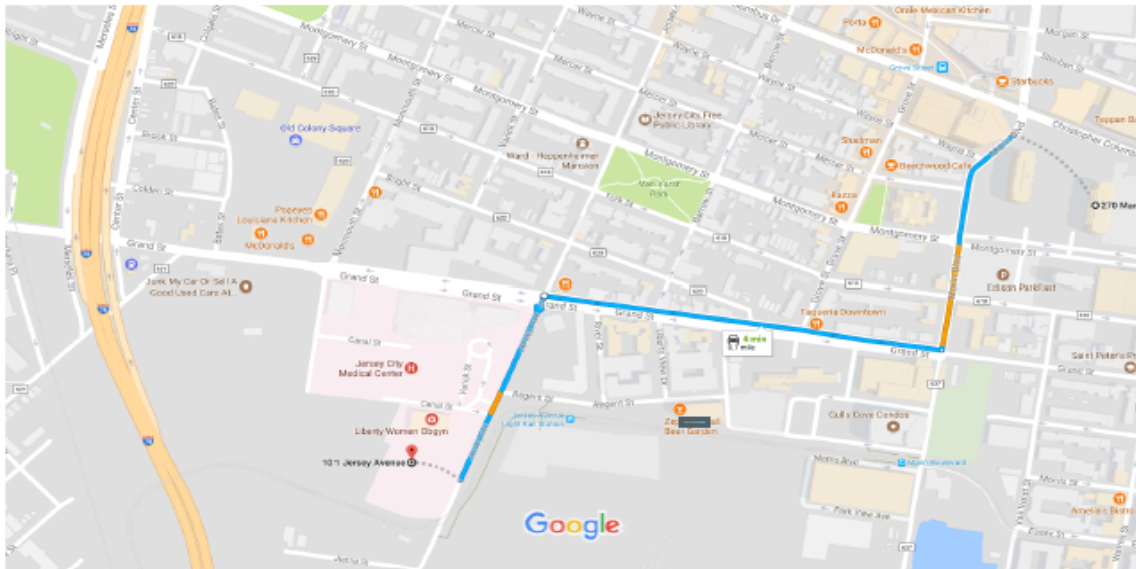
Jersey City Medical Center
101 Jersey Ave
Jersey City, NJ

270 (201) 915-2000

8/1/2017

270 Marin Blvd to 101 Jersey Ave, Jersey City, NJ 07302 - Google Maps

Google Maps 270 Marin Blvd to 101 Jersey Ave, Jersey City, NJ 07302 Drive 0.7 mile, 4 min



270 Marin Blvd

Jersey City, NJ 07302

- ↑ 1. Head southwest on Marin Blvd toward Wayne St
0.2 mi
- ↘ 2. Turn right onto Grand St
0.3 mi
- ↙ 3. Turn left onto Jersey Ave
Destination will be on the right
0.2 mi

101 Jersey Ave

Jersey City, NJ 07302

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Occupational Clinic- Address, written directions, and mapped route from site

OCCUPATIONAL CARE CLINIC

Once the injury has been reported, seek treatment at the identified occupational care clinic for non-critical injuries; i.e. injuries of the First Aid variety.

Concentra Medical Center/Urgent Care
574 Summit Ave
4th Floor
Jersey City, NJ 07306
201-656-7678

8/1/2017

270 Marin Blvd to Concentra Urgent Care, Jersey City, NJ - Google Maps

Google Maps

270 Marin Blvd to Concentra Urgent Care, Jersey City, NJ

Drive 1.5 miles, 9 min



270 Marin Blvd

Jersey City, NJ 07302

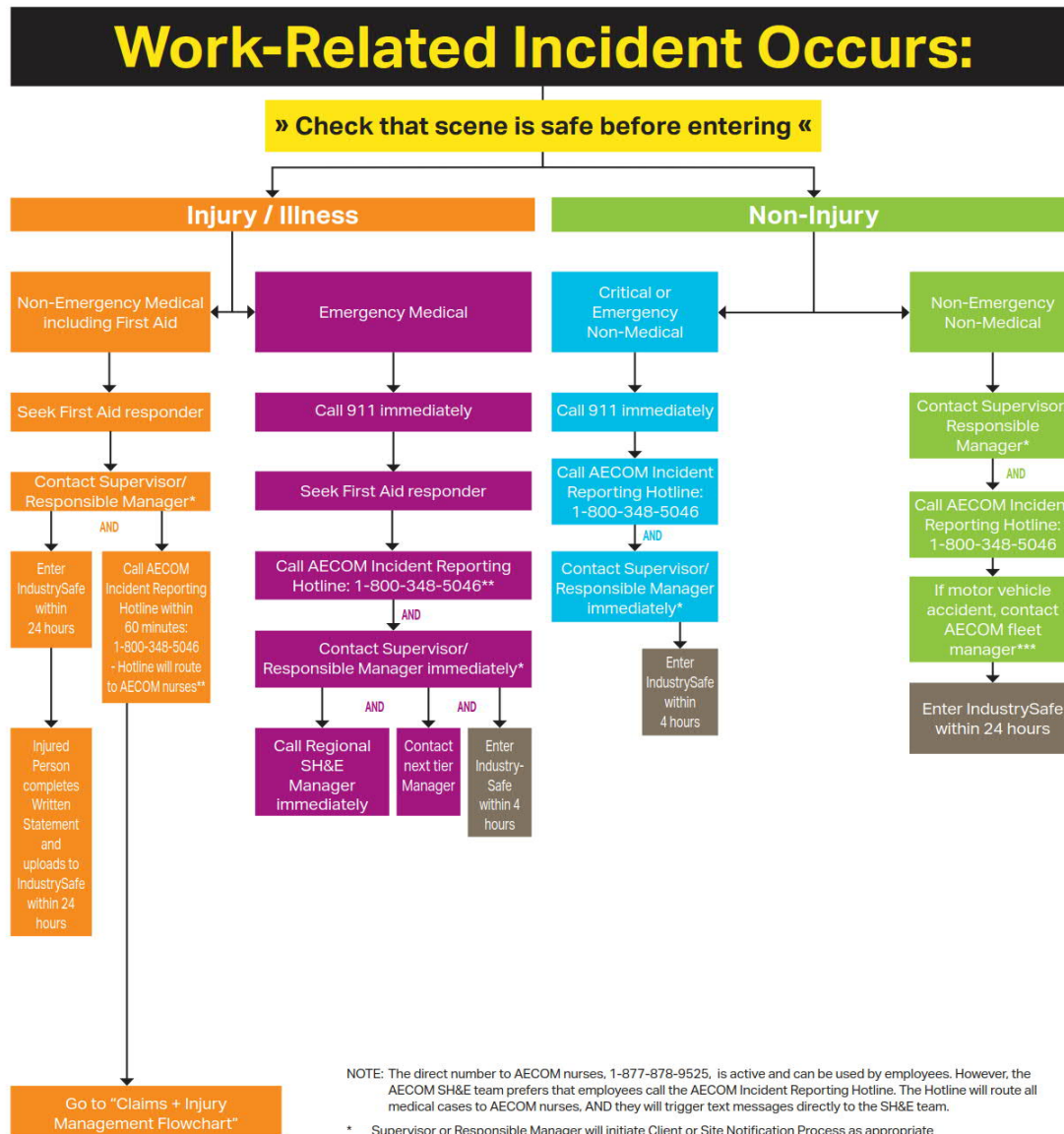
- ↑ 1. Head northeast on Marin Blvd toward Christopher Columbus Dr 121 ft
- ↙ 2. Turn left at the 1st cross street onto Christopher Columbus Dr 0.5 mi
- ↘ 3. Turn right onto Monmouth St 0.1 mi
- ↙ 4. Turn left onto Newark Ave 0.5 mi
- ↙ 5. Slight left onto Pavonia Ave 0.3 mi
- ↘ 6. Slight right onto Summit Ave
Destination will be on the right 499 ft

Concentra Urgent Care

574 Summit Ave, 4th Floor, Jersey City, NJ 07306

Work-Related Incident Flowchart for Employees | Updated October 2016

DCS - Americas



Attachment B

AECOM SH&E Field Applicable Procedures

All AECOM SH&E Procedures, in their controlled copy version, are available on the [internal SH&E Policy and Procedures ecosystem page](#).

Programmatic procedures referenced in this document (for example SH&E Training) **DO NOT** need to be printed for inclusion in this HASP. Only procedures that are needed for field activity reference and application **MUST** be printed in full and included in this section.

Copy the Field Procedure Checklist from the Physical Hazards section 7.1 to become your table of contents for these attachments. Include only those procedures checked as applicable to this project

Attachment C

Safety Data Sheets (SDSs)

Attachment D

Site Orientation

AECOM will conduct a site safety briefing for a person's initial visit to the site. The briefing will be conducted:

- Prior to the start of work;
- For any new AECOM or subconsultant personnel; and
- At each mobilization, or whenever there is a change in task or significant change in task location.

All personnel working on the project who have received the site briefing (including the HASP review) will sign the Personal Acknowledgement located at the end of the HASP. Visitors may receive a shortened version to address the hazards specific to their visit.

The following items, at minimum, will be discussed during the site safety briefing:

- Contents of this HASP;
- The Emergency Response Plan;
- Contractor SH&E Management expectations;
- Injury management, including notification and hospital and occupational clinic locations;
- The AECOM 4-Sight program;
- Stop Work authority;
- The JSAs (Attachment E) for the tasks that will be performed on a given job;
- Completion of a THA each day (Attachment E);
- Types of hazards at the site and means for minimizing exposure to them;
- Instructions for new operations to be conducted, and safe work practices;
- PPE that must be used;
- Lone worker check-in procedures;
- Emergency evacuation routes, muster points, and tornado/storm shelters; and
- Location and use of emergency equipment.

These meetings must be documented and maintained in the project files.

Attachment E

Project/Task-Specific Pre-Job Hazard Assessments or Job Safety Analysis

The preparer shall download and prepare one Pre-Job Hazard Assessment for each discrete task being performed during the project (i.e. Driving, Inspection, Sample Collection, etc). Checklist [S3AM-209-FM4*](#) shall be used. The AECOM [electronic job safety analysis \(eJSA\) toolbox*](#) may also be used to find previously approved job safety analyses (JSAs)

Insert list of Pre-Job Hazard Assessments or Job Safety Analysis here. Include after this cover sheet in the final HASP.

Blank Daily THA and Daily Tailgate Forms

The preparer shall download a sufficient number of copies of the daily Task Hazard Analysis and Tailgate Meeting form* ([DCS SH&E ecosystem page](#)) and insert after this cover sheet in the final HASP. One copy of the THA/ Tailgate MUST be prepared at the start of each shift, and signed by all staff involved in the operation. The THA should be consulted and updated throughout the day if conditions change.

*Client required equivalents may be substituted